Initiative on "Capacity Development to support National Drought Management Policy"
(WMO, UNCCD, FAO and UNW-DPC)
Country Report

Drought conditions and management strategies in Romania

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Background

The drought represents a state of a biologic system in which the water requirements/need is below the optimal values, the supplying functions significantly vary, function of the growth and development stage. This phenomenon can be considered as being strictly meteorological, hydrological, agricultural, economic, etc., and the analytical methods used allows the assessment of the severity level, function of the characteristics of intensity, duration, frequency, time and space extent, as well as the consequences upon the environment (Sandu et al, 2010).

In Romania, the drought affects 7.1 million ha, which represent 48% from the total agricultural land (RNIS, 2010). The South, Southeast and East parts of our country are the the most hit areas (<600 m3 water /hectare – extreme and severe pedological drought) during the extremely droughty years average yields of various crops representing only 35-60 percent of the potential yields. An analysis of the 1901–2010 interval focused on annual mean air temperatures recorded by weather stations that possess observation data sequences covering more than 100 years has shown an increase of 0.5°C in the annual mean temperature over 1988-2010 (10.2°C) as against the whole analysis interval (9.7°C), which is lower than the global mean warming of 0.6°C. As regards the decadal evolution of annual mean air temperature, it was higher by 0.4...0.6°C over 2001-2010 than in every decade from 1961 to 2010. Concerning precipitation, the 1900-2010 period highlighted a general decreasing trend in the annual precipitation after the year 1961 and a parallel enhance of the precipitation deficit, especially in the south, south-east and east of the country. Since 1901 until now, Romania has seen in every decade one to four extremely droughty/rainy years, an increasing number of droughts being more and more apparent especially after 1981 (table 1).

DECADE	XX-TH CENTURY	
	EXTREMELY DROUGHTY YEARS	EXTREMELY RAINY YEARS
1901-1910	1907-1908	1910
1911-1920	1917-1918	1911, 1912, 1915, 1919
1921-1930	1923-1924, 1927-1928	1929
1931-1940	1934-1935	1937, 1939, 1940
1941-1950	1945-1946, 1947-1948, 1949-1950	1941, 1944, 1947
1951-1960	1952-1953	1954, 1955, 1957, 1960
1961-1970	1962-1963, 1964-1965	1969, 1970
1971-1980	1973-1974, 1975-1976	1972, 1974, 1975, 1976
1981-1990	1982-1983, 1985-1986, 1987-1988	1981, 1990
1991-2000	1992-1993, 1997-1998, 1999-2000	1991, 1997
	XXI-ST CENTURY	
2001-2010	2000-2001, 2001-2002, 2002-2003, 2006-2007, 2008-2009	2005, 2006, 2010
2011-2020	2011-2012	

Table 1. Droughty/rainy years in Romania, 1901-2010

Significant rainfall deficits were recorded in 1907-1908, 1923-1924, 1927-1928, 1934-1935, 1945-1946, 1947-1948, 1949-1950, 1952-1953, 1982-1983, 1985-1986, 1992-1993, 1999-2000 and, more recently, in 2000-2001, 2001-2002, 2002-2003, 2006-2007 and 2011-2012.

A total of eight droughty months were recorded during the agricultural year 2011-2012, November 2011 being the droughtiest month in the last 52 years in Romania, with a monthly mean of only 1.2 mm as against the multi-annual mean of 43.9 mm. July 2012 is the second, in top 5 droughtiest months over 1961-2012, with a monthly mean of 40.5 mm as compared with a normal value of 78.2 mm. July 2012 was also the warmest month in the last 52 years in Romania, the monthly mean temperature being 23.7°C as against the multi-annual mean of 19.2°C – a positive deviation of 4.5°C.

Drought monitoring and early warning systems

The Romanian Government is assisted in taking decisions on drought, land degradation and desertification issues by the interdisciplinary National Committee to Combat Drought, Land Degradation and Desertification, which is a consultative body. This Committee is coordinated by The Ministry of Agriculture and Rural Development. The National Meteorological Administration (NMA) is one of the three institutions that collaborate with the Technical Secretariat of the National Committee to Combat Drought.

National Meteorological Administration is the national authority in the meteorological field in Romania, with a continuous service since 1884 and operates under the authority of the Ministry of Environment and Climate Change (MECC). The NMA is responsible for carrying out the weather forecasts and warnings as well as operationally disseminate them to decisional factors and all end-users. The National Meteorological Observation Network within the NMA includes 7 Regional Meteorological Centers (RMC). Romanian agrometeorological observation network of NMA provides weekly in-situ monitoring and information are collected, analyzed and compiled by the Agro-meteorological Service. The agrometeorological of NMA investigates the impact of climate variability and change on crops (including phenology and yield), and on the main components of soil water balance. Currently this service enabled monitoring of drought dynamics and assessing the spatial extent and intensity of drought phenomenon. The monitoring is done daily for agro-meteorological parameters and the changes in the soil moisture content at the plant level, identifies periods and agricultural areas seriously affected by extreme events, elaborates weekly bulletins, and carries out long-term agro-meteorological forecasts upon soil moisture reserves. Modeling and GIS techniques are used to monitor the spatial extent of extreme weather phenomena, including drought, and to assess the most vulnerable areas.

The meteorological profile (2013):

Synoptic and climatological observations and measurements: 159 stations

Number of automatic weather stations (MAWS): 126

Agrometeorological observations and measurements stations: 55

Radar network: 8 radars (5 C-band and 3 S-band Doppler radars)

Pluviometric observations and measurements: 67 stations.

DROUGHT INDICATORS (thematic maps at national/regional level) used by NMA:

1. Climatic indicators: SPI, Aridity Index, etc;
2. Agrometeorological indicators: Soil moisture, heat waves, ETP, etc;
3. Drought indicators based on satellite-derived products: NDWI, fAPAR, NDVI, CWSI, LAI, etc.

Department of Water, Forests and Pisciculture from the Ministry of Environment and Climate Change (MECC) coordinates at national, regional and local level the necessary procedures for the management of emergencies produced by the hydrological drought, such as management of irrigation systems during the extended drought periods including adjustment of irrigation systems

which supply water from the Danube River Basin during conditions of hydrological drought. The "Romanian Waters" National Administration (RWNA) togheter with the National Institute of Hydrology and Water Management (NIHWM) produces river basin plans for restriction and use of the water during critical periods, elaborated for each of the 11 Water Basins Administrations (WBA). These plans are elaborated in conformity with Ministerial Order on the methodology for water restrictions.

Vulnerability assessment

The present-day and foreseeable climatic data highlight the increase in frequency and intensity of the drought phenomenon, its potential effects on the most vulnerable sectors (agriculture, waters and forests, biodiversity, energy, transport etc.)., requiring specific adaptation measures to the limiting environmental conditions.

Hazards associated to the climate change are greater for:

(1) human health (a higher frequency and longer duration of the heat waves have an impact of the health of the elderly, negatively impacting the health services, which are overstressed even in normal weather situations);
(2) food safety (troubles in agriculture, caused by drought and by a non-sustainable approach as regards the land cultivation at subsistence level);
(3) biodiversity (forest fires, discontinuation of the ecosystems' dynamics because of high temperatures and the modification of precipitation distribution patterns);
(4) energetic safety (drought influences both over the hydroelectric power plants and the nuclear power plant from Cernavoda, as their regular activity relies on the befitted level of the Danube River. This is all the more relevant whereby at country level almost 36% out of the electricity produced comes from hydro sources and 19% from nuclear sources.).

One of the most visible effects of this situation is noticeable in agriculture, where the vegetal yield varied largely from year to year, in the context of variable climatic conditions. The 2001-2012 interval was particularly droughty; the drought negatively impacted the agricultural productivity; the mean yield by ha, decreased by more than 50% on the land surfaces where irrigation systems are absent. According to Ministry's of Agriculture and Rural Development data, the excessively droughty agricultural years 2011-2012 strongly impacted about 5.9 million hectares, the level of losses varying over different area and culture. Nevertheless, the most affected cultures include corn, wheat, barley, two-row barley, sunflower, and rape and soya.

Culture	**Average yield 2009-2010-2011 (Thousand tonnes)**	**2012 (Thousand tonnes)**	**Yield decline**
Corn	9,577	5,158	- 46.1 %
Wheat	6,048	4,941	- 18.3 %
Barley/Two-row-barley	1,273	972	- 23.6 %
Potato	3,788	2,430	- 35.8 %
Sunflower	1,383	1,165	- 15.7 %
Rape	750	148	- 80.2 %
Soya	125	70	- 44.0 %

Taking into account the estimations presented at the 4-th IPCC Report, relative to the 1980-1990 intervals, it is expected the same annual mean warming in Romania as that projected for the

whole Europe, with slight differences between models over the first decades of the 21st century and much greater ones toward the end of the century, (within 0.5°C - 1.5°C for 2020-2029, respectively). As to precipitation, more than 90% of the models have projected for Romania pronounced droughts during the summer, mainly in south, south-east and east of Romania, with negative deviations from the current interval 1980-1990 topping 20% (Busuioc at al, 2003; Christensen at al, 2007).

In the conditions in which the climatic scenarios estimate a decrease of the precipitation amounts, it is expected that the intensity of pedological drought phenomena increased in the most vulnerable areas already known today, respectively the south, south-east and east of Romania (fig.1). The pedological drought will reach the highest intensity values (extreme/Co-300 m^3/ha and severe/600-900 m^3/ha).

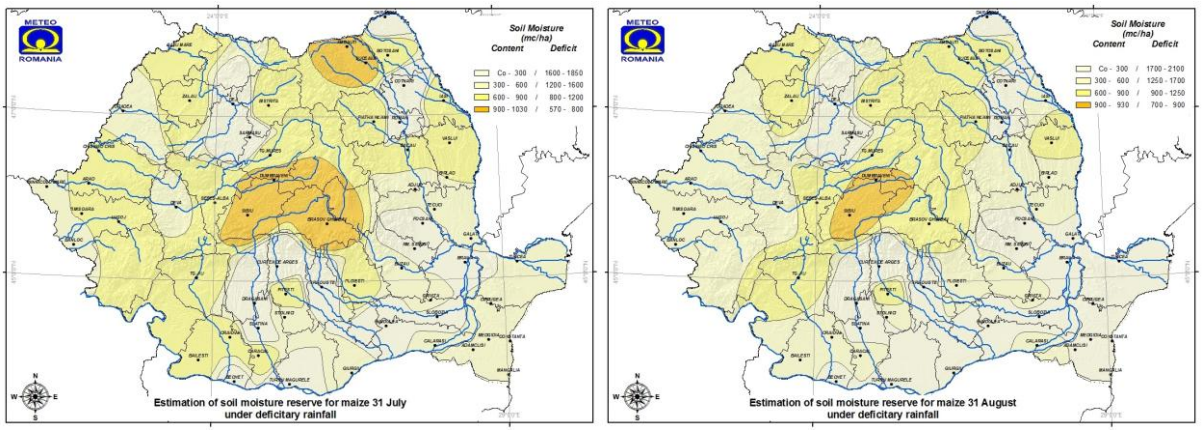

Figure 1. Estimations of the distribution of soil moisture reserve in Romania in the context of predictable climate change

Emergency relief and drought response:

Information management is one of the most important issue for water use and demand, and especially for an integrated water resource planning and sustainable development in agriculture. A good information management system is an invaluable tool, succinctly upheld by the maxim: "to measure is to know", and can be used to support Water Demand and Drought Management requests.

Early warning drought and risk management systems are obvious and efficient contributors that can facilitate adaptation to climate variability and changes, if:

- the existing network of meteorological and agrometeorological are developed in order to ensure reliable ongoing data at national/ regional/local level;
- a historical climate data archive can be provided, especially an archive on climate impacts in vulnerable sectors on water scarcity and droughts;
- climate data analysis are developed in order to determine the patterns of inter-annual and intra-seasonal variabillity and extremes;
- the gaps in the development of regional climate scenarios and enhance capacity/experience in the use of different models are improved;
- information on the characteristics of system vulnerability and adaptation effectiveness such as resilience, critical thresholds and coping mechanisms are extended to identify opportunities for adaptation measures to drought, and the potential of particular practices.

Practices to alleviate drought impacts

Given the effects of climate change in Romania reflected by temperature and precipitation regime shift, increasing number of droughts events being more and more apparent after 1981, the pedological extreme and severe drought that is manifested especially in the south, south-east and east part of Romania as well as the climate change projections in Romania for the 21st century, that will result in a high variability of agricultural production, with negative consequences on food supply and on national economy, the following measures to adapt to the effects of changes climate in the agricultural sector are required:

- ✓ supporting agricultural research and experimental production for the modification the structure of crops and selecting varieties with resistance to drought;
- ✓ improving the availability and applicability of modeling and adaptation options for the use of farmers (providing data and results on the response of water resources to climate change scenarios, promote the use of GIS technology, etc..)
- ✓ further elaborating of the Good Practice Guides for agriculture, especially for non-irrigated agriculture;
- ✓ develop and implement local action plans (at the communa level) for climate change adaptation;
- ✓ institutional capacity building in relevant domains regarding drought and water scarcity, as well as mechanisms to facilitate the exchange of information between institutions.
- ✓ conduct educational activities for public awareness on the effects of drought, desertification and water shortages, particularly in rural areas;

At the farm level are very important some elements of adaptation to climate change. Possible solutions to medium term should include:

- ✓ adaptation of the periods for conducting agricultural activities;
- ✓ selection of the crops and varieties better adapted to changes in the growing season and water available, as well as with greater resistance to new climatic conditions and moisture;
- ✓ crop adaptation based on use of existing genetic diversity and of the new opportunities offered by biotechnology;
- ✓ introducing of animals heat-resistant species and adapting of the animal nutritional regime to the demands caused by climate extremes.
- ✓ efficient use of water by: reducing water losses, improvement of the irrigation techniques, water recycling and storage;
- ✓ better management of soils by increasing water retention to maintain soil moisture;

At the national level, especially in south, south-east and east of Romania where drought will reach the highest intensity values (extreme/Co-300 m3/ha and severe/600-900 m3/ha) and taking into account the increase of intensity and frequency of droughty years, it is necessary to provide investments in irrigation infrastructure and improvement of the water resources management.

Strategy of the Ministry of Agriculture and Rural Development in irrigation sector has the following main objectives:

1. Rehabilitation of irrigation infrastructure belonging to the public domain of the State on the area of approx. 823 thousands hectares, economically viable
2. Changing power solution for 3 irrigation systems with the surface of approx. 56 thousands ha, which are currently fueling from Siret and Prut powered from magistral channel Siret – Bărăgan
3. Fitting of the area of approximately 425 thousands ha, to be arranged with irrigation works in areas adjacent of the magistral channel Siret – Bărăgan, powered from the magistral channel Siret - Bărăgan.

State of play of the studies/actions already done to reduce exposure to drought risks:
- The *Climate Change Adaptation Guide* was elaborated and endorsed by the Minister of Environment through the Ministerial Order 1170/2008.
- Further more, several studies have been finalized or are underway, such as follows:
- INTERREG III-B: "*Agriculture and Climate Change: How to alleviate effects and threats*" delivering as particular outcome the "*Attitude Code towards mitigating the climate change impact in agriculture*"
- INTERREG IV-C: "*Water scarcity and drought: coordinated actions at EU regional level*" (2012-2013).
- "*CLIMHYDEX – Changes in climate extremes developments and associated impacts to hydrological events*" (2012 – 2015), quantifying and assessing the impact of extreme climate events to hydrological regime and drought conditions.
- *„ADER 111 Geo-reference indicators on various space and time scales for evaluating the vulnerability and adaptation measures of agro-eco-systems against global changes" (2011-2014)* aiming to enhance the decision support for adaptation measures concerning good practices and adequate technologies in agriculture, mainly dealing with pedological drought
- *MIDMURES – Mitigation Drought in Vulnerable Area of the Mures Basin (2011-2012),* financed by the CE-DGE under the development of prevention activities to halt desertification in Europe. The main goal of the MIDMURES project was to contribute to improving agricultural water saving and drought forecasting in the Mures pilot area through the combination of various technical approaches. The expected results refers to: modeling long-term agro-climatic data in order to establish the risk factors, to spot the areas with high vulnerability and provide timely drought forecasts; assessing the impact of climate changes on soil water availability for crops cultivated in the most vulnerable area of Mures River basin to drought and water scarcity, rainwater conservation in soil for optimizing water availability according to the plant needs throughout the growing season and in the period with high deficit.
- *The National Climate Change Strategy (2013-2020)* addresses two main components: the reduction in the concentration of greenhouse gases (Mitigation) and the adaptation to climate change (Adaptation), which is under approval by Romanian Government. On the Adaptation component were identified 13 sectors vulnerable to climate change: Food, Agriculture and Fisheries, Tourism, Public Health, Construction and Infrastructure, Transportation, Water Resources, Forestry, Energy, Biodiversity, Insurance, Recreation, Education. In this context, the integration of the adaptation in the sectorial strategies will help to have a comprehensive approach and select appropriate measures for the direct and indirect effects of climate change (including drought and floods). According to the provision of the National Strategy on Climate Change - Adaptation Component, the strategy has to be assumed and continuously improved at the local government level, through relevant, specific measures for the geo-political conditions, economical context and local public needs. At the same time, local authorities will develop action plans on climate change.

The need for knowledge and skills on drought management:

The need to improve national drought monitoring and management policies with the goal of improving preparedness and reducing drought impacts will be based on two main topics:

1) Monitoring and prediction which should contribute to a broad early warning system;
2) Mapping and assessing the impact of droughts, promote adaptation of best practices, and develop infrastructure for irrigation based on scientific knowledge (climatic data, soil and crops data).

Crop efficiency is strongly influenced by climate variability, thus the agro-meteorological monitoring methods corroborated with additional specialized field observations are the crucial information sources needed for a correct assessment of vegetative stage, pointing also to the main

characteristic of the limiting factor. Accurate diagnose of agro-meteorological conditions is a crucial process needed for understanding the risks caused by extreme weather events and for decision making and sustainable development actions. Due to the complex nature of drought as well as its large spatial and temporal extent, the drought risk management system should be developed on the cross-sectoral whilst national/regional level. There is a major need to elaborate the risk maps for drought hazard. Thematic drought maps will illustrate the most vulnerable areas to drought and water deficit at different spatial and temporal scales, including also the impacts on agriculture, forest, water supply and energy and environment. In order to choose the best decision it is needed a more detailed description of current situation regarding the current conditions and forecast of limitative conditions (water deficit and drought) in order to elaborate the disaster management plan in timely manner. In this way the farmer and not only may get benefit by the complex analyses and advisories to mitigate the effects of limitative conditions.

The second topic will be achieved by: selecting and assembling drought related data and information concerning drought formation exposure to drought and impacts of droughts; developing a set of drought indices for various applications that can be calculated in a timely manner based on the information that is readily available; coupling tools for operational drought early warning and long term prediction; building a concept for drought hazard, susceptibility to drought and vulnerability maps generation with the use of GIS techniques; identifying drought management approach (immediate response or decrease vulnerability) to recover or mitigate direct and indirect impacts of drought within economic, environmental and social contexts.

Concerning the set of drought indicators (climatic indicators like SPI and Aridity index or agro meteorological indicators such as soil moisture, ETP, heat weaves, etc) should be considered a set of the national and international indicators specific in the field of meteorology and agrometeorology, climatology, hydrology and soil indicators.

Meteorological activity in Romania is in a extensive process of modernization, so that Romania should be able to secure and expand the compatibility of their data and meteorological information communicated according with the commitments through international agreements and conventions in the field of meteorology. The modernization of meteorological activity in Romania started in previous years- begun recently, through the NIMS – National Integrated Meteorological System (automatic weather stations, Doppler rader, satellite receiving station, communications and high-performance processing equipment, etc). On November 29, 2010, Romania officially joined the Convention on the establishment of an European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). The membership is beneficial for Romania given that data and products from geostationary satellites are received, processed and forwarded to the central and local authorities. Satellite data are used both in operational activities such as weather forecasting and agrometeorology, as well as in studies and researches developped in meteorology, agrometeorology, climatology, remote sensing and geographic information systems. By continuing the modernization and development of national meteorological system components is essential to ensure permanent interoperability with the European and international systems and other specialized institutions in this field.

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