

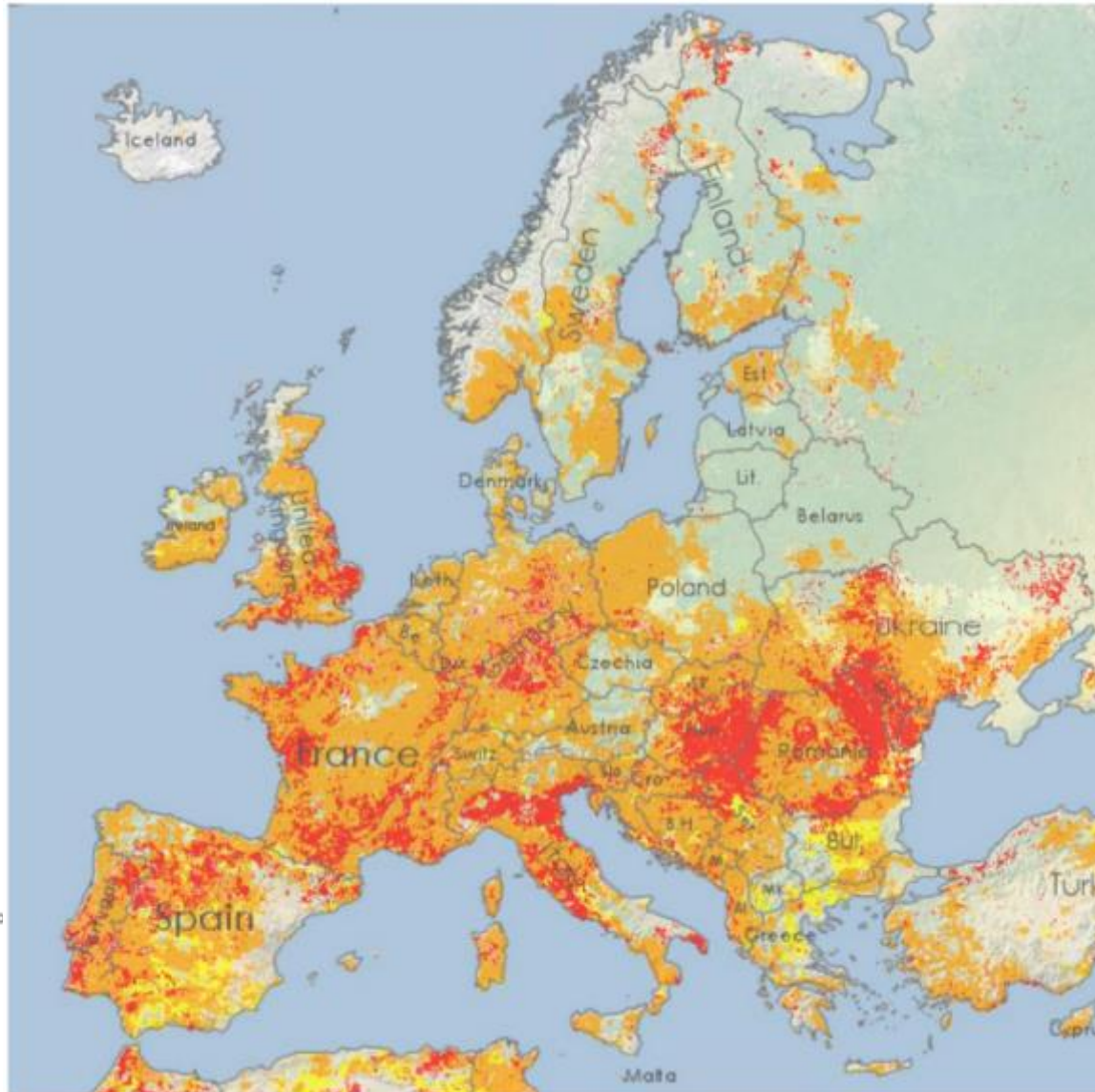
DROUGHT RISK AND RESILIENCE ASSESSMENT IN ROMANIA

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Drought in Europe 2022

Combined Drought Indicator (CDI v.2.1)
- beginning of August 2022
(<https://edo.jrc.ec.europa.eu/>)



Drought in Romania 2022



Context of the study

Specific objectives:

- Assess the historical drought's impacts, with a focus on the 2022 event, using all the available data.
- Provide a broader overview of drought risk, vulnerability and resilience in Romania.
- Lay the foundation for future analytical work and interventions in drought management.

Integrated Drought Risk Management

Monitoring
and Early
Warning

Risk & Impact
Assessment

Risk
Mitigation,
Preparedness
and Response

IDMP

Integrated Drought Management Programme



WORLD
METEOROLOGICAL
ORGANIZATION

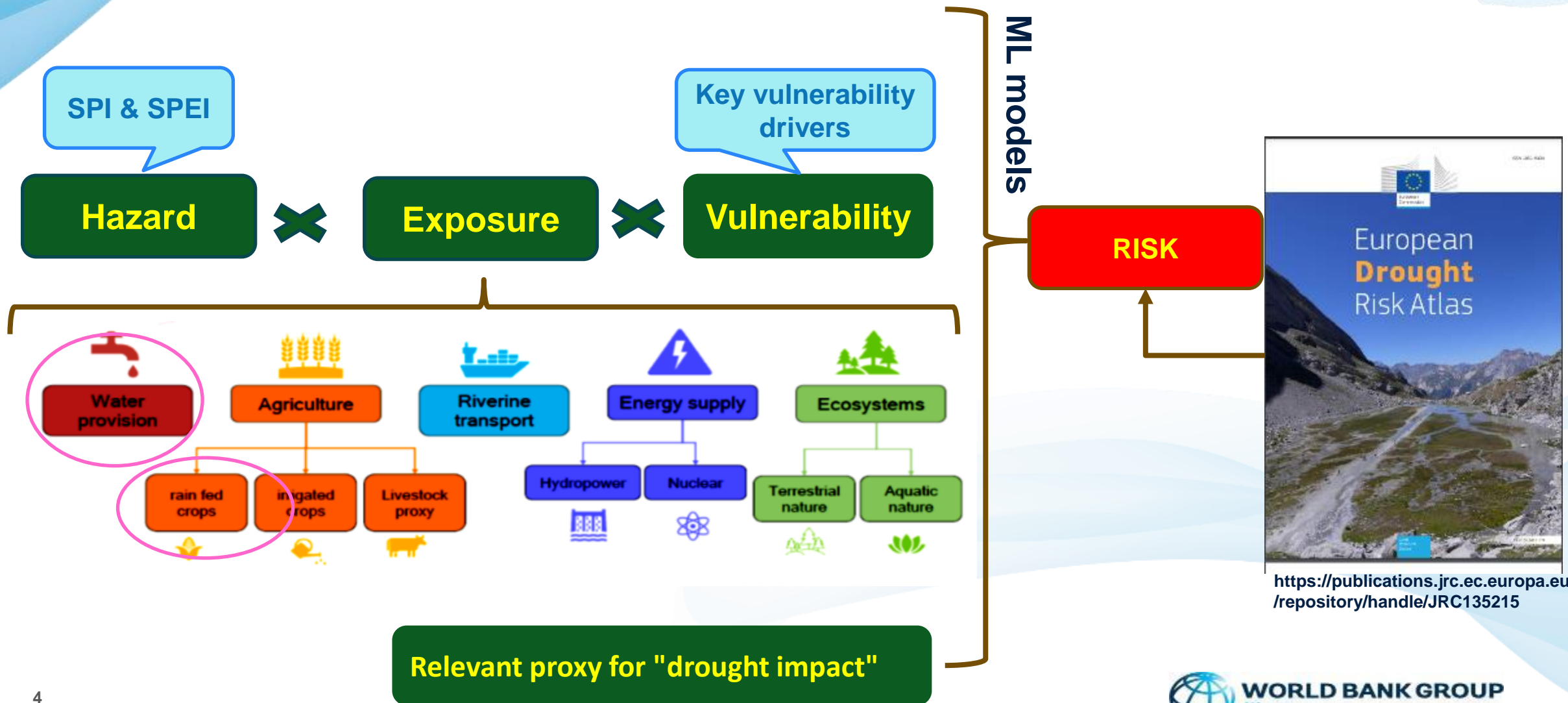


Global Water
Partnership



WORLD BANK GROUP
Water

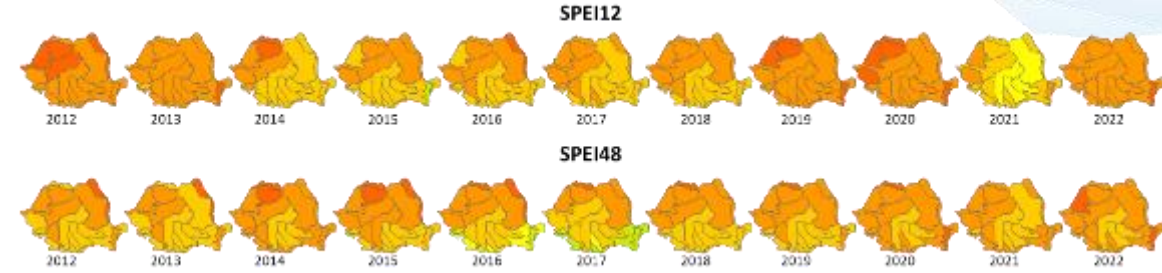
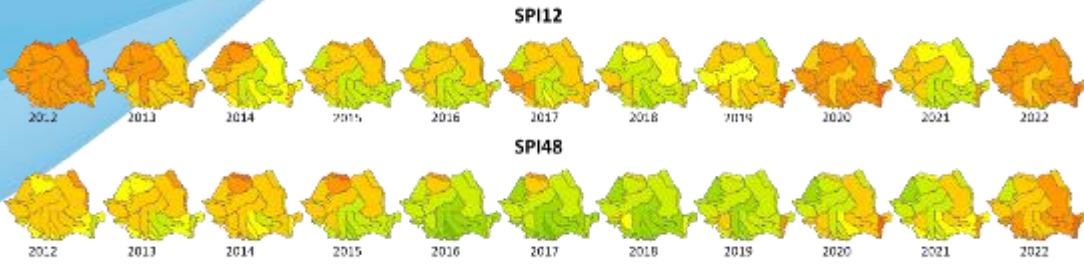
EDORA Methodological approach



Data sets for drought risk assessment

	Data item	Source	Spatial resolution	Temporal resolution	Temporal coverage	Comments
Hazard	Precipitation	Global CWatM, ISIMIP 3a & 3b	0.5 seg	Daily/monthly	1990 -2019 2021 -2100	
	Potential Evapotranspiration	Global CWatM, ISIMIP 3a & 3b	0.5 seg	Daily/monthly	1990 -2019 2021 -2100	Based on the FAO Penmann-Monteith equation
	Soil moisture	Global CWatM, ISIMIP 3a & 3b	0.5 seg	Daily/monthly	1990 -2019 2021 -2100	
	Streamflow	Global CWatM, ISIMIP 3a & 3b	0.5 seg	Daily/monthly	1990 -2019 2021 -2100	Monthly minimum streamflow for the largest river
Impact	Crop yields	National Institute of Statistics TEMPO Online statistics Romania	NUTS3	Annual	1990 -2021	18 crops and crop groups
	Water abstraction for public water supply	EUROSTAT	River basin	Annual	2008 -2017	
	Water use for hydropower generation	ANAR Romania	River basin	Annual	2009 -2020	
	Transport in vessels for Romania	National Institute of Statistics TEMPO Online statistics Romania	National	Annual	2005 -2021	
	Net primary productivity (NPP)	MODIS/Terra NPP Gap-Filled Yearly Global	500 meters	Annual	2001 -2022	
Exposure	Forest/Wetland map	MODIS/Terra+Aqua Land cover type yearly L3 Global	500 meters	Annual	2015	Used landcover classification by the IGBP, five forest landcovers, and one wetland covers.
Vulnerability	Dominant tree species	Brus et al., 2012	0.0174 deg	-	Multi annual	
	Ecological zones	EEA Digital map of ecological regions	-	-	Multi annual	
	GDP	Kummu et al., 2020	0.008333 deg	Annual	2015	
	Aridity index	Zomer and Trabucco, 2022	0.008333 deg	Annual average	1970 -2000	
	Government effectiveness	EQI European Commission	NUTS3	Annual	2021	Average of indicators
	Agro-ecological zones	FAO-IIASA GAEZ v.4	0.008333 deg	Annual average	1980 -2010	
	Share of irrigation relative to arable land	IIASA/IFPRI SPAM crop distribution model.	0.08333 deg	Annual	2010	Data on these aspects is also available in National Institute of Statistics TEMPO Online statistics Romania
	Available water capacity of the soil	Hengl and Gupta, 2019	250 meters	Annual average	1950 -2017	
	Soil compaction	ISRIC GLASOD	-	-	~1990	Soil compaction as major land degradation level

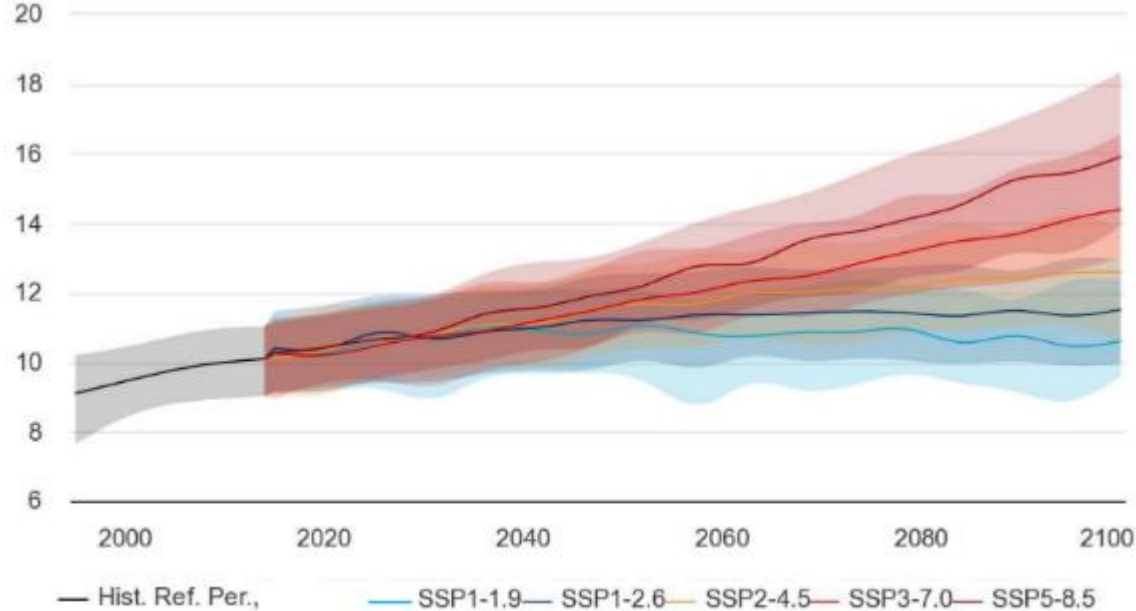
Hydro-meteorological drought hazard in Romania



MINIMUM INDEX
VALUE IN THE YEAR

- 2 - 3
- 1 - 2
- 0 - 1
- 0
- 1 - 0
- 2 - -1
- 3 - -2

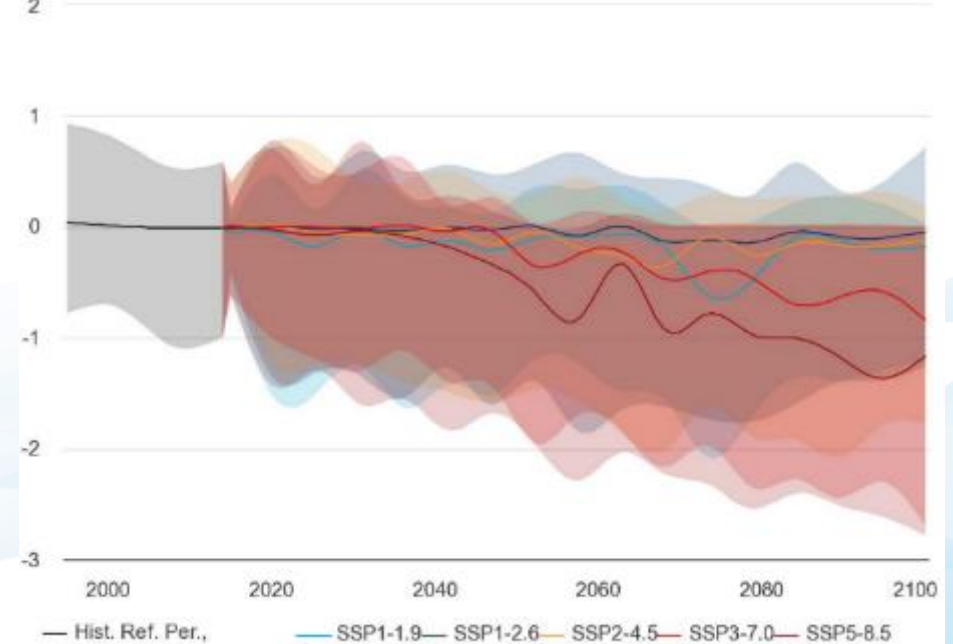
Projected Mean-Temperature



MINIMUM INDEX
VALUE IN THE YEAR

- 2 - 3
- 1 - 2
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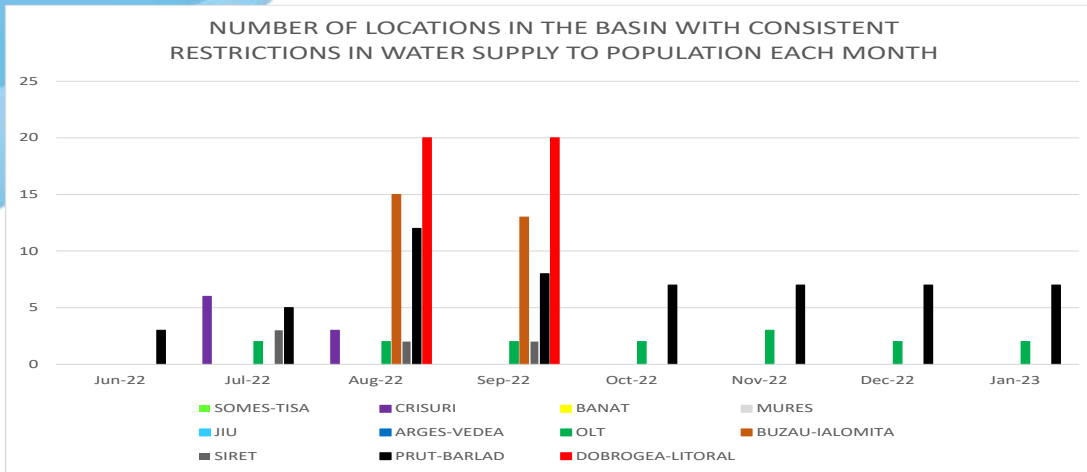
Projected Annual SPEI



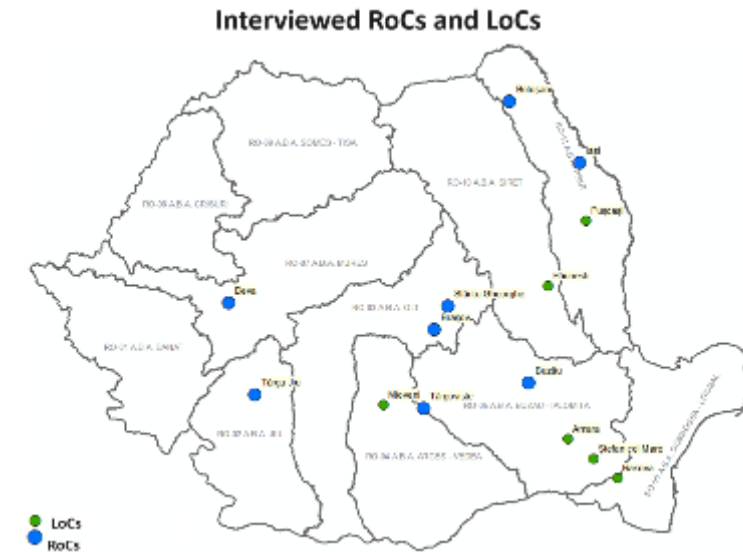
Reference period: 1995-2014,

Multi-Model Ensemble. SOURCE: Coupled Model Inter-comparison Project 6, World Climate Research Program

WSS - drought impacts assessment



- Short survey to ROCs: 27/44 responded, clustering of ROCs based on water source and drought impact
- Analysis of the benchmarking data: correlation analysis between drought indices with data on operational costs and revenues from ROCs
- Detailed interviews with selected Water Service Providers: understanding how they are economically impacted and their current and planned drought risk management

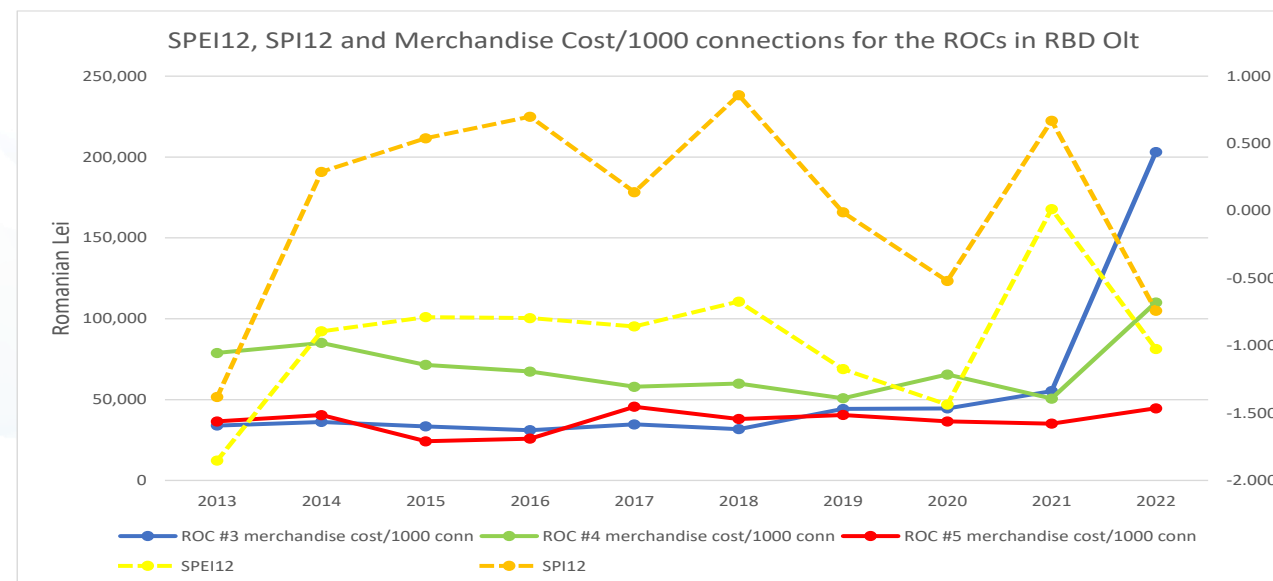
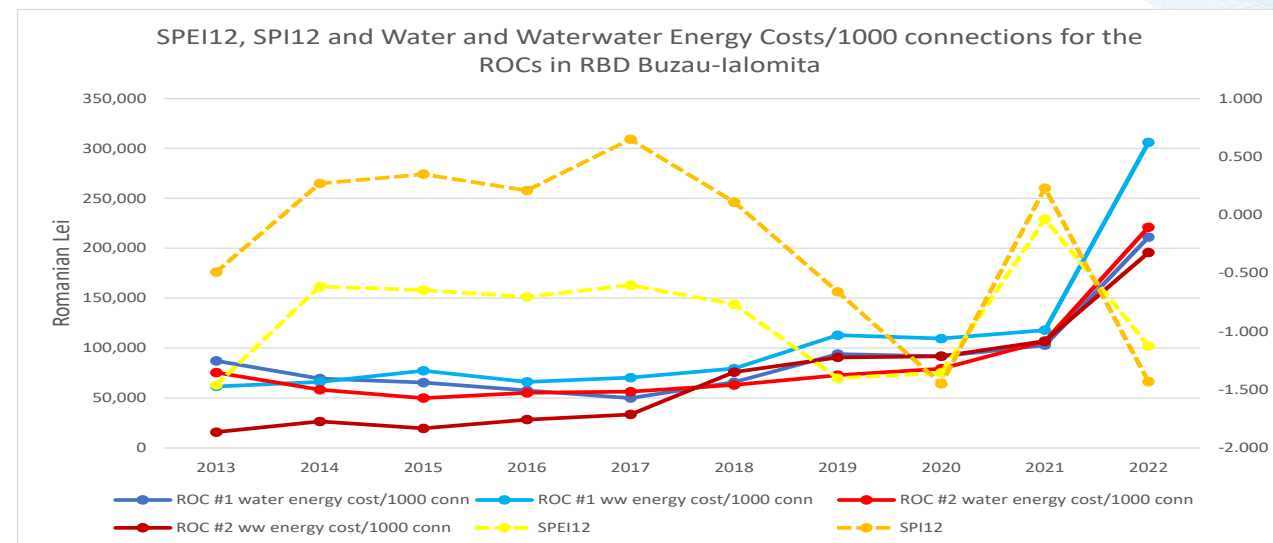


WSS - drought impacts on ROC's costs

Lower SPEI values (more acute precipitation deficiency / drought) are correlated with higher electricity costs, across all ROCs in RBD Buzau-lalomita and in RBD Olt for merchandise costs (including chemicals for water treatment).

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) costs_raw_water Lei / 1000 connections	1.000							
(2) costs_treated_water Lei / 1000 connections	-0.499***	1.000						
(3) costs_merchandise Lei / 1000 connections	0.169	-0.733***	1.000					
(4) costs_electricity Lei / 1000 connections	-0.003	-0.050	0.247	1.000				
(5) costs_maintenance Lei / 1000 connections	-0.006	-0.472***	0.587***	0.235	1.000			
(6) costs_external_service Lei / 1000 connections	0.029	0.304*	-0.112	-0.201	-0.012	1.000		
(7) costs_water_activity Lei / 1000 connections	0.108	-0.619***	0.818***	0.367**	0.748***	-0.004	1.000	
(8) losses_distribution M ³ / 1000 connections	0.639***	-0.093	-0.225	-0.043	-0.335**	0.082	-0.356**	1.000
(9) SPEI12	0.031	-0.001	-0.159	-0.360**	-0.140	-0.047	-0.195	0.015
	(0.851)	(0.994)	(0.329)	(0.022)	(0.389)	(0.772)	(0.227)	(0.927)

***, **, * = Statistical significance at 1%, 5%, and 10%, respectively

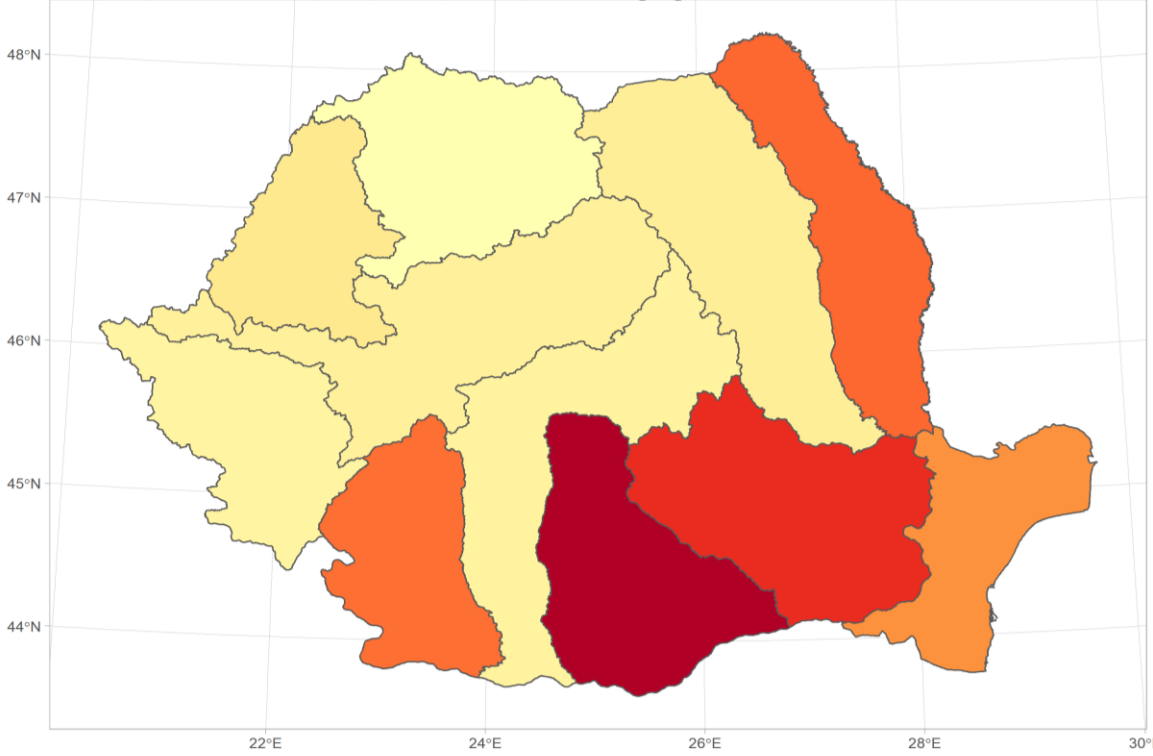


WSS- Findings from the Interviews with the ROCs and LOCs

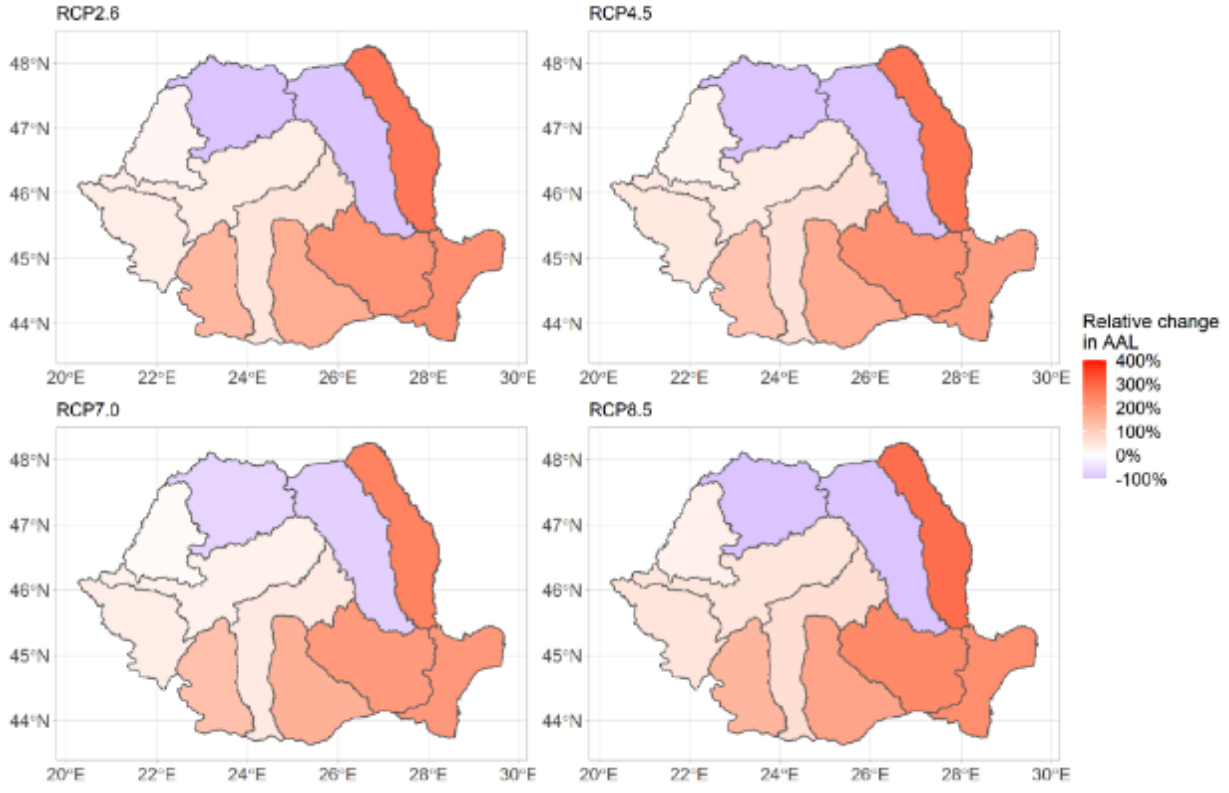
- Drought leads to increased demand (up to triple), esp. in rural areas with impact on unauthorized uses and increased NRW volumes.
- Significant decrease in water levels in wells compared to 2010 and eutrophication in reservoirs / natural lakes.
- Competing uses of sources and priorities with impacts on water available for population.
- Investments required in diversification and interconnection of sources, reduction of water losses and increasing storage capacity by ANAR and by operators.
- No Drought risk management plans by ROCs / LOCs and few drought risk management measures are applied, mostly monitoring (in larger ROCs) and awareness campaigns. Very low awareness for the impacts of drought.

WSS - drought risk

Water withdrawal for WSS



Present conditions at the river basin level



Future conditions at the river basin level by 2100 (relative to baseline period, 1990 -2019)

WSS – drought impact assessment conclusions

- Drought is a problem and will not be limited to small rural areas in the future: **need for ROCs and LOCs to assess future drought risks!**
- Small operators need financial and technical support for drought risk assessment and management
- Drought risk needs to be integrated in all strategic and operational planning

Other sectoral impacts and risks

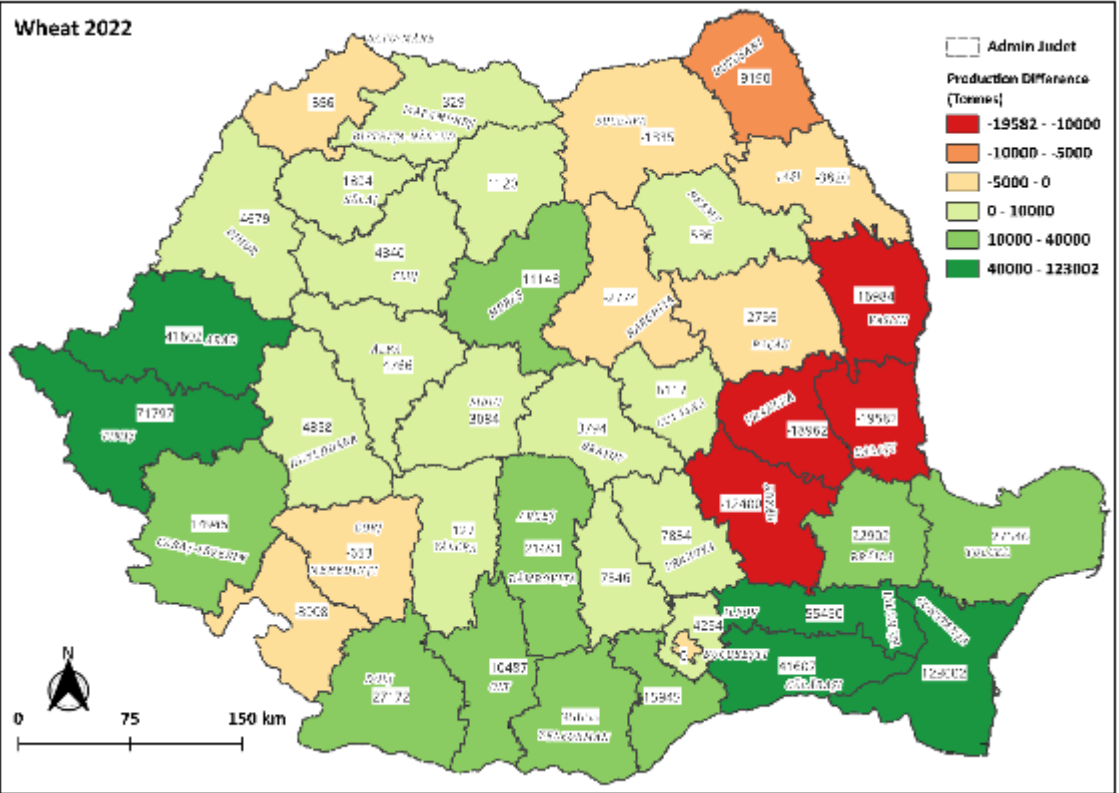
- **Hydroenergy production:**

- **Impact:** in 2022 only 85% of total yearly energy production was reached.
- **Risk:**
 - ✓ **Present conditions:** Water-use for hydro-electricity production shows an AAL of about 6.3% at the national level
 - ✓ **Future conditions:** Changes in AAL in the future under different RCPs mostly worsen drought impacts on energy production, where all currently high impact regions expect significant increases, reaching AALs of 16.2% -19.9%.

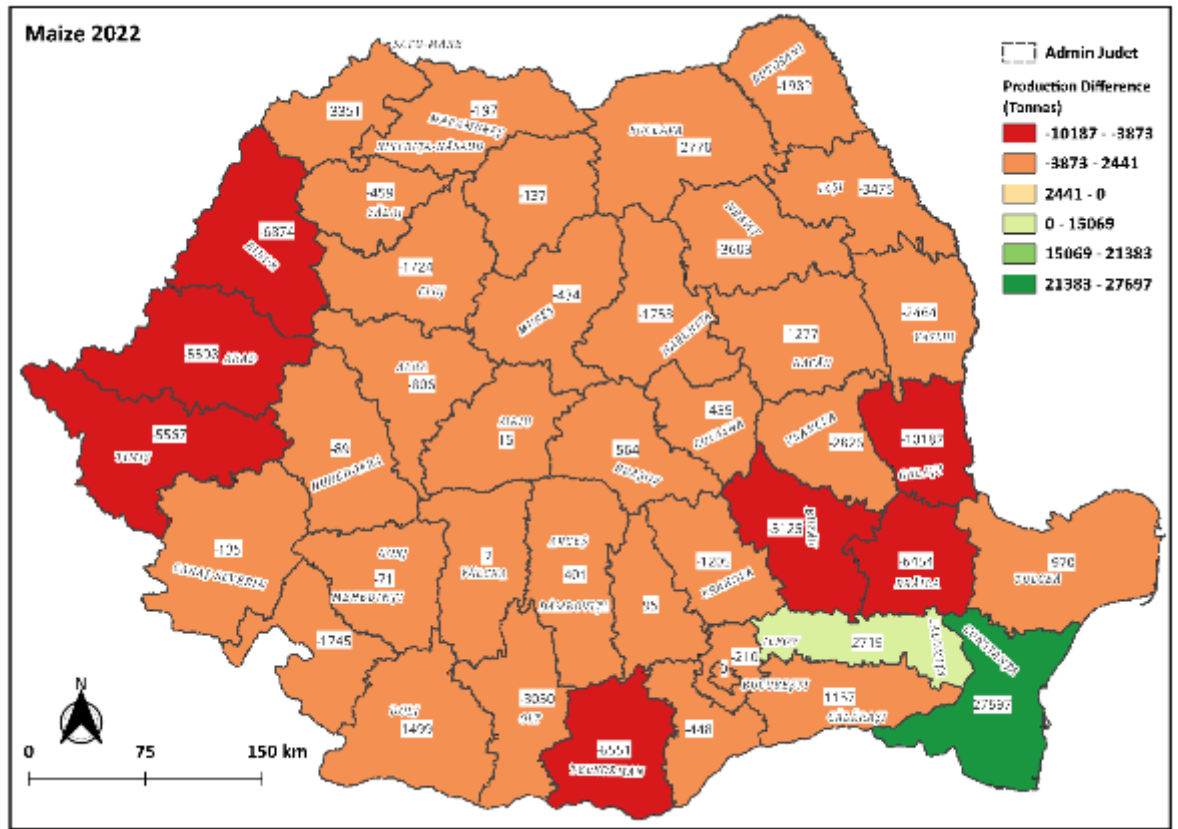
- **Navigation:**

- **Impact:** in 2022 a 4.6% reduction in transport was observed compared to normal yearly values, with only 81% of the average transportation expected in Q3.
- **Risk:**
 - ✓ **Present conditions:** the reduction in goods loadings/unloading in Romania associated with drought is estimated almost at 1.4%.
 - ✓ **Future conditions:** Changes in AAL in the future for most RCPs are expected to worsen the drought impacts on inland water transport, in RCP 7.0 and 8.5 are expected to reach 3.05% and 3.25%, respectively by the end of the century.

Agriculture - drought impacts

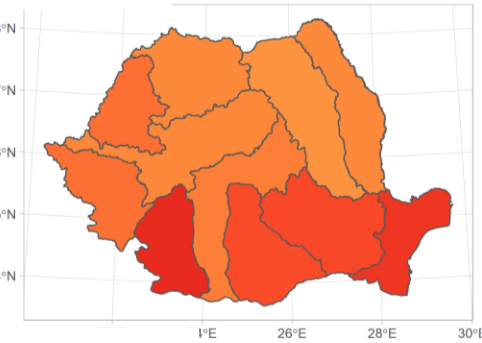


Production (tons), difference from average at the county level

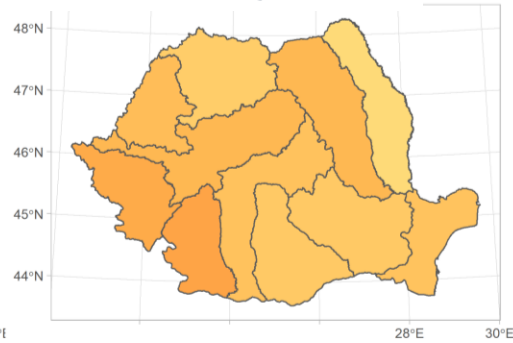


Agriculture - drought risk

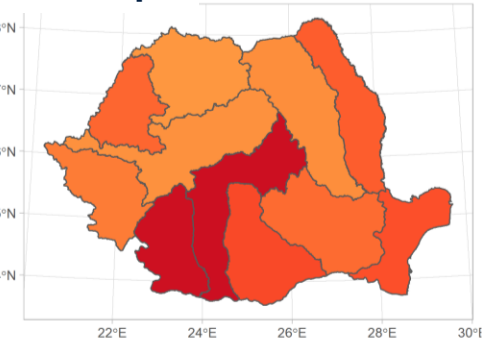
Cereals



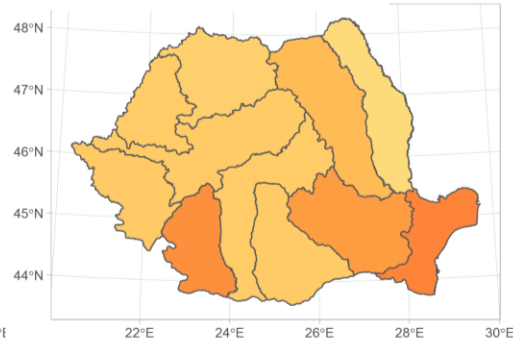
Fruit and Vegetables



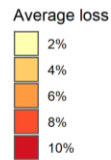
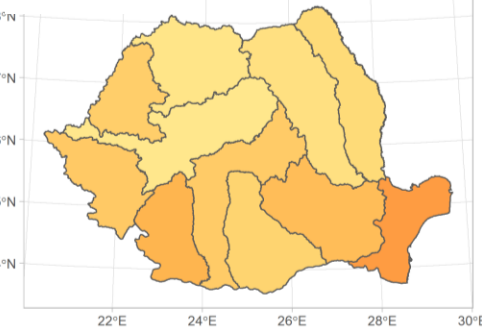
Oil crops



Roots and Tubers

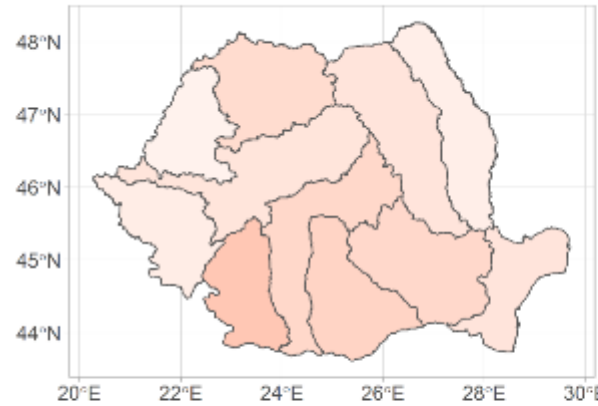


Fodder

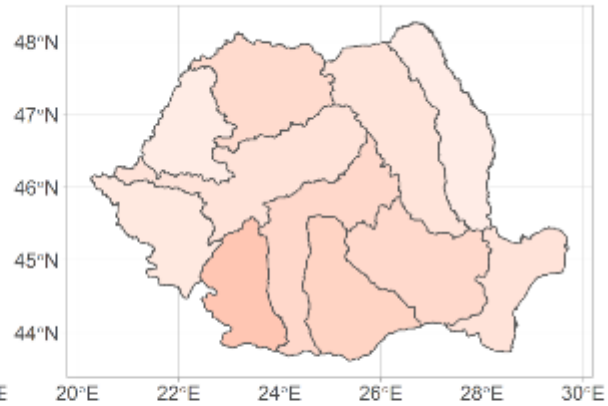


**Present conditions
at the river basin level**

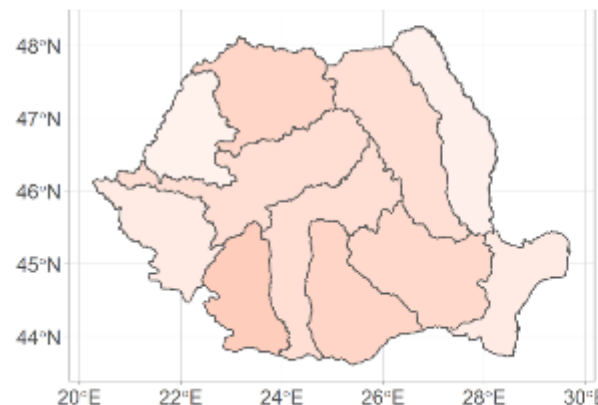
RCP2.6



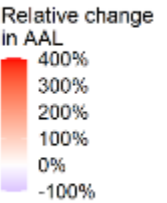
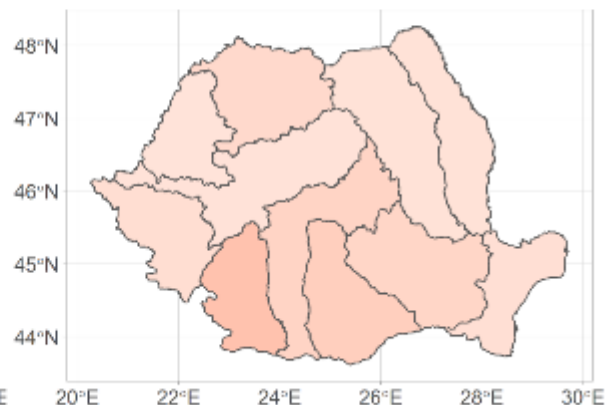
RCP4.5



RCP7.0



RCP8.5



**Future conditions at the river basin level by 2100
(relative to baseline period, 1990 - 2019)**

Conclusions

- **EU Drought Atlas & EDORA methodology**
 - **Efficient impact-based tools to assess drought vulnerability and drought risk**
 - **Additional data sources allows detailed drought risk assessments in different sectors and at different scales**
- **Results show droughts substantially impact many different sectors. Sectoral approaches needed for:**
 - **Tools to monitor sector specific impacts and to quantify the risk;**
 - **Sector specific plans for drought risk management;**
 - **For all sectors: Promote sustainable water usage & invest in water storage.**



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Thank you!

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