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THE IMPACT OF CLIMATE CHANGES ON THE VILLAGES NEAR COMANA PROTECTED AREA, GIURGIU COUNTY, ROMANIA

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Abstract

The main atmospheric climate parameters are important for the daily and seasonal variation of the parameters of the Comana Puddle aquariums. The anomalous variation of temperatures, precipitation and evaporation induces a fluctuation in the volume of water from the pond and the river Neajlov. Atmospheric temperature and precipitation directly affect winter phenomena and breakdown processes during the summer period, with significant effects on the agriculture, the most vulnerable domain on climate changes. In the hilly or hill area, the amount of rainfall decreases, thus influencing the water intake in these aquariums. The high warming time of the heat season leads to an increase in evaporation values, so that a water deficit is recorded in the hillside, hillside and plain areas, which also entails a loss in the volume of water in the lagoons. These seasonal fluctuations directly affect the limbic or aquatic fauna, but also the agriculture. In the cold season winter phenomena (ice bridge, ice on the shore, slopes, snowballs) and blocking water as snow, creates a deficiency in the water supply of lakes, ponds, puddles and swamps. This paper analysed the impact of climatic changes but also the possibilities of the recovery a part of the gloss of water, a gloss that existed years ago and which was greatly diminished after the work done downstream changed the hydrological balance of the area. This effect adds to the fact that climate change has made it possible for the volume of evaporation to be increased and sometimes to exceed the volume of precipitation.

Key words**:** *climate changes, floods, draughts, wet area*

INTRODUCTION

Experts' forecasts for the average air temperature increase of only 3^0C by 2070 show that more than 30% of the Giurgiu County's territory will be affected by desertification and ca. 38% of increased aridity. Geographical location of Giurgiu County in the South of Romania makes this threat to be one of great impact for socio-economic development and quality of life in the county. The main types of risks identified in the Giurgiu County are: storms and blizzards, floods, heavy snowfalls, tornadoes, drought, extreme temperatures, forest fires, landslides, earthquakes of land, accidents, damage, explosions and fires in industry, water pollution, collapse of buildings, installations or facilities, public utilities failure, falling objects and the space atmosphere, remaining unexploded ordnance during military conflicts, epidemics, epizootic diseases/zoonotic risk radiologic - induced by ionizing radiation, fire [5].

The absolute maximum temperatures are 39.0°C in Greaca and 42.4°C in Giurgiu, values which highlights the phenomena of dryness and deep drought. The average annual air temperature is 11ºC. The coldest month is January with average values below -2ºC. The warmest month is July, when average temperature is over 23ºC.

According to STAS 6054/84, the depth of freezing in the area is 70-80 cm. In winter, due to arctic cold air invasions, the absolute minimum temperatures are - 32ºC in Greaca and -30.2ºC in Giurgiu [4].

In terms of global solar radiation, it has annual values of 127.5 kcal/cm^2 of the horizontal surface. The sunshine duration has average annual values of over 2,250 hours of

sunshine and the relative humidity of the air is approx. 76%.

Due to the particularities relatively uniform plains, days with different thermal characteristics do not tolerate too much changes in its extent: approx. 30 days of winter, 90 -110 days with frost (are possible from middle of September to late May), 115-120 days of summer, etc., the most numerous being in the field, where the winter - summer thermal contrast is bigger.

MATERIALS AND METHODS

In this paper, time series have been used with regard to the evolution of meteorological parameters.

Analysis of mean annual temperature in the Giurgiu County in the year 2013 shows an increase of 1.1^0C, higher than normal standard climatological (1961-1990).

The same change was seen in the years 2014, 2015 and 2017 when the annual average temperature in the county (10.2ºC) was higher than normal climatological 1.3ºC standard (1961-1990).

In April 2015 Giurgiu County joined freezing conditions, with negative deviations from the annual average of 10°C. In the same year, in July, was recorded in Giurgiu County the peak of the heat wave was 41ºC. In 2017, the annual average annual temperature (9.9^0C) was 0.7^0C higher than normal climatological (1981-2010).

Temperature fluctuations during the day are key factors conditioning for the maintenance of habitats and species dynamics/stocks of Comana Puddle. Water temperature is a major factor that contributing to selection of species of fish, most fish species present in the Comana Puddle is euriterme that supports the wide variations in water temperature.

Thus, the low water level and the exposure to direct solar radiation, associated with the low water flow, causes a strong heating during the summer, between 2 pm and 6 pm, when maximum water temperature values of 24-26^0C are recorded.

The high temperature of the water allows the penetration of the sunlight and the heating of the water in depth, so that the entire volume of water has approximately the same temperature.

In the villages of Călugăreni, Comana and Mihai Bravu the annual temperature was not monitored so for analysis was taking into account the values recorded in Giurgiu.

Atmospheric precipitations have annual average values of 500-575mm: 530mm in Greaca and 575mm in Giurgiu.

Precipitation is spread throughout the year, with some accents in early summer (average rainfall of June reaching 76 mm). The decrease in precipitation volume is recorded early in autumn and in winter (especially in February).

The maximum rainfall in the 24 hours has reached or even exceeded 90 mm. Such values were recorded in Greaca (99.4 mm) and Giurgiu (96.6mm).

The number of days with snow is an average of 50 days; the average thickness of a decade is 8-15 cm, and the absolute maximum of more than 120 cm.

In non-periodic climate variations were recorded particularly rainy years the annual amounts were recorded almost double.

In 2014, the annual quantity to the national average precipitation (67.3 mm) was higher by 26.6% than the normal climatological standard (1961-1990). The year 2014 will remain in history as one of the rainiest years for the south part of the country since 1961 until present. Decreasing the amount of precipitation in February 2014, compared to normal climatological (1961-1990), and calculated as a percentage, was negative. Negative deviations of more than 85% were recorded in the Southern half of the Giurgiu County, with the highest values being 99%. In Giurgiu there were exceedances of the absolute maximum precipitations in 24 hours (58.4 mm in November 2014) [2].

In 2015, in Giurgiu County the water quantities in July had values of 58 mm and 61 mm in September.

Hydrological regime affects fish populations by frequency, intensity and duration of floods. The highest flows of the river are recorded during the spring period, being caused mainly

by the sudden melting of the snow in the river Neajlov river basin and by the rainfall that falls more frequently during this period. The increase in river flow and the flooding of important floodplain areas overlap with the reproduction period of fish species. Adult fish use submerged vegetation, roots and stems of emerging plant species as underwater supports for their pontoons.

The annual average relative air humidity is 72%. Concerning the lowest value, that is recorded in July (61%); the highest value characterise December (80%). During the growing season the relative humidity is 64%.

The dominant wind is the east and the west with the highest annual average frequency Danube corridor (21.3% and 23.2% east west).

Table 1. The main types of risks identified in Călugăreni, Comana and Mihai Bravu villages

Village	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Călugăreni									
Călugăreni	x	x	x	x	x	x	x	x	x
Brăniștari	x	x	x	x	x	x	x		
Crucea de Piatră	x	x	x	x	x	x	x		x
Hulubești	x	x	x	x	x		x		
Uzunu	x	X	x	x	x		x		x
Comana									
Comana	x	X	x	x	x	x	x		x
Budeni	x	X	x	x	x		x		
Falaștoaca	x	X	x	x	x	x	x		
Grădiștea	x	X	x	x	x		x		x
Vlad Țepeș	x		x	x	x	x	x		x
Mihai Bravu									
Mihai Bravu	x	X	x	x	x	x	x		x
Village	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Călugăreni									
Călugăreni	x	X	x	x	x	x	x	x	x
Brăniștari	x	X			x	x	x	x	x
Crucea de Piatră	x	X			x	x	x	x	x
Hulubești	x	X			x	x	x	x	x
Uzunu	x	X			x	x	x	x	x
Comana									
Comana	x	X	x	x	x	x	x	x	x
Budeni	x	X		x	x	x	x	x	x
Falaștoaca	x	X		x	x	x	x	x	x
Grădiștea	x	X		x	x	x	x	x	x
Vlad Țepeș	x	X		x	x	x	x	x	x
Mihai Bravu									
Mihai Bravu	x	X		x	x	x	x	x	x

Legend: 1 - storms and blizzard; 2 – flooding; 3 - heavy snow, drought; 4-5 - extreme temperature; 6 - forest fires; 7 – earthquake; 8- accidents, damage, explosions and fires industry; 9- accidents, damage, explosion or fire in storage and transport activities dangerous products; 10 - accidents, damage, explosion and fire in transportation activities, pollution of waters; 11, 12 - collapse of the building, installation or arrangement; 13 - the failure of public utilities; 14 - falling objects in the atmosphere or space; 15- unexploded ammunition; 16 – epidemics; 17- epizooties;18 – fires.

Source: Data from the Territorial Risk Scheme in the Giurgiu County, 2018, I.S.U. Giurgiu.

Overall, however, the wind is more common in the field (where calm is 17- 35%) than in the Danube corridor, where calm is 34-38%. Speeds annual average values 2.7-3,7m / s in the Danube corridor and around. 2.9-3.3m / s in the field.

The correlation between temperature and precipitation revealed the presence of only phenomena in the dry plain. The peculiarities of the active surface structure require local changes of the climatic parameters, allowing the individualization of several natural and anthropic topoclimate.

The effects of the extreme weather events have affected Giurgiu County through the significant economic losses suffered in agriculture, water management, energy supply and transport.

Since the last century, in the south of Romania there has been a significant increase in the temperature, accompanied by a sharp decrease in precipitation. Expected weather for the period 2061-2090 growth trends of the same average temperature during the summer months and reducing the annual precipitation in the summer months.

RESULTS AND DISCUSSIONS

In Giurgiu County most villages are at the risk of flooding.

In 2013, strong winds and torrential rains from 30 September to 1 of October caused important damages in Giurgiu County.

After ecological restoration of Comana Puddle, the number of recorded floods decreased considerably in Comana Commune by 85.71% compared to the reference year 2013 and in the village Mihai Bravu there were no interventions to remove the effects of floods [3].

Table 2. Flooding registered products during 2013-2018

Location	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Călugăreni	3	4	11	3	1	26
Comana	7	3	1	2	4	1
Mihai Bravu	1	-	-	-	-	-

Source: Inspectorate for Emergency Situations "Vlasca" of Giurgiu County.

As with floods, the severity of droughts in the last decade has increased, so that situations with a probability of 1% (once in a hundred years) occur at intervals of only a few years.

For example, the drought of 2003, when the flow of the Danube was so low that it reached a new record, was followed by catastrophic floods in 2005.

At the level of Giurgiu County, the drought is a dramatic problem and it manifests, especially, in the southern part of the county. The driest years, recorded in the period 2006 – 2014, were: 2007, 2008, 2009, 2012, 2013 and 2014.

In Giurgiu County, landslides are caused by triggers earthquakes and periods of prolonged and/or intense rainfall. Another important problem is deforestation, that may increase the likelihood of landslides. Therefore, the frequency of landslides may increase as a result of climate change and changes in precipitation associated with them, patterns of flow of water and vegetation.

Giurgiu County is located in terms of landslides in the area A, with flat land with perfect stability, in general the land are not affected by landslides.

The highest probability of occurrence of landslides exists in Izvoru, in the vicinity of localities Vieru, Ghizdaru, Daia, Băneasa, Pietrele and Puieni, on the right side of Câlnişteі river (tributary right Glavacioc), in the locality Naipu, on the right side Glavacioc, in the south of the Bila commune, in Tangâru locality, on the right side of Neajlov between localities Călugăreni and Radovanu.

Wildfires are extreme natural events that can be triggered by natural causes such as lightning or human activity, whether deliberate or not.

The probability of wild fires is influenced by climatic variability of several periods of time. For example, the inter-annual variability of relatively moist climate and determines the period during relatively dry.

In wet periods, there is an accumulation of vegetation, which provides fuel for fires in dry periods. The projected increase in seasonal variation in rainfall could lead to an intensification of favourable conditions for wildfires.

The frequency of these fires in Giurgiu County increased lately. The damage caused by wildfires can be substantial, especially from the economic point of view.

In villages Comana, Călugăreni and Mihai Bravu there were wild fires, according to data provided by the Inspectorate for Emergency Situations of Giurgiu County, as follows: in 2017, 1 fire vegetation in common Mihai Bravu and 1 fire vegetation village Brăniştari (6 ha of dry vegetation and underbrush outlet).

Concerning the agriculture activities, the total land area in Giurgiu County and in the three communes analysed remained the same in 2011-2014.

Table 3. Total land area 2011-2014 (ha)

Localization	2011	2012	2013	2014
Giurgiu County	352,602	352,602	352,602	352,602
Călugăreni	11,937	11,937	11,937	11,937
Comana	10,335	10,335	10,335	10,335
Mihai Bravu	6,654	6,654	6,654	6,654

Source: www.insse.ro.

In Călugăreni Commune of the total area of 11,937 hectares, 79.87% are agricultural lands, 70.73% are arable lands, 7.43% are pastures, 1.71% are alive, 20.13% are non-agricultural land, 6.44% are forests and forest vegetation, 4.43% is occupied by water and ponds, 4.99% is occupied with construction. 2.44% is occupied by railways and communications, 1.81% are degraded and unproductive land.

Table 4. Land area in Călugăreni, 2014

Călugăreni, 2014		
Mode of use:	Total area (ha)	Percentage of total joint (%)
Agricultural	9,534	79.87
Arable	8,443	70.73
Pasture	887	7.43
Hayfields	-	-
Wine vineyards and tree nurseries	204	1.71
Orchards and nurseries	-	-
Total non-agricultural land	2,403	20.13
Forest and other forest vegetation	769	6.44
Busy waters, pools	529	4.43
Busy construction	596	4.99
Means of communication and railways	292	2.44
Degraded and unproductive lands	217	1.82

Source: www.insse.ro.

In the commune of Comana, from the total area of 10,335 hectares, 47.75% is the agricultural land, 43.49% are arable land, 3.11% pastures, 1.13% are vineyards and viticulture nurseries, 52, 25% are non-

agricultural lands, 34.99% are forests and forest vegetation, 9.70% of the area is occupied by water, ponds, 4.45% are occupied with constructions, 2.87% are roads and railways, 0.22% are degraded and non-productive land.

Table 5. Land area in Comana, 2014

Comana, 2014		
Mode of use:	Total area (ha)	Percentage of total joint (%)
Agricultural	4,935	47.75
Arable	4,495	43.49
Pasture	322	3.12
Hayfields	-	-
Wine vineyards and tree nurseries	117	1.13
Orchards and nurseries	1	0.009
Total non-agricultural land	5,400	52.25
Forest and other forest vegetation	3,617	34.99
Busy waters, pools	1,003	9.70
Busy construction	460	4.45
Means of communication and railways	297	2.87
Degraded and unproductive lands	23	0.22

Source: www.insse.ro.

In the Mihai Bravu commune, of the total area of 6,654 hectares, 50.19% is the agricultural area and 30.73% is the arable land. Wine vineyards and nurseries occupy an area of 1% of the total land, 49.80% are non-agricultural land, 38.83% are forests and other forest vegetation, 5.77% is a surface occupied by waters and ponds, 3.27% is occupied with construction, communications and railways hold 1.90%, and degraded and non-productive land occupy 0.01%.

Table 6. Land area in Mihai Bravu, 2014

Mihai Bravu, 2014		
Mode of use	Total area (ha)	Percentage of total joint (%)
Agricultural	3,340	50.26
Arable	2,045	30.73
Pasture	1,228	11.46
Hayfields	-	-
Wine vineyards and tree nurseries	67	1
Orchards and nurseries	-	-
Forest and other forest vegetation	3,314	49.80
Păduri și altă vegetație forestieră	2,584	38.83
Busy waters, pools	384	5.77
Busy construction	218	3.28
Means of communication and railways	127	1.91
Degraded and unproductive lands	1	0.01

Source: www.insse.ro.

CONCLUSIONS

Climate change impacts on biodiversity and ecosystems and often exacerbates other pressures such as pollution, over-exploitation, invasive species, fragmentation, degradation and deterioration of habitats [6].

Ecosystems play an important role in regulating climate. At the same time, climate changes affect more and more natural systems. The continuous decline of biodiversity and degradation of ecosystems reduce their ability to provide essential services. By actions for conserving nature and restoring ecosystems it is possible to reduce their vulnerability and increase the level of resistance [7].

Peatlands, wetlands, soil, and forests play a crucial role in absorbing and storing carbon, thus helping local communities to protect themselves against climate changes [8].

Wetland plants and soils play an important role in the purification of water, removing high levels of nitrogen and phosphorus, and in some cases even toxic chemicals. This role is important in preventing eutrophication process, which leads to a rapid increase in algae, which means that sometimes the surface is completely covered by plants, is completely covered by the plants, so that the mass of water decreases much light and therefore photosynthesis, which is why it is no longer can produce enough oxygen, although demand is increasing by multiplying organisms. This can lead to fish death and other unwanted phenomena. The protected area of Comana has significant potential for reducing future emissions of greenhouse gases through maintaining healthy ecosystems and restoring degraded environments by restoring peatlands and wetlands, by reforestation and reducing other pressures on nature. In addition, semi-natural and managed ecosystems, including those used for agriculture, offer many opportunities for active carbon sequestration and reduction of emissions. The wetlands tend to slow down the force of the water, encouraging storage that will reach the sediment water. Nutrients are often associated with sediments and can be stored at the same time. These nutrients, especially nitrogen and phosphorus derived from agricultural sources, but also downloads the industrial accumulate into the ground and can be converted by chemical and biological

processes or may be made by vegetation wetland can then be removed effectively from system. These areas act as purification systems for drinking water, protecting land from floods and are considered the most productive ecosystems in the world, their structure and functions are determined mainly hydrology of the area. This type of ecosystem is about ten times more productive than usual ecosystems because, in addition to supplying solar energy they receive additional energy intake represented by entries in areas that are in permanent contact, water and land. Thus, water movement is crucial to ensure their productivity. The excess of organic matter (biomass) can be stored or can be exported to the surrounding ecosystems.

The wetlands contribute to the recharge of groundwater which stores about 97% of fresh water unfrozen a third party.

Wetlands often fulfil a crucial role in preventing floods. By storing water in the soil surface or by stopping it in lakes or marshes, wetlands reduce the need for expensive construction.

Decreases power wetlands rain, preventing downstream flooding producing, storing or retaining water in the soil on the surface of a lake, so that wetlands advantageously replaced by artificial structures constructed at great expense. They allow the recharging underground aquifers are of vital importance to humans, their only source of drinking water or water for irrigation, slow down the passage of water, nutrient, and sediment deposition favouring the flowing water conveyed.

These areas plays a double role in terms of climate change and management of greenhouse gas emissions (carbon dioxide) and buffering the impact of climate change, by plants and soil purifies water, removing high concentrations of nitrogen and phosphorus in the some cases of chemical compounds being able to remove the highly toxic biodegradable.

During the period 2013-2017, in the communities of Comana, Călugăreni and Mihai Bravu, the effects of climate change have stagnated compared to the reference year 2013, but also to previous years.

A positive aspect of the ecological reconstruction of Comana Puddle is the decreasing the number of floods. After the ecological reconstruction of Comana Puddle, the number of recorded floods decreased considerably in Comana commune by 85.71% compared to the reference year 2013 and in Mihai Bravu there were no interventions for removing the effects of the floods.

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