



Climate change challenges in Romania - influence on water resources and adaptation measures-

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CONTENT:

1. World and European context of climate change adaptation
2. Studies on estimating the impact of climate change on the maximum flow rate and average flow rates of rivers in Romania
3. Climate change adaptation measures
4. Conclusion



1. World and European context of climate change adaptation

In April 2013 the EC adopted an EU strategy on adaptation to climate change.
The aim: Europe more climate resilient

Climate change adaptation measures- partially taking into consideration by MS in implementation of FD

Sendai Framework is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters

Priority 1 Understanding disaster risk

Priority 2 Strengthening disaster risk governance to manage disaster risk

Priority 3 Investing in disaster risk reduction for resilience

Priority 4 Enhancing disaster preparedness for effective response, and to «Build Back Better» in recovery, rehabilitation and reconstruction

Paris Pact on water and adaptation on climate changes

- ✓ launched at the 21st Conference of the Parties to the United Nations Convention on Climate Change (COP 21), 30.11-11.12.2015, Paris, France.
- ✓ Objectives :
 - Strengthening development and knowledge capacity;
 - Adaptation of river basin planning to climate change;
 - Strengthening governance in water;
 - Ensuring adequate funding.
- ✓ signed by 348 water representatives from 87 countries, including Romania through N.A. "Romanian Waters" together with the 11 W.B.A. and I.N.H.G.A.



2.1. Studies on estimating the impact of climate change on the maximum flow rate of rivers in Romania through hydrological simulation

To estimate the impact of changes and climate variables on the hydrological maximum flow regime, long-term simulations are carried out using the CONSUL hydrological model (INHGA), using the rainfall and temperature series (NMA) - regional model REMO.

The comparative analysis for two time periods: 1951 - 2010 and 2011 - 2050 respectively revealed the following:

Mureş river basin: the maximum flows with the probabilities of exceedance of 0.1%, 1%, 2%, 5% and 10% have a **decreasing trend** in the upper and lower part of the Mureş River and a **tendency of slight increase** in the middle area.

Jiu river basin: the maximum probability of exceedance of 0.1%, 1%, 2%, 5% and 10% has a **growth trend** of up to 15% in the upper zones, up to -20% in the middle area and maximum -8% in the lower area of the Jiu basin.



2.1. Studies on estimating the impact of climate change on the maximum flow rate of rivers in Romania through hydrological simulation

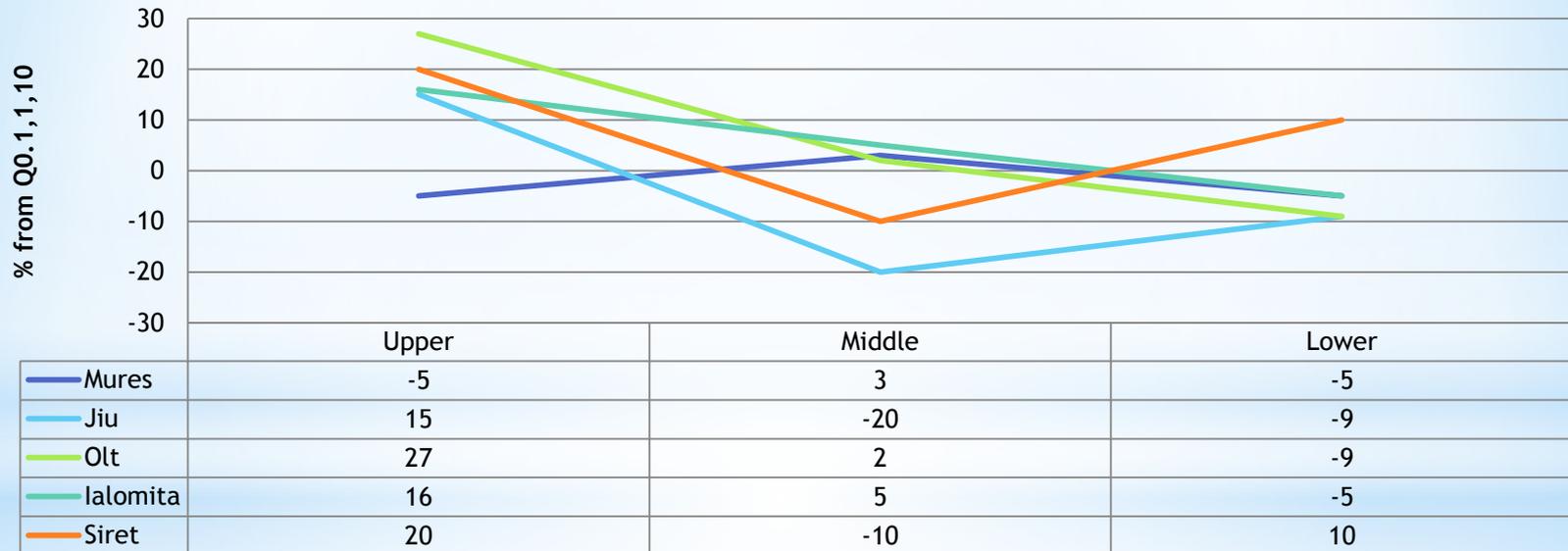
Olt river basin: the maximum flows with the probabilities of exceeding 0,1%, 1%, 2%, 5% and 10% generally have an upward trend of up to 24% in the upper zone (from source to downstream confluence with the Homorod River), declining and then growing varying between -4% and 9% in the middle zone and a decrease of maximum -6% in the lower area of the Olt river basin.

Ialomita river basin: the maximum probability of exceedance of 0.1% has a growth trend across the hydrographic basin of maximum 27%, the probability of exceedance of 1%, 2% and 5% have a maximum growth trend 16%, in the upper and lower zone, of maximum -5%, in the lower area of the river basin
-probability of exceedance of 10% have a decreasing tendency in the entire hydrographic basin, up to -9%.

Siret river basin: the maximum probability of exceedance of 0,1%, 1%, 2%, 5% and 10% has a growth trend of up to 20% in the upper zone and maximum 10% in the lower, up to -10% in the middle of the basin.



Influence of CC on maximum flow rate



Conclusion: upper part of river basins have a general increasing tendency of maximum flow rate

- Different trends on the same river basin (upper, middle, lower part)
- Different trends for exceedance probabilities (0.1% - 1% increasing, 10% decreasing)



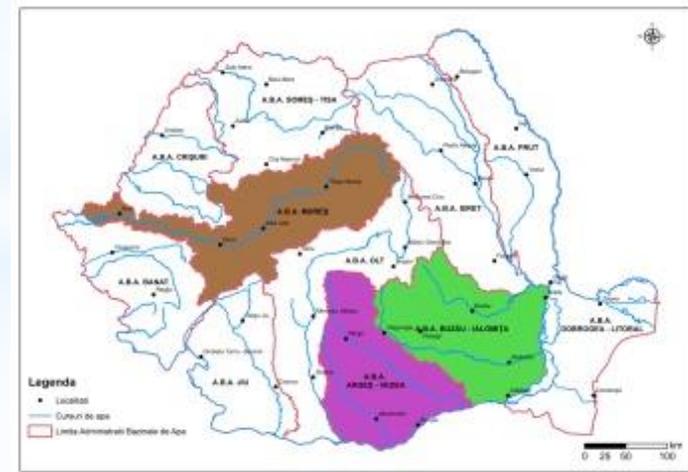
2.2 The results of N.H.G.A. from international projects (CECILIA, CLAVIER): 4 river basins in Romania were studied in order to quantify the impact of climate change on average flows

✓ For the Buzău and Ialomița hydrographic basins:

- ❑ a reduction in the average annual flow rate of 15-20% for the period 2021-2050 and 30-40% for the period 2070-2100;
- ❑ the possibility of early floods from snow melting and the amplification of extreme phenomena.

✓ For the Argeș și Mureș hydrographic basins:

- ❑ an annual average flow reduction of 10-15% for the period 2021-2050;
- ❑ the possibility of flooding in the winter, and although the floods caused by torrential rains will occur more often, the frequency of long-term and high-volume floods is expected to decrease.





3. Climate change adaptation measures

3.1. Adaptation measures from the point of view of ensuring the use of water

- ✓ Adaptation measures - ensuring availability at source
- ✓ Adaptation measures to water uses

3.2. Adaptation measures from the perspective of flood risk management

- ✓ Measures to adapt existing buildings, infrastructure and defense structures
- ✓ Measures to increase the resilience of the population (implementation and adaptation of protective measures for various objectives - buildings, constructions)
- ✓ Natural water retention measures



3.1 Adaptation measures at water uses levels

- **conservation and more efficient use of water** (including through the introduction of water prices to stimulate water conservation and quality protection);
- **loss reduction;**
- **adaptations of lifestyle;**
- **introduction of varied, more resistant agricultural crops and lower water requirements;**
- **increasing the percentage of water recirculation, especially in industry;**
- **re-evaluating legal, technical and economic regulations on water resource management in the hypothesis of possible climate change;**
- **adapting** dispatcher curves and **operating rules** for storage lakes to modified hydrological regime and new water requirements that also take into account climate change (eg Vârșolț reservoir).
- **alternative back-up water supply systems**



3.2 Adaptation measures from the perspective of flood risk management

- **Resizing/relocation of existing embankment / defense works**
 - ✓ Eg.: *Overgrazing of the dams on the Râmnicu Sărat River on the Slobozia-Botești Măicănești sector, Vrancea County*

Correlation with wetland reconstruction – water retention areas creation
- **Optimisation of dam operating rules** for increasing mitigation capacity
 - ✓ Eg.: *Optimize the exploitation of storage lakes to increase retention / mitigation capacity*
 - ✓ Eg.: *Revision of exploitation rules and updating of operating regulations at Caraula Reservoir; Revision of exploitation rules and updating operating regulations at Cornu Reservoir*
- **Aging water infrastructure -Proper maintenance of infrastructure; Studies on structural behavior of dams, operative plans in case of incidents/accidents** (*Ex: Oroville USA, last accident in Laos*)



3.2 Adaptation measures from the perspective of flood risk management

- Measures to increase the resilience of the population (implementation and adaptation of protection measures for various objectives - buildings, constructions) - less used / applied in Romania

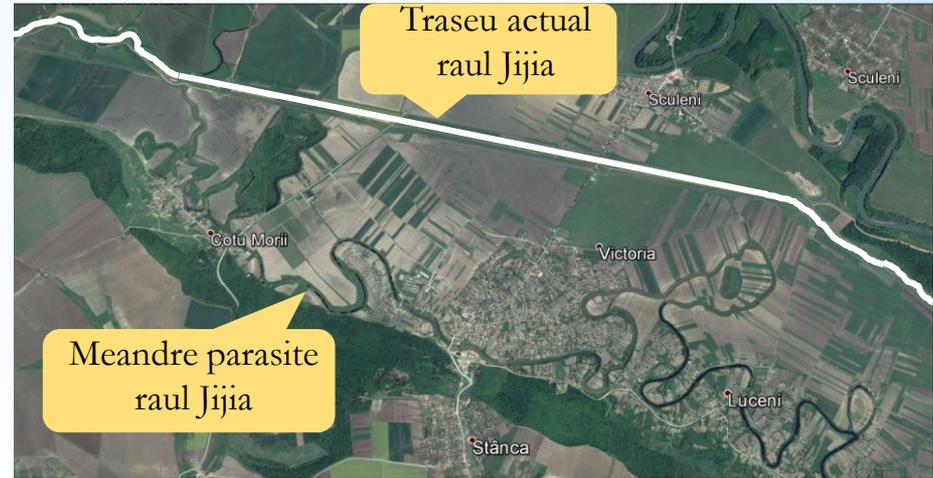


- Construction oversight, underground flood control (Wet Floodproofing); construction materials must be waterproof and all utilities must be above flood projected (the measure does not apply to floods characterized by high depths and high water velocities)
- Dry Floodproofing - waterproofing the building with impermeable materials (waterproofing or other materials to prevent water from entering the dwelling) and is applicable in areas characterized by low depth and low water velocity in case of flooding
- Local thresholds / dams / flood protection walls (Berms / Local Levees and Floodwalls) - low height ring structures that can be placed around a single building or a small group of buildings (must include drainage and drainage systems) evacuation of protected water)

HOW TO ASSURE GOOD GOVERNANCE AND TO CREATE LOCAL PROGRAMES FOR SUCH MEASURES?



3.2 Adaptation measures from the perspective of flood risk management



- Natural water retention measures

• Natural water retention measures in urban / populated areas:

- "Green" rivets, canals and gutters, drainage systems etc .;
- Collection and storage of rainwater in buried / underground tanks;
- Permeable pavements, green roofs, bioretention areas, infiltration channels, landscaped green spaces (including planting trees and shrubs for biological drainage of excess humidity).

• Measures for the restoration of retention areas (floodplain, wetlands, etc.): creation of new wetlands; reconnection and restoration of floodplain; re-naming the watercourse

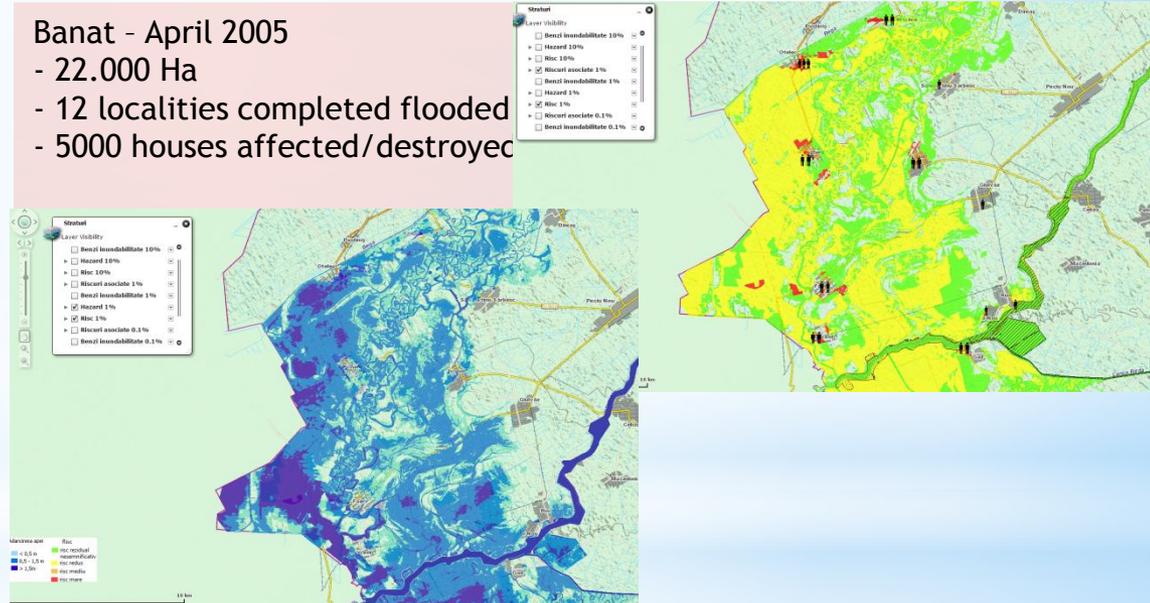
- ✓ Eg. : *The Creation of the wet area on the Jiu river on the Arginești - Filași sector; Reconnect old arm on the right bank Jijia, Victoria - Golăești Iași County; Restoration of meanders Jijia left, Boșia, Iași County*



Climate change adaptation measures - governance and policy level



Banat - April 2005
- 22.000 Ha
- 12 localities completed flooded
- 5000 houses affected/destroyed



EU Policy level and governance concerning Climate change adaptation measure:

- existing link between Water Framework Directive and Flooding Directive (also with another EU Directive, Biodiversity and Habitats, Inspire) - needs to improve
- Needs to take into consideration aging infrastructure - WFD-FD, Critical Infrastructure Directive



Conclusion:

Climate change adaptation measures needs to be addressed for both extreme phenomena: floods and droughts, many times in the same areas



Strengthening links between WFD - FD, spatial development

- education/awareness, warnings and forecast improvement, hazard and risk communication, increasing of emergency intervention efficiency, etc; - horizontal measures

- green infrastructure, land use adaptation, improvement of construction/infrastructure resilience and of existing standards/norms, etc; - vulnerability reduction measures

- natural and artificial retention measures, adaptation of existing flood defense infrastructure and operating rules, etc; - hazard reduction measures

- **Needs to adaptive and aggregated measures, is no way to find only one “miracle” solution**
- **Needs to take into consideration world discrepancy in development - best practices sharing and know how transfer between countries**

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Thank you!