Ministry of Environment

State Hydro-meteorological Service

Workshop

Decreasing the vulnerability of the agricultural systems in the Republic of Moldova to climate change – operationalization of the agenda on climate change

Historical climate tendencies in Moldova and their implications for agriculture

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Contents

Introduction

Global climate warming is considered to be not only the biggest meleo-climatic risk, but also the biggest environmental risk, whose negative consequences are reflected throughout all Earths geospheres.

The large number of investigations carried out in the last decades, both in the physical area and in the biological area, and their interaction with climate change at regional and national level have provided the possibility to undertake an even larger and more conceited assessment of the relation between the examined warming and its consequences.

Based on the large volume of factual information, collected from different written sources from the last two thousand years, as well as a result of the national hydrometeorological monitoring, the main climate evolution tendencies on the territory of the Republic of Moldova have been established, together with the main necessary measures for adjusting the national economy to current and future climate conditions.

1. Evolution of climate and natural hazards in the Republic of Moldova in the last two millennia

Recent paleogeographical reconstructions show that the climate of the first thousand years A.D. Have been humid and relatively cold, particularly in the first half.

In general, the first millennium in South East Europe is characterised by a high frequency of harvestless years, mainly due to long torrential rains, floods and harsh winters with abundant snow.

In the second half of the first millennium there is a tendency of regional climate change towards aridification and general increase of seasonal variation.

Thus, there is a simultaneous rise in the number of signalled droughts, harsh winters and floods.

The increased variation of climate is also pointed out by the extremely large number of cropless years, which rises to about 35% of the total number of years.

According to profile sources in Western Europe, in the first thousand years of A.D. over 630 cases of extreme processes have been recorded, including 70 droughts, 24 rainy summers, 75 floods, 101 harsh and frosty winters, 15 earthquakes and over 310 cropless years, accompanied by epidemics and long famines (tab. 1).

Table 1. Distribution according to centuries of the main groups of calamities throughout the first millennium of the current era

Phenomena \ years	**0 99**	**100 199**	**200 299**	**300 399**	**400 499**	**500 599**	**600 699**	**700 799**	**800 899**	**900 999**	**total**
Droughts	3	2	2	2	10	5	2	9	11	24	**70**
Infestations		1				3	1				**5**
Rainy autumns	1	1				1	1	1	1	1	**7**
Rainy summers	1	1	5	1	3	4	3	1	1	4	**24**
Floods	7	12	3	8	3	2	3	4	17	16	**75**
Harsh winters	3	7	9	5	14	9	8	14	15	17	**101**
Frosts						1		1	1		**3**
Storms				1		1	1			1	**4**
Earthquakes	3	1	1	1		5			1	1	**13**
Epidemics and epizooties	1	1	2	2		6		1		2	**15**
Extreme, cropless years of famine	16	19	7	10	32	56	33	44	53	42	**312**
Total of cases recorded	**35**	**45**	**29**	**30**	**62**	**93**	**52**	**77**	**100**	**108**	**631**

Continuation

All in all, during the last millennium 2130 extreme processes have been recorded in Bessarabia, divided as follows: 462 droughts, 112 pest infestations, 371 summers with heavy rain, 63 autumns with heavy rain, 314 large floods, 392 harsh winters, 119 late spring or early autumn frosts, 85 big storms, 109 epidemics and şi epizooties, 107 strong earthquakes, etc. (tab. 2).

Continuation

Table 2. Distribution according to centuries of the main groups of calamities throughout the second millennium of the current era.

Fenomene \ Anii	**1000 1099**	**1100 1199**	**1200 1299**	**1300 1399**	**1400 1499**	**1500 1599**	**1600 1699**	**1700 1799**	**1800 1899**	**1900 1997**	**Total**
Droughts	35	41	31	37	45	37	49	51	72	64	**462**
Pest infestations	5	5	6	7	9	6	16	10	37	11	**112**
Rainy autumns	13	8	7	3	2	1	5	8	9	7	**63**
Rainy summers	26	38	45	38	31	46	44	21	50	32	**371**
Floods	30	22	21	34	29	25	47	34	54	18	**314**
Harsh winters	28	26	43	44	53	50	52	32	43	23	**394**
Frosts	16	12	6	9	11	9	15	9	13	19	**119**
Storms	9	2	8	5	5	5	3	2	22	24	**85**
Earthquakes	3	5	1	1	4	8	10	7	16	52	**107**
Epidemics and epizooties	9	4	2	10	18	6	28	2	23	7	**109**
Total for 100 years	**174**	**163**	**170**	**188**	**207**	**193**	**269**	**176**	**339**	**257**	**2136**

2. Evolution of climate and natural hazards in the Republic of Moldova during the last century

The changes in temperature and rainfall have been determined based on the measurements within the monitoring hydrometeorlogical network of the SHS, active since 1886 (tab. 3).

According to this table the average air temperature at the meteo station in Chisinau has been in a constant rise during the three mentioned periods. For the period between 1886 and 2007 this rise has constituted about 1^{o}C.

The amount of rainfall for all the periods mentioned has also been on the rise, and has constituted 60 mm, or a 11% increase, for the period of 1891-2007.

Table 3. The evolution of the annual average temperature and of the rainfall amount at the Chişinău weather station for the following periods: 1886-1960; 1960-2007; 1886-2007

Period	Air temperature °C	Period	Rainfall amount, % (mm)
1886-1960	+0,5	1891-1960	8 (40)
1960-2007	+0,5	1960-2007	3 (20)
1886-2007	+1,0	1891-2007	11 (60)

A particularity of the last 100 years is a higher temperature level in winter, spring and summer (tab. 4).

In this way, the average air temperature during winter season at the Chişinău weather station has been 1,3^{o}C higher, in spring - 0,9^{o}C higher, in summer - 0,7^{o}C and in autumn 0,2^{o}C higher. In the last 100 years the average temperature has increased with 0,8^{o}C.

The amount of rainfall in the last 100 years has also increased with 56 mm or 12%, but this rise according to seasons is different. The biggest increase has been recorded in the autumn season (with 30mm), while in spring it even dropped with 4mm.

Table. 4. Evolution of annual average air temperature and rainfall amount during the last 100 years according to seasons at the Chişinău weather station

Season	**Air temperature, °C**	**Rainfall, % (mm)**
Winter	1,3	9(9)
Spring	0,9	-4 (-5)
Summer	0,7	11 (20)
Autumn	0,2	30 (32)
Annual	**0,8**	**12 (56)**

During the last 100 years the year of 2007 was the hottest, when the average annual air temperature has been 12,1^{o}C, which is 2,6^{o}C higher than the norm. The coldest year has been 1933, when average annual air temperature was 7,2^{o}C, or 2,3^{o}C less than the usual.

The most humid year was 1912, when the amount of rainfall has been 915 mm, or 75% higher than the normal rate.

The year with the biggest lack of rainfall was 1896, when there was only 301 mm of rainfall, or only 58% of the normal amount.

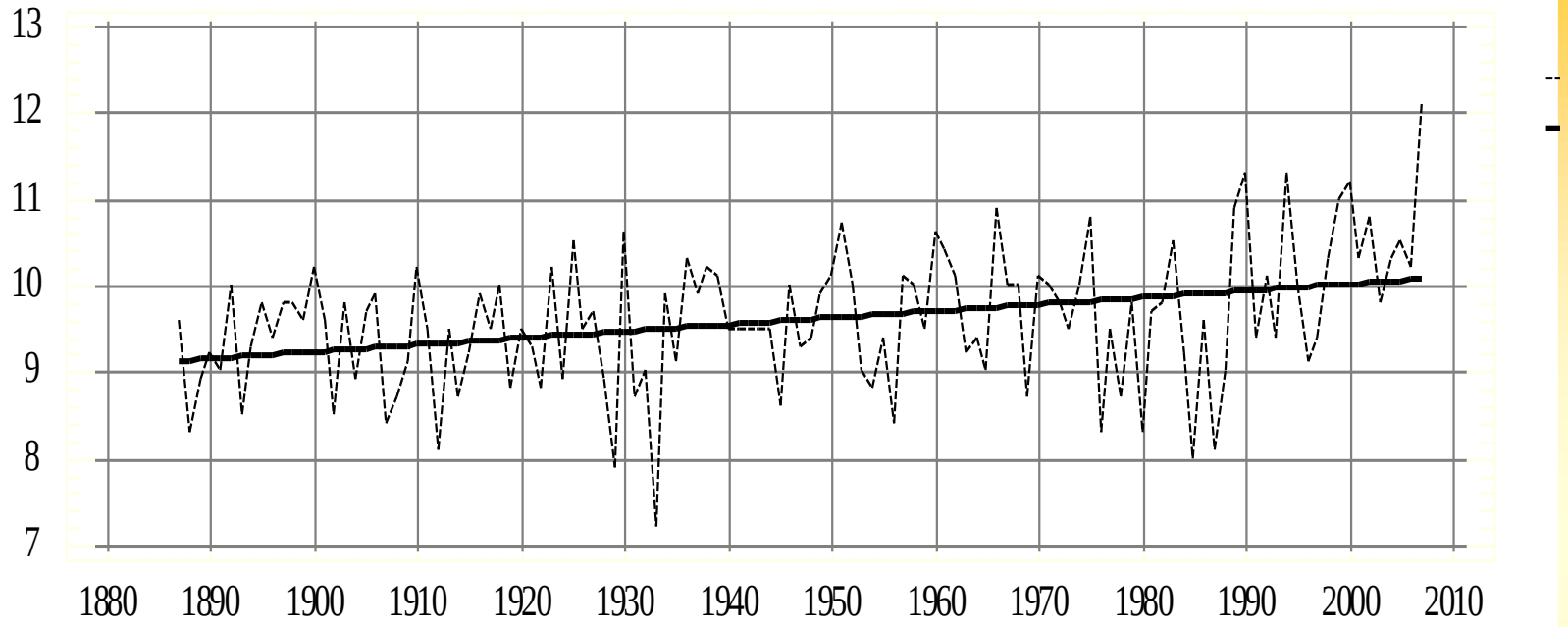

Diagram. 1. The change of average annual air temperature. Chişinău (1886-2007)

1– current pace

2– century pace (trend)

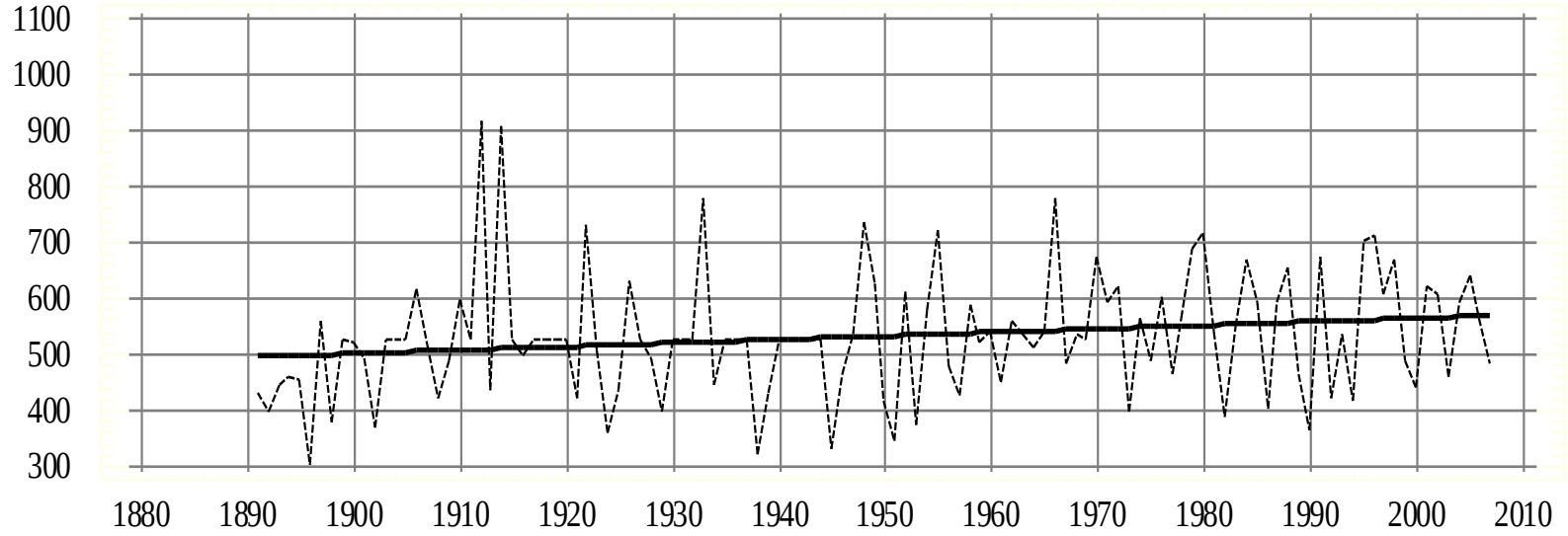

Diagram.2. The change in annual rainfall.
Chişinău (1891-2007)

1– current pace

2– century pace (trend)

3. The territory of Moldova – agricultural risk area

Republic of Moldova is vulnerable to a number of natural risks with a big impact on the economy and society. These risks include: land slides and erosion, strong winds and rain, long droughts, devastating floods and many others.

As an agricultural country Moldova is being affected all year round by different risk phenomena, which often heavily reduces agricultural production.

For instance, the strong hurricanes, excessive drought and large floods in 1994 have caused loss of lives (47 persons) and damages to the national economy, officially estimated to over two billion Moldovan lei.

In Moldova in the season of spring large and catastrophic droughts prevail, in summer extreme droughts are more frequent, while in autumns catastrophic droughts have a bigger frequency.

The droughts in Moldova account for 12.5% of the total number of hazards, causing great losses of agricultural production.

The analysis of the materials from the main survey period has shown that within this time frame during the vegetation period 22 years of strong droughts and 19 years of moderate and weak droughts have been recorded, which represent 34% of the total of years (i.e. once in every 3 years).

There are records of continuous drought during 2 years (3 times) and twice during 3 years.

It has been established that the frequency of drought on the territory of the country on average is as follows: 1 – 2 droughts in 10 years in the north of the country; 2 – 3 droughts in the central part and 5 – 6 droughts in the south of the country.

Estimations show that the rainfall deficit is characteristic basically for the entire territory of the country, belonging to the sub-humid and semi-arid regions with a high probability of drought and of desertification processes.

The probability of emergence of very strong droughts (≤ 50% of the standard rainfall) with catastrophic consequences in some months of the vegetation period throughout the country represents 11 - 41%.

In the last two decades droughts have been recorded to be more frequent, as well as more intensive. This way, between 1990 and 2009 10 years have been registered in the country (1990, 1992, 1994, 1996, 1999, 2000, 2001, 2003, 2007, 2009) with droughts of different intensity, which lead to a drop in agricultural crop yield.

In the years of 1990, 1992, 2003 the droughts have lasted throughout the entire vegetation period, in the rest of the years they were registered only in summer time.

The State Hydrometeorological Service of Moldova, based on the yearly detailed analysis of the hydrothermic coefficient (HC), has established that a value of HC ≥ 1,0 characterises a sufficient humidity, a HC ≤ 0,7 indicates a dry climate, a HC = 0,6 represents a light drought and a HC ≥ 0,5 is a strong and very strong drought.

The catastrophic drought of 2007 has affected over 80% of the territory of the country, being the most rigid drought during the entire survey period.

According to the main agrometeorological values this drought has exceeded even the drought of 1946 (table 3, 4), causing the national economy losses of over 1 billion USD.

The drought of 2007 on the territory of the Republic of Moldova has basically started in the fall of 2006. In the period between 01.09.2006 and 06.08.2007 the amount of rainfall throughout the country has constituted basically 50-70% of the climate norm.

The situation has worsened to the maximum between May and July 2007, when the rainfall amounted to only 30 % of the climate norm. The continuous lack of rainfall during the specified period varied in the limits of 27-73 days, and the number of days with a relative air humidity ≤ 30% amounted to 55-78 days, exceeding 3-4 times the climate norm.

Between May and July 2007 the average air temperature in the country was 21 – 23°C, which is 3 – 4°C higher than the norm (and a record).

The number of days with maximal temperatures of ≥30°C has constituted 36-45 days, exceeding the norm threefold. On July 21st the highest record temperature was registered, 41,5°C (at the Camenca weather station).

The stocks of productive humidity from the superior and medium layers of soil on the crop fields during the largest part of the summer time have been insufficient, and in some places even missed completely by the end of the month of July.

The agro-industrial sector is the one that has suffered most. The average yield of winter wheat at the country level in 2007 has constituted 15,3 ch/ha, which is twice lower than the average amount of the predicted yield and 10-11 ch/ha less than the average yield of the last 10 years.

The yield of the main late crops (maize, sunflower, sugar beet, tobacco, fruit trees) has been largely compromised, and the enterprises of the agro-industrial sector were left with no raw material. A difficult situation concerning providing of forage has been created in the zootechnic sector.

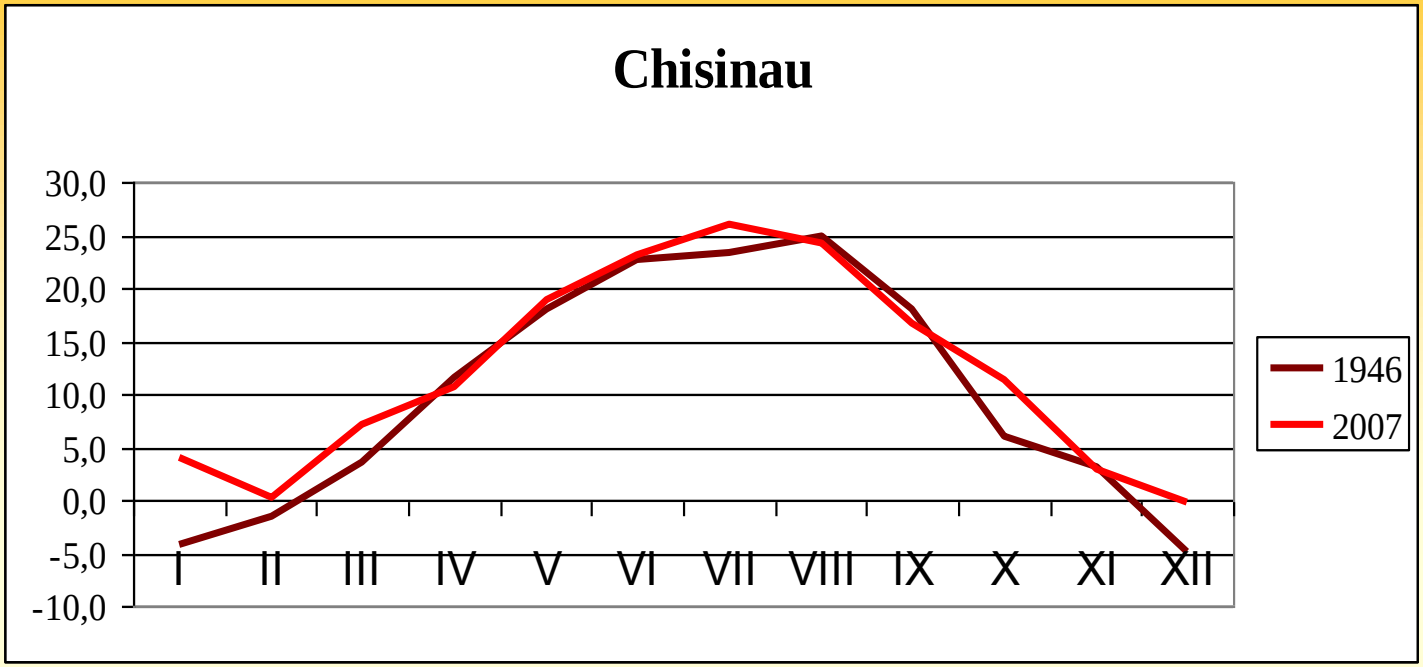

Table 3. Average monthly air temperature (°C) for the years of 1946 and 2007.

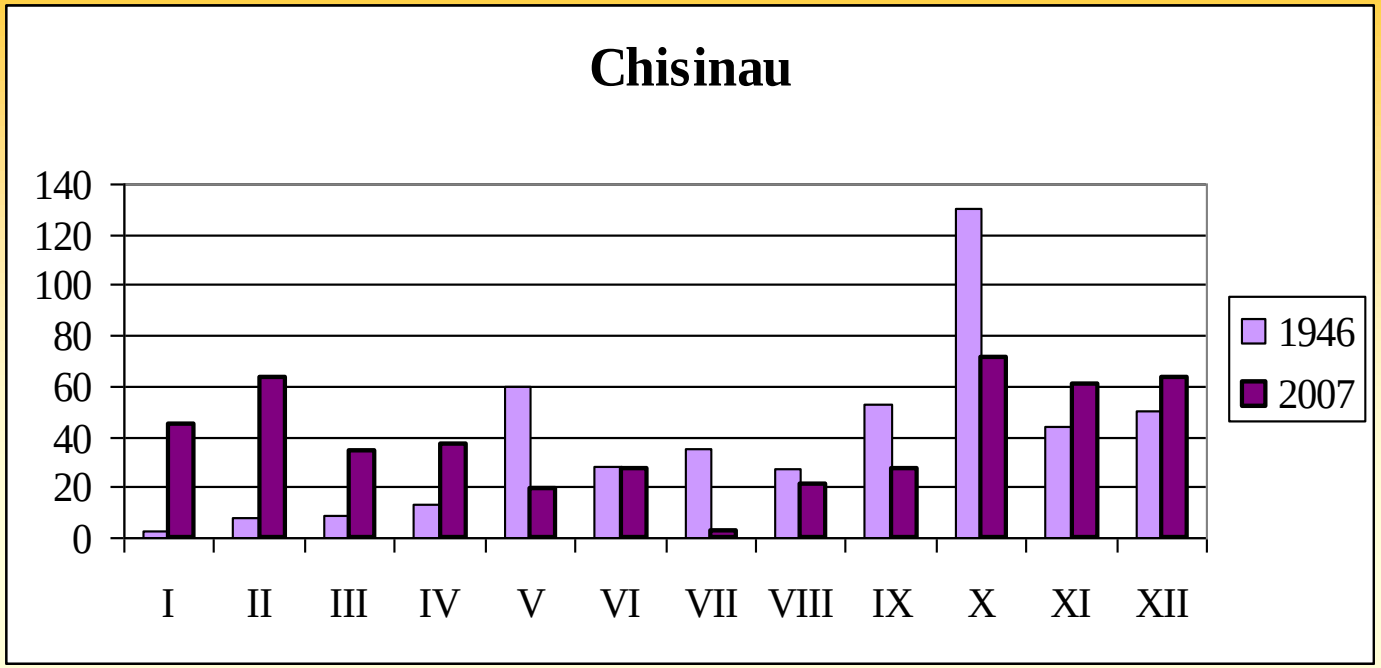

Table 4. Rainfall amounts (mm)
for the years of 1946 and 2007

Consequences

Conclusions

The main conclusion is that regional climate change, particularly the rise in temperature and the intensification of natural hazard phenomena, influences many of the natural and artificial ecosystems.

Climate change and the change in rainfall leads to the alteration of the vegetation periods and of the hydrological regime of rivers, to soil erosion, floods, drought and extremely strong torrential rains.

Improving the administration of water and irrigation systems, changing the land tilling technologies and usage of varieties and hybrids of agricultural crops with a higher level of resistance, together with other such measures are specific activities within the National Adjustment Strategy.

Thank you for your attention!

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