Integrated Drought Management System and measures to mitigate the impact of the climate change in Kosovo

Detailed analysis of the state of play and the framework for addressing drought management in Kosovo

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INTRODUCTION

Drought poses significant challenges to Kosovo's water resources, agriculture, and socio-economic stability. As part of a comprehensive effort to address this pressing issue, this report offers a detailed analysis of the state of play and the framework for managing drought in Kosovo.

The report is structured to provide a thorough examination of various aspects related to drought management. It follows the Integrated Drought Management Three pillar approach. It begins by exploring the policy background, drawing insights from drought practices in the European Union (EU) and examining national legislation addressing drought. Furthermore, it scrutinizes the current institutional setup for drought management in Kosovo.

Moving forward, the report delves into understanding drought in Kosovo, considering water resources, sectoral uses, and past drought episodes. It then evaluates existing drought monitoring systems, existing indicators in use, and threshold values for meteorological, agricultural, and hydrological drought.

Moreover, the report identifies drought impacts and risks, categorizing the types of impacts and assessing current mitigation, preparedness, and response measures. It also examines existing communication strategies before, during, and after drought events.

Critically, the report highlights weaknesses and gaps in drought management in Kosovo and concludes with a forward-looking section that synthesizes findings from the analysis, offering recommendations to address the identified gaps and strengthen Kosovo's resilience against drought.

1. POLICY BACKGROUND

1.1. Drought practices in EU

Managing drought needs to be reconceptualised in the light of climate change, taking into account that drought is a slow onset disaster. It takes a long time: months or years to become disastrous, but may cause more severe damage to humans and the environment than many rapid onset disasters. The amount of damage is increasing therefore there is an urgent need to move from crisis management to drought risk reduction policy. In other wording a shift from managing short term drought episodes to the long-term adjustments in water use efficiency is inevitable. This new approach requires multi-party conversation among public and private hydrological and climate change experts, water managers, those responsible for agricultural policy and major water users such as irrigators and urban water suppliers.

There is currently no EU directive or policy especially dedicated to drought, however countries are encouraged to prepare a Drought management plan as part of RBMSs in the framework of WFD (also with help of GWP guidelines). Drought is frequently mentioned also in other parts of current legislation, in sectoral policies and instruments – binding or not – in the fields of water, agriculture, climate change, energy, industry, transport, nature protection, and biodiversity. These documents are partially or at least marginally related to drought management and can therefore support drought management policies.

1.1.1. Guidelines for preparation of a Drought Management Plans[1]

They are following the principles of the three-pillar approach of the Integrated Drought Management and are adjusted to the regional situation - fill gaps in implementing the EU Water Framework Directive (WFD). They provide a better understanding on drought management integration into RBMPs. They focus on seven steps related specifically to the environment of the region and will help shape the integration of vertical planning and decision-making processes at different levels using a multi-stakeholder approach, including key sectors such as agriculture, energy, and tourism.

1.1.2. Revision of the EU policy instruments, related to drought and water scarcity mitigation[2]

There is currently no EU directive or policy especially dedicated to drought but current legislation, sectoral policies, and instruments – binding or not – in the fields of water, agriculture, climate change, energy, industry, transport, nature protection, and biodiversity are partially (at least marginally) related to drought management and can therefore support drought management policies.

In this revision, EU policies, related to water, agriculture, climate change, energy, industry, transport, nature protection, and biodiversity, have been analysed and it serves as a background for the integration of drought management into most relevant existing policies.

1.1.3. EU policies and actions to prevent and to mitigate water scarcity and drought situations[3]

The EU has a set of different policies in place to support countries in increasing their drought resilience.

In the framework of the Common Implementation Strategy for the implementation of water legislation "Ad Hoc Task Group on Water Scarcity and Drought" has been established. Mandate of the Task Group is to strengthen our scientific knowledge on water scarcity trends in Europe, as well as to elaborate new guidance documents based on existing best practices to support the Member States and river basin authorities to design a more effective strategy to cope with water scarcity.

1.1.4. Danube Drought Strategy[4]

Danube Drought strategy (final outcome of the DriDanube project) is a proposal of a new framework for improved drought management in the Danube region. The key point of the strategy is to identify the common steps that were used to launch the proactive drought management. Optimal Drought Management Model (ODMM)[5], as an essential feature provides a conceptual scheme to demonstrate how involved stakeholders can collaborate during each stage of drought, to reduce the environmental damage and to secure vital water supply on national scale.

[1] https://www.gwp.org/globalassets/global/gwp-cee_files/idmp-cee/idmp-guidelines-final-pdf-small.pdf
[2] https://www.gwp.org/globalassets/global/gwp-cee_files/idmp-cee/revision_of_the_policy_instruments_of_drought_2020.pdf
[3] https://environment.ec.europa.eu/topics/water/water-scarcity-and-droughts_en
4 https://www.interreg-danube.eu/uploads/media/approved_project_output/0001/44/92e3269145b45f82df9c8ab2ce5a685fdc2f77c1.pdf
5 Why an optimal drought management model is needed? https://www.youtube.com/watch?v=1DPT2r2-S24

1.1.5. Slovak National Action Plan to address the effects of drought and water scarcity

The aim of the Action Plan is to prevent drought through preventive measures and to eliminate the negative effects of climate change. Main parts of the plan:

- Prevention first (specific focus on forests, agriculture, urban settlements, increase of the natural retention capacity of the landscape)
- Management and operation measures (measures for flood protection and drought mitigation - reconstruction, maintenance of water storage constructions, focus on nature protection projects - revitalization of wetlands)
- Research, education and public awareness

1.1.6. EDORA - European Drought Observatory for Resilience and Adaptation[6]

Main goal of the project is to enhance the resilience and adaptation to drought across the EU Main actions: (1) multi-sectoral drought impact database; (2) drought risk assessment methodology in different sectors; (3) drought risk atlas for current and future climate; (4) Start a network of drought observatories; (5) drought management plans across Member States; (6) Analysis of climate adaptation actions in different sectors.

1.2. National Legislation Addressing Drought

As a starting point to discuss drought policy, it is important to identify the national strategies, legislation and policy documents that are available and have been used for drought management. At this stage we identified that there are no official documents that are addressing drought and water scarcity in Kosovo, except the "Kosovo Drought Risk Management Framework" and "Drought Management Plan of Regional Water Company". Drought issues were treated also through the technical documents and reports, such as the last report of “Integrated Drought Management Program for Drin Basin”, project funded by NOAA funds via Global Water Partnership (Activity 3: Decision support on Drought).
Kosovo doesn’t have the Drought Management Strategy nor Drought Management Plan, but issues of drought and water scarcity are addressed through other legal acts, such as: Law No. 04/L-147 on Waters of Kosovo and secondary legislation that outcomes by law on waters of Kosovo, and strategics documents as: “National water strategy, 2017-2036”[7], “Strategy for climate change”, “Disaster risk reduction strategy and plan of action”. For more details and description of the main points in these documents, related to drought, see table below.

Table 1. National legislation documents addressing drought

6 https://edo.jrc.ec.europa.eu/edora/php/newsletter.php?id=1

7 Water Strategy 2017-2036 http://kepweb.org/documents_custom/water-strategy-2017-2036/

Document title	Field	Main points related to drought
Kosovo Drought Risk Management Framework[8]	Drought	This document presents proposals for a Drought Management Framework in Kosovo. It has been elaborated at the special request of the Water Task Force and the Copyright of this information is hereby vested only to the client (WTF). The views expressed are the professional views of the Consultant, and do not represent national policy or guidance at this time.
Drought Management Plan, Regional Water Company		Exist the Drought Management Plans for RWC of Radoniqi/Gjakove, RWC "Hidroregjioni Jugor/Prizren, RWC "Bifurkacioni"/Ferizaj, RWC "Pristina"/Pristine and RWC "Hidromorava" /Gjilan. The local drought management plan should provide a dynamic framework for an ongoing set of actions to prepare for and respond effectively to drought, including: sound management of the supply-demand balance during periods of water scarcity, the periodic review of technical needs and investment priorities as well as the periodic change of goals, tools and resources. These drought management plans have been drafted since 2018,but have not been updated per year.
Law No. 04/L-147 on Waters of Kosovo[9]	Water management	All the issues related to the following are regulated by this Law: surface waters, lakes, storage, reservoirs, natural resources, underground waters, wetlands, lands near the shores of the rivers, issues related to their management, use and water distribution, protection and preservation of water, protection from harmful actions of water, including submergence, floods, **droughts**, erosion; water facilities and infrastructure, water financing and also conditions, methods and activities by which the waters can be used or released.
Law no. 06/l -035 for hydrometeorological activities	Hydro-Meteo. Monitoring	This law aims to determine the manner of conducting meteorological activities, early warning system, expertise, products and services

[8] Kosovo Drought Risk Management Framework

[9] Law No. 04/L-147 on Waters of Kosovo https://gzk.rks-gov.net/ActDetail.aspx?ActID=8659

		offered by these activities, to support the information, local and central institutions and the public as well as international and regional institutions.[10]
National water strategy, 2017-2036	Water management	This document is elaborated in accordance with Law No. 04/L-147, Article 31. Approved by the Government at date 20.12.2017, and then by the National Assembly of the Republic of Kosovo in the plenary session held on 30.05.2018. It is one of the major regulations of water resource planning in Kosovo. The aim of the Strategy is to offer an integrated and sustainable development of the water sector by meeting the following needs: Drinking water supply; Water for food production; Water for irrigation of agricultural lands; Water for industry; Sports and recreation; and Electricity generation. In addition, the strategy aims to define the objectives, actions, activities and measures for: Water resource conservation and protection, Economic valorisation of water resources, Management, as well as protection from possible situations **like drought** and floods, etc. Chapter 9 of the Strategy "Actions and Investments – Water Use", included "Drought Management plan" as a request that should be fulfilled [11].
River Basin Management Plan of River Basin "Drini i Bardhe"		-***Document is in phase of public consultation***, River Basin Management is a continuous process of planning (to develop River Basin Management Plans) and delivery. "The River Basin Management Plan of river Drini i Bardhe" shall perform the following functions: It shall act as an inventory and documentation mechanism for the information and data assessed including: environmental objectives for surface and ground waters, quality and quantity of waters, and the impact of human activity on water bodies.

10 Law no. 06/l -035 for hydrometeorological activities https://gzk.rks-gov.net/ActDetail.aspx?ActID=18129

11 http://kepweb.org/wp-content/uploads/2019/11/F_KEP_D8.01.01_Water_Strategy_final-ENG /

		Coordinate programs of measures and other relevant programs within the river basin district, including the actions and measures of **drought management,** etc.
Strategy for climate change [12]/Adaptation and Mitigation	Climate change	In terms of climate change, drought is considered as one of the highest risk factors. There is significantly increasing forest fires risk, especially in spruce woods, having a negative impact on the productivity of agriculture and water supply.
Disaster risk reduction strategy and action plan[13]	Civil Protection	It is a substantial document aiming to coordinate the work of actors at the local level, relevant ministries as well as the foreign and local donors to reduce disaster risk from Natural disasters and other disasters (NDOD), at the same time contributing to sustainable development of Kosovo, including the drought events.

1.3. Current Institutional Set Up of the Drought Management in Kosovo

Drought management includes a variety of activities, from the adoption of laws to the organisation of the monitoring of the water resources, its management policy and use. The authorised and responsible bearers of these activities are the Government and local institutions. The Capacity of those institutions to deliver on mandates and activities of drought management and integrated water resources planning remains weak and as a result enforcement of plans and rules remains haphazard. Roles and responsibilities of government and local institutions are listed under table 2.

Table 2. Role and responsibilities of institutions, related to drought managing

Level	Institutions	Role, responsibilities related to drought monitoring
Government & Assembly of Kosovo	Inter-ministerial Council for Waters	Article 15 of Law No. Law no. 04/l-147 on Waters of Kosovo, Inter-ministerial Council for Waters is a coordinating and decision-taking body that examines the systematic issues of water, the harmonisation of different needs and interests, and proposes measures for the development, utilisation and protection of water resources and system of Kosovo.

[12] Strategjia për ndryshimet klimatike 2019- 2028 dhe plani i veprimit për ndryshime klimatike 2019- 2021
https://gzk.rks-gov.net/ActDocumentDetail.aspx?ActID=29356
[13] Disaster risk reduction strategy and plan of action 2016 – 2020
https://www.fao.org/faolex/results/details/en/c/LEX-FAOC170267/

Assembly of Kosovo	Water Regulatory Authority	Article 48 of Law No. 05/L -042 for the Regulation of Water Services, WRCs draft and submit Drought Management Plans to ARW for review and approval.
Ministry of Environment, Spatial Planning, and Infrastructure (MESPI)	Department of environmental and water protection	Article 13 of Law no. 04/l-147 on Waters of Kosovo, The DEWP is responsible for, development and implementation of policies and legislation, on water resources.
	Authority of River Basins District	Article 32 of Law no. 04/l-147 on Waters of Kosovo, Authority is responsible for the preparation of RBMP for each river basin, including the drought management plan.
	Kosovo Environmental Protection Agency	Drafts reports on the overall state of the environment in Kosovo, as well as specific reports as for: air, water, soil, biodiversity, climate change, (including the impact from drought events and fire in forest).Cooperates with the EEA and other relevant institutions of the European Union to ensure publication and/or access to environmental information, considering European standards and communication technology.
	Kosovo Hydrometeorological Institute (KHMI)	Article 6 of Law no.06/l-035 on Hydrometeorological Activities: -Provides systematic measurements and monitoring (observations) elements and phenomena of hydrological and meteorological. - provides information on extreme weather conditions, as well as hydrological and meteorological disasters. - issues hydrometeorological bulletins during drought. -Provides early warning of meteorological and hydrological natural disasters which entirely constitute the Hydro-meteorological Early Warning System. (Article 13, Law No. 06/l-035.
	Inspectorate	Is responsible for inspecting implementation of procedures, regulations, permits, licensing in the sectors of environment, water, nature, and constructions. Inspect the Hydroelectric Power Plants (HPP) to find out whether the requirements of preserving/keeping the biological minimum have been met on the site of operation.
Ministry of Economy /Municipality	Regional Water Companies	Each RWCs should draft the Drought Management Plane and implement water management measures on water courses.

	Public enterprise Irrigation companies	They are water users and provide water for irrigation in sufficient quantity and the quality required for the needs of the users. They make requests to the Ministry of Environment and Spatial Planning for the quantities of water needed.
Ministry of agriculture forestry and rural development	Division for Plant Production and Irrigation	Is responsible for elaborating and implementing irrigation and drainage policies for agricultural land in Kosovo. The Ministry through the Irrigation Section is competent for monitoring, instructing and control over transferring the management responsibilities of secondary and tertiary canals from company to association – federation, and keeps the register of companies, associations, and federations.
Ministry of Internal Affairs	Emergency management Agency	Have directorates that are responsible for civil protection, prevention, risk management, fire, and rescue, as well as the National Training Centre (NTC), In charge of coordination of the activities of all relevant governmental institutions with regard to emergency and natural disaster and other disaster management (in line with the Law on Emergencies).

2. UNDERSTANDING DROUGHT IN KOSOVO

2.1. Water Resources and sectoral uses

The current state of waters in Kosovo Water resource management and preserving water resources are of vital importance for the society for its vital importance for the survival of all living beings but also as an important factor for sustainable socio - economic development. So far, Kosovo has not met the requirements set for unlimited water supply, collection and treatment of wastewater, irrigation, flood and erosion management, thus river and groundwater pollution contribute to increasing environmental degradation as well as degradation of the life quality of citizens. Water resources of Kosovo include surface water, groundwater, and sources of drinking water. Drinking water is mainly provided by the surface water. Regarding the rivers, the hydrography of water flows of Kosovo is split into five river basins: Drini Bardhe (Adriatic Sea basin), Ibri (Black Sea basin), Lepenci (Aegean Sea), Morava e Binqes (Black Sea basin), and Plava River (Adriatic Sea).

2.1.1. Hydrography

The Republic of Kosovo is divided into five watershed lines creating the five river basins, Drini i Bardhë, Sitnica, Morava e Binçës, Lepenc and Plava River Basins.

- The water of Drini i Bardhë River flows in the south-western direction and discharges in Adriatic Sea,
- The water of Ibri-Sitnica River flows in the northern direction and discharges in Black Sea,

- The water of Morava e Binçës River flows in the south-eastern direction and discharges in Black Sea, and
- The water of Lepenci River flows in the southern direction and discharges in Aegean Sea.
- Within the territory of Kosovo there are six major surface accumulations (reservoirs):
- Gazivoda,
- Batllava,
- Badovci,
- Përlepnica,
- Livoqi and
- Radoniqi

The mineral and thermo-mineral water sources are spread throughout the territory of the country, some of the most well-known sources are:

- Kllokot,
- Peja,
- Veleknica,
- Mirash and
- Runik.

There are few natural lakes, and six artificial accumulation sites which meet the water demand, not only for drinking, but for industrial and agricultural needs as well. Water from this lake is conducted through canals to Pristina, where it is used for water supply, as well as cooling of turbines of thermal power station in Obilic. Besides Gazivode Lake, the main artificial accumulations in Kosovo are Batllava Lake, Badovac Lake, Livoc Lake, Radoniq Lake, Prelepnica Lake.

Table 3. Main Water Storage Reservoirs

Reservoir	Water flow (River)	Catchment		Volume (Million m³)
		km²	Live Storage	Total Volume
Gazivoda	Ibër	1,060.0	350.0	**390.0**
Batllava	Batllavë	226.0	25.1	**30.0**
Badovci	Graçankë	103.0	20.0	**26.4**
Radoniqi	Lumëbardhi i Deçanit	130.0	102.0	**113.0**
		1,572.6	**500.4**	**563.6**

Parameters	Indicators
Drinking Water Supply (country average)	92%
Water Supply (managed by Regional Water Companies - RWC)	84%

Source: National Water Strategy 2017 - 2036

The National Water Strategy, as one of the major documents of water resources planning and management, is devised based on a multi-sector approach that addresses the most important water related issues including:

Water use

- Drinking water supply
- Food production and Irrigation of agricultural land
- Extracting and processing industry
- Generation of electricity
- Fisheries
- Tourism, sport and recreation

Water Protection

- Domestic wastewater collection (public sewerage system)
- wastewater collection from extracting and processing industries (independent systems)
- rainwater (snow, rain, etc.) collection (public systems)
- wastewater treatment (infrastructure)
- monitoring the parameters of the wastewater discharged into the recipient

Protection from Water

- Floods (regulation of river segments, biological measures, flood defence walls, gabions, dikes, etc.)
- Overflows (defence walls, land surface elevation with artificial fill, etc.)
- Erosion (mountain embankments, afforestation, forest protection, etc.)
- Drainage (drainage channels, etc.)
- Drying (drainage channels, fillings, injections, etc.)
- Drought (early warning systems)
- Climate change

Despite the considerable progress that has been made in recent years as a result of many initiatives and improvements undertaken in the water sector, much remains to be done in all parts of the country.

Currently, 79 % of Kosovo`s population is supplied with drinking water from functional water supply systems. While the urban population has 100% coverage with public water supply systems, the

percentage of rural population coverage is at 69.7%. In the rural areas population either has no access to the public water supply system or has non-operational public water supply systems.

Figure 1. Drinking water coverage in Kosovo

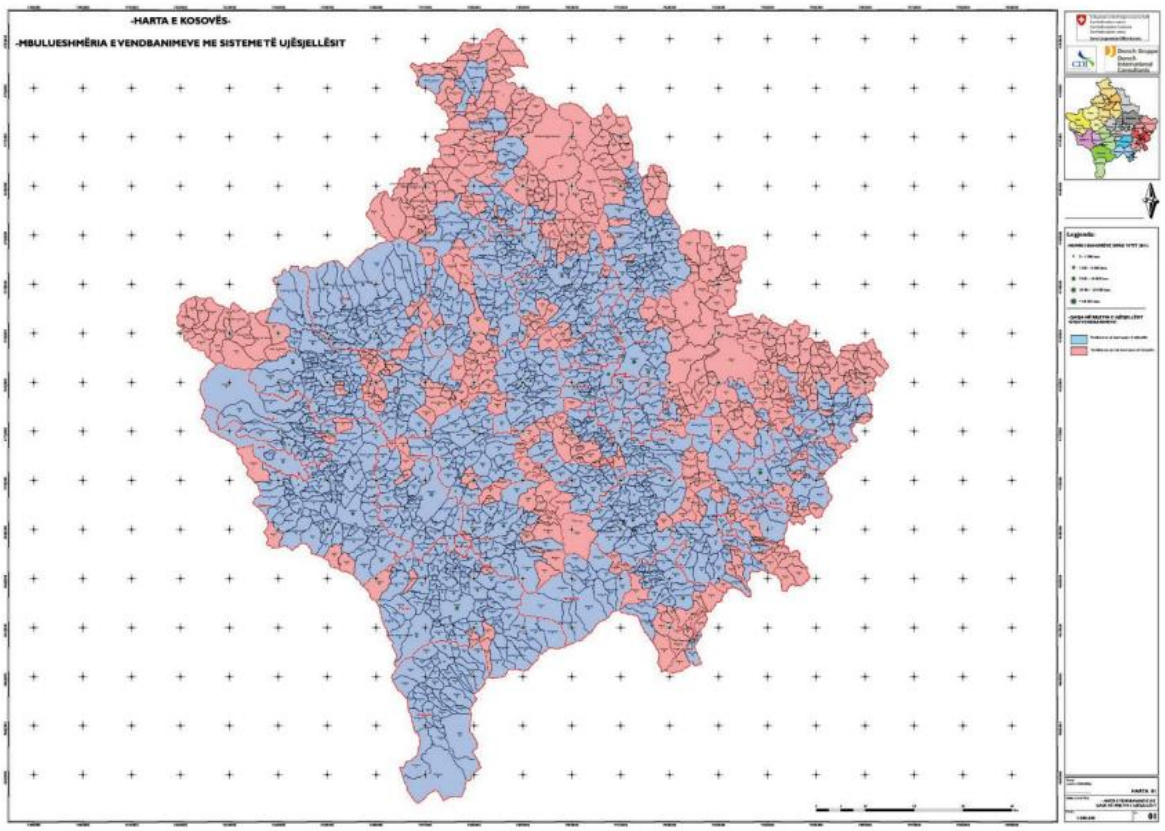


Table 4.Classification of public enterprises dealing with water service delivery

Central Public Enterprises:	Regional Water Companies	Local Public Enterprises
Public Company: **• Hydro-system Iber-Lepenc JSC** **Regional Irrigation Companies:** **• Irrigation Company "Drini i Bardhe JSC** **• Irrigation Company "Radoniqi-Dukagjini" JSC**	• RWC "Pristina" JSC,Pristina • RWC "Hidrodrini" JSC, Peje • RWC "Hidroregjioni Jugor" JSC, Prizren • RWC "Mitrovica" JSC Mitrovice • RWC "Hidromorava" JSC, Gjilan • RWC "Radoniqi" JSC, Gjakova	• Water and Waste Company "Iber", Zubin Potok • Water and Waste Company "24 Nentori", Leposaviq • Water Company "Bifurcation"-JSC, Ferizaj / Kaçanik

Source: Law on Public Enterprises (currently being revised) (Law 03/L-087)

Table 5. Estimated Current Water Resources Consumption by Sector

	Volum per annum	Proportion %
Urban & Rural Water Supply (including unaccounted for water)	178,118,000.00	52%
Irrigation	140,193,000.00	41%
Industry	25,916,000.00	8%
Total	344,227,000.00	100%

Source: National Water Strategy 2017 – 2036

Table 6. Irrigation in agriculture in Kosovo, 2002-2014

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Agriculture irrigation system (mil m3/year)	34	36	33	36	39	41	44	40	42	46	50	52	55

Source: Kosovo Water Statistics 2015

Groundwater reserves are limited and are found mainly in the Western part of Kosovo, where surface water reserves are also larger compared to the Eastern part. There is no precise information on groundwater extraction capacity. Because of unfavourable hydrological conditions, underdeveloped water resources, and increasing service demand, the country faces quantitative shortages (MMPH 2014). In the alluvial plain of the Sitnica river affluent of the Ibër River the groundwater is abundant, partially also from return flows from Iber Lepenc, and very vulnerable to local pollution. The central/northern high-lying plateau, that covers about half of the country, holds the country's largest development potential as most of the mining, agricultural, and industrial activities are located here. This part of the territory has limited water resources (Iber basin). This is the only river basin in Kosovo that originates from a neighbouring country. The Iber originates in Montenegro and flows through Serbia before reaching Kosovo. The country's most important reservoir The Ujmani (Gazivoda) which is located in the north of Kosovo brings water to the central plateau through the Ibër-Lepenc canal. It brings water to the area with the highest population density and the commercial and administrative centre of Kosovo.

Water shortages are far more likely to arise in the east of the country than in the west. Since 2004, 80 percent of Kosovo municipalities have suffered from water shortages in a result of hydrological drought and the misuse of water resources, ecosystem degradation and reduction of ecosystem services, increase and new forms of pollution and water-related diseases. The Dukagjini Plain is warm in summer and wet in winter and with adequate water storage and irrigation is considered as Kosovo's prime agricultural area (Radoniqi-Dukagjini Irrigation Scheme and Drini e Bardhe irrigation scheme are in this plain). This area also faces flooding issues in winter.

2.2. Hydrological & climatological characteristics

Kosovo is exposed to natural hazards like flood, (especially flash floods), heavy rainfall or snowfall, droughts, landslides, avalanches, etc., which are directly or indirectly related to hydrology, meteorology and weather conditions. The climate of Kosovo is affected by the Mediterranean temperate climate and European Continental Climate but also by hydrographic masses (Atlantic Ocean and Mediterranean Sea) and atmospheric masses (tropic, arctic and continental) which are due to its position towards Eurasia and Africa. If we refer to the climatic conditions of Drini i Bardhe River Basin, important factors influencing the climate cover the relief, hydrography, and vegetation. Even though Kosovo is a landlocked country, there are differences between territories and ther amount of precipitation due both temperate maritime and continental precipitation regime. Due to its large extension from west to east, and diverse relief, the Drini i Bardhë River Basin also shows great differences in climate. In 2017 the maximum temperature in August was 31.7 ℃, in July 2016 it was 29.4 ℃, while the minimum temperature in January 2016 was - 4.9 ℃, and in January 2017, -9.3 ℃. Temperatures can range from -27 ℃ in winter to +39 ℃ in summer, while the average annual temperature reaches +11°C (Fig. 9).

Fig 9 and Tables 8-11 illustrate the temperature and precipitation at Peja station. River discharge is generated from different hydrological and hydrogeological processes including precipitation in the form of rainfall and snow as well as discharge from natural springs.

The average annual precipitation is approximately 800 mm per year, with heavy snowfalls in winter in the high mountain areas, heavy rainfall in hills and valleys, and with hail during July and August. About 150 mm represents the estimated groundwater recharge. Precipitation is the main contributing factor to river discharge during the winter months. The rainfall stations in Drini i Bardhë River Basin are presented in Table 8, the hydrometric stations are listed under Table 9 while in Figure 9 both are shown.

Table 7. Meteorological stations in RB Drini i Bardhë

Rainfall station	Latitude	Longitude	Elevation (m.a.s.l)
Peja	20°18'	42°39'	501
Prizren	20°44'	42°14'	389
Gjakovë-Skivjan	20°21'	42°28'	415
Suharek	20°49'	42°21'	420
Klina	20°34'	42°38'	385

Table 8. Hydrometric stations in RB Drini i Bardhë

River	Station	Area (km²)	Elevation (m.a.s.l.)	Number of years
Istog	Berkovë	432	447.45	12
Klina	Klinë (Klina)	423	376.60	21
Lumbardhi i Pejes	Drelaj	120	939.37	27
Lumbardhi i Pejes	Grykë (Peja)	264	594.58	25
Mirusha	Mirushë	126.5	365.00	7
Mirusha	Kpuzaj (Kepuz)	336	354.54	10
Drini i Bardhë	Kpuzë (Kepuz)	2116	381.33	30
Lumbardhi i Deçan	Deçan	114	675.19	31
Ereniku	Gjakova (Ereniku)	455	335.23	15
Drini i Bardhë	Krajk	3391	296.43	5
Toplluha	Piranë (Pirana)	512	298.79	11
Drini i Bardhë	Gjonaj	3951*	290.61	13
Llumbardhi e prizerenit	Prizren	158	483.72	22
Llumbardhi e prizerenit	Vllashnje	561*	306.44	7 (only in 1991/97)
Drini i Bardhë	Vërmicë	4368	269.87	12 (only in 1960/86)
Pllava	Orqusha	252	771.44	24

Discharge from springs.

The flow from karstic springs, which are found in considerable number and yield particularly in the Northern part of the Drini i Bardhë basin, is estimated in 46 mm/year. Much of the discharge from springs is directly diverted into irrigation systems around Istog and Peja. It is thus converted into evapotranspiration.

Table 9. Climate and water resources per River Basin in Kosovo

No.	Climate and water resources per River Basin	Unit	Drini and Bardhë	Plava	Lepenci	MoraveBinçës	Iber
1.	Annual precipitation (P)	mm/y	839	1,076	842	677	693
2.	Annual precipitation (P)	Mio m^3/y	3,791	271	490	1,046	2,778
3.	Mean annual outflow	M^3/s	61.01	4.71	8.70	10.80	32.60
4.	Runoff (Q)	Mio m^3/y	1,924	149	274	341	1,028
5.	Runoff/Precipitation (Q/P)	%	51	55	56	33	37
6.	Minimum flow requirements	Mio m^3/y	443	34	63	78	236
7.	Specific available resource per inhabitant	$M^3/inh/y$	2,211	3,268	1,320	1,380	1,092

Table 10. Averages of monthly and annual temperatures for the meteorological station Peja (2002-2019) (HKMI)

Pejë ºC	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2002	-3.1	5.7	10.2	10.4	16.1	24.2	27.8	15.3	12.7	7.5	2.3	1.6	10.9
2003	1.8	1.2	6.7	9.6	14.8	21.4	25.8	27.2	14.6	12.3	6.8	2.3	12.0
2004	-1	1.2	4	12.9	14.3	18	21.8	23.4	17.2	13.8	6.3	3.6	11.3
2005	-2.5	6.7	11.5	11.3	17.1	21.7	23.3	29.8	15.8	10.6	8.2	2.5	13.0
2006	-1.1	-1.1	5.8	12.3	14.2	17.7	21.2	25.8	18.4	12.2	9.2	3.1	11.5
2007	4.8	5.6	8.6	15.5	16.8	21.2	24.6	22.4	15.3	10.3	4.1	0.4	12.5
2008	1.3	6.2	8.4	12.5	17.6	25.2	26.3	26.8	16.1	12.6	7.9	3.8	13.7
2009	1.2	2.3	6.3	12.5	17.8	20.5	22.5	20.8	15.3	8.6	5.1	2.9	11.3
2010	-4.3	0.5	2.3	6.5	16.4	16.4	15.9	17.6	11.3	6.8	3.6	-1.2	7.7
2011	0	-2.6	5	10.1	15.8	17.4	21.1	19.6	16.8	11	4.2	1.8	10.0
2012	-1.5	4.1	7.6	11.8	16.3	23.1	25.3	26	16.8	11.6	8.5	4.1	12.8
2013	1.9	5.1	7.4	9.8	15.9	20.2	21.9	22.5	17.8	14.5	7.2	1.2	12.1
2014	-2.8	6.4	7.6	10.6	15.8	19.1	22.5	23.2	17.6	12.1	7.7	0.5	11.7
2015	-0.3	1.9	5.5	10.9	17.8	19.5	25.1	23.9	18.5	13	7.6	1.4	12.1
2016	1.1	7.4	7.5	13.3	14.5	20.2	23.7	21.1	17	10.1	5.8	-0.4	11.8

Figure 2. Averages of monthly and annual temperatures for the meteorological station Peja

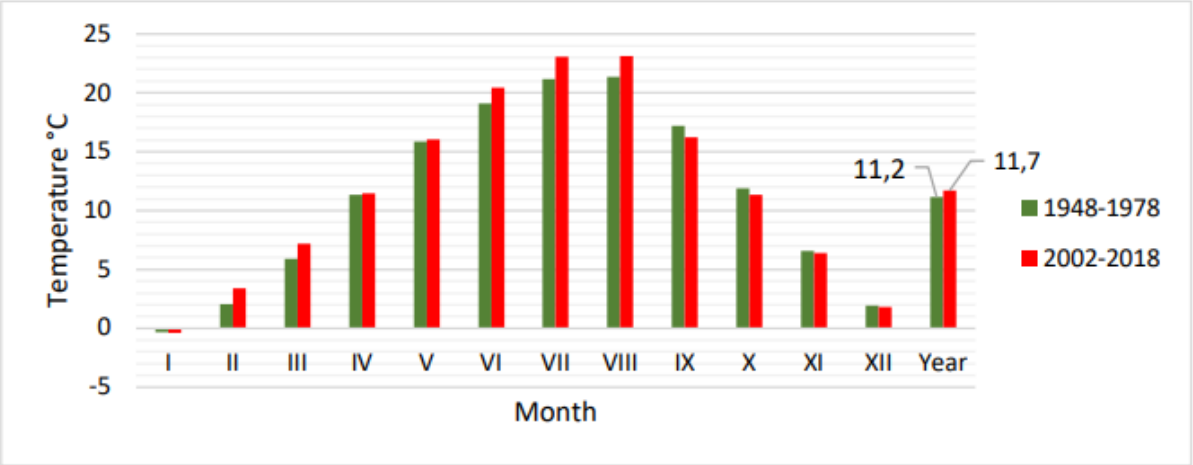


Table 11. Monthly averages of Precipitation station Peja (1948-1978)

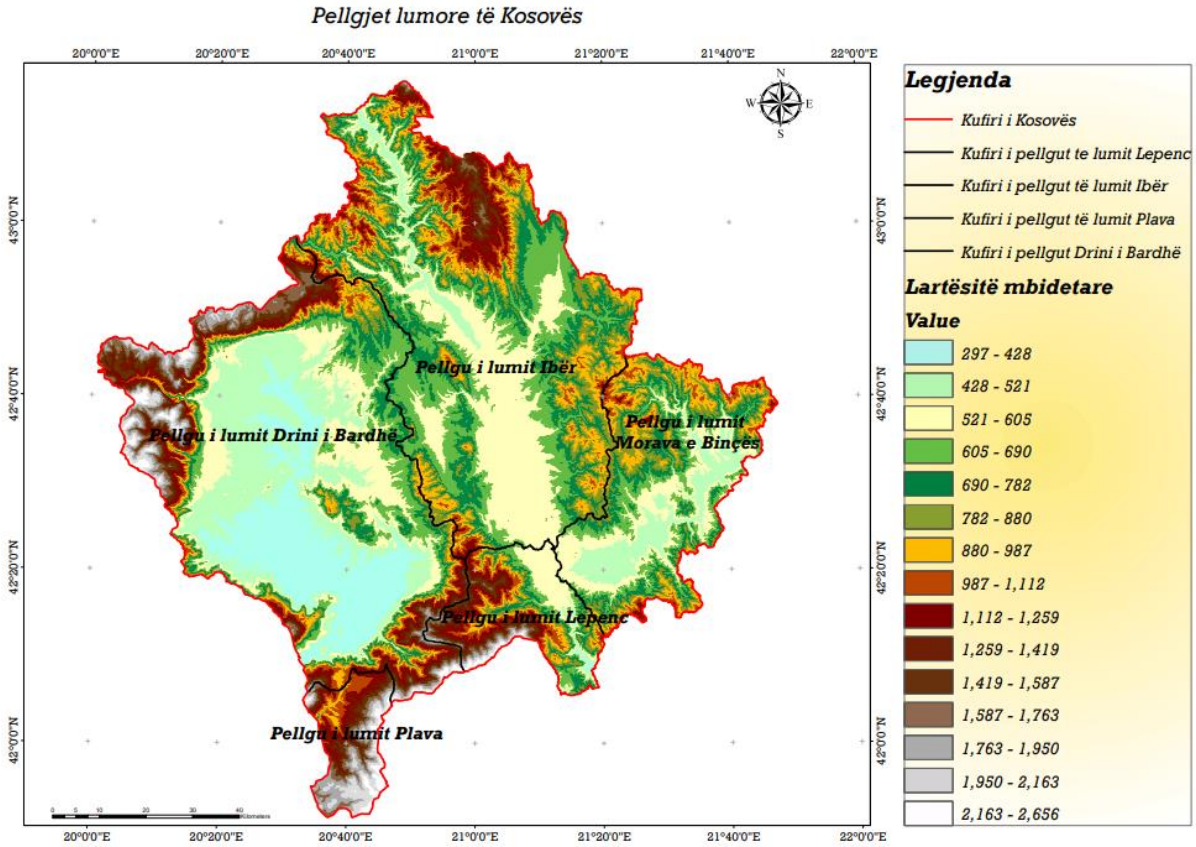
Peja (mm) 1948-1978	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year (mm)
	87	71	71	64	76	63	53	42	53	85	114	101	880.0

Table 12. Averages of monthly and annual Precipitation for the meteorological station Peja (2002-2020) (HKMI)

https://konsultimet.rks-gov.net/Storage/Consultations/09-42-35-10022023/alb.-DRINIRBMP_Final-Report---14-Nov-2022.pdf

Peja (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year (mm)
2002	16.5	62.4	26	93.6	81.3	8.6	39.6	139.3	11.8	20.1	14.1	110.7	624
2003	220	48.4	2.5	34.6	66.4	45.3	9.5	31.2	80.3	159.4	99.3	47.5	844.4
2004	77.8	117.8	101.2	86.7	140.4	92.3	61.1	24.9	110	61.5	112.4	95.8	1081.9
2005	37.3	114.5	66.2	57.9	63.6	38.2	23.8	53.2	45.7	47.2	96.5	212.2	856.3
2006	96.8	93.6	97.8	37.1	43.9	106.1	91.5	63.6	44.1	39.1	54.2	21.5	789.3
2007	70.1	37.6	103	18.6	51.8	49.8	1	18.5	71.1	131.1	159	26.2	737.8
2008	14.1	8	118	9.4	47.3	68.1	39.7	23	60.4	27.6	39	203.1	657.7
2009	87.4	49.2	108.3	70.9	61.8	76.7	62.9	52.2	23.6	182.5	115.2	107.2	997.9
2010	69.9	80.7	44.3	58	50.8	45.8	10.5	15	25	77.7	89.9	50	617.6
2011	30.7	34.7	51	54.1	98.2	55.4	55.6	76.8	21.1	35.9	41.7	87.6	642.8
2012	121.6	41	13.2	58.4	96.3	5.8	40.6	0.3	24.7	34.5	65.4	70.3	572.1
2013	25.4	51.8	70.3	40.4	113.1	69.6	27.6	15	59.1	46.7	38.7	29	586.7
2014	85	7.5	37	86.1	51.3	131.6	6.1	17.3	143.3	75.1	63.2	67.6	771.1
2015	64.8	87.9	141	40.2	44.3	92.7	11.8	59.3	65.1	134.8	100.6	2.1	844.6
2016	56.2	84.9	175.8	32.2	116.4	28.2	74.5	54.4	111.2	57	179.8	1.9	972.5

Figure 3. The river basins of Kosova



2.3. Past Drought Episodes in Kosovo

In the recorded history of Kosovo, there have been several notable periods of severe drought. Some of the main ones are as follows:

I. Kosovo experienced a severe drought in 1949, with a significant lack of rainfall.
II. In 1972 also, Kosovo faced a great drought. The lack of rainfall had substantial consequences for agriculture and water resources in the region.
III. Throughout the year 2000, Kosovo experienced a severe drought, which was influenced by a prolonged period of low rainfall. This resulted in a lack of water for crops and major concerns for farmers and the local economy.
IV. The period from June 2012 to March 2014 experienced a prolonged deficit of below normal rainfall. This led to a major drought on a continental scale across southern Europe, including eastern Kosovo. December 2013 was the fifth driest month in recorded history of Kosovo.
V. Droughts continued in recent years in the 2021-2022 period. These are just some of the significant periods of drought in the history of Kosovo. It is recognized that climate change has increased the threat of drought in the Balkan region, potentially leading to more droughts in the future.

The period June 2012 – March 2014 saw a prolonged deficit of precipitation below normal. This led to a major continental scale drought across southern Europe, and in eastern Kosova in particular. December 2013 was the fifth driest month in the recorded history of Kosovo.

Observing the seriousness of the situation, the Inter-Ministerial Water Council (IMWC) in a result of its third meeting (05 February 2014) established an inter-institutional working group (WG) to manage the drought situation in Prishtina and Gjilan. The WG's tasks were to:

- Analyse the situation,
- Assess technical and policy proposals,
- Inform the Council / Government on the situation and measures,
- Propose and undertake policy and technical measures for managing and overcoming the situation.

February 2013 registered the driest month in the recorded hydro-meteorological history of Kosovo, since 1927 with only 2.1 mm precipitation, which expressed in Standardized Precipitation Index (SPI) was -2.49 (fig. 1). The chance of getting this value in February was 1 in 156. So, since June 2013, consecutively there have been dry months, i.e., there was rainfall deficit (a meteorological drought) that consequently led to a hydrological drought.

Figure 4. Standardized Precipitation Index for Prishtina

2002	-99	-99	-99	2.12	-0.92	-3.06	-0.17	-0.62	-1.24	0.09	-0.36	0.49
2003	1.36	-0.04	-1.34	1.23	0.85	0.85	0.18	-0.44	-0.06	0.79	0.63	0.49
2004	-0.46	1.33	-0.64	-0.01	0.22	0.72	0.28	0.98	0.24	0.49	1.05	-0.66
2005	-0.42	-0.30	1.13	0.18	1.26	1.17	0.96	-0.70	0.21	-0.16	1.30	-0.27
2006	-0.19	-0.85	-0.65	0.65	-0.50	-0.14	-1.02	0.64	-1.19	-1.73	-0.32	-0.69
2007	1.21	1.85	-0.74	-0.57	-1.92	1.77	-1.63	0.15	1.64	0.81	-0.48	0.21
2008	-0.15	-0.12	1.54	0.91	0.60	1.38	-0.93	-0.03	1.16	-0.33	0.40	-0.90
2009	0.86	0.56	0.93	1.20	1.71	0.68	1.04	0.49	0.84	0.79	-0.19	-0.42
2010	0.77	1.06	1.66	-0.54	-0.47	-0.27	-0.55	0.19	-1.03	0.35	-1.75	-0.12
2011	-0.05	-2.64	0.74	1.93	0.27	-1.03	0.19	1.07	-2.54	0.43	-1.64	-1.07
2012	0.26	-0.75	0.41	-0.44	0.08	-0.25	-1.43	-0.11	-0.39	-0.22	-1.45	0.56
2013	0.36	-0.26	-1.54	-1.05	-2.49	0.68	3.90	0.32	-99	-99	-99	-99

By March 2014 the water supply reservoirs of Batllava, Badovc and Përlepnica were at 25% of normal levels, and nearly exhausted. There was approximately 6-8 weeks of water supply remaining for upwards of 500,000 citizens.

Figure 5. The effects of drought-Batllava

Photo: February-2014

Photo: April-2014

Graph 1 Volum Curve of Batllava Lake

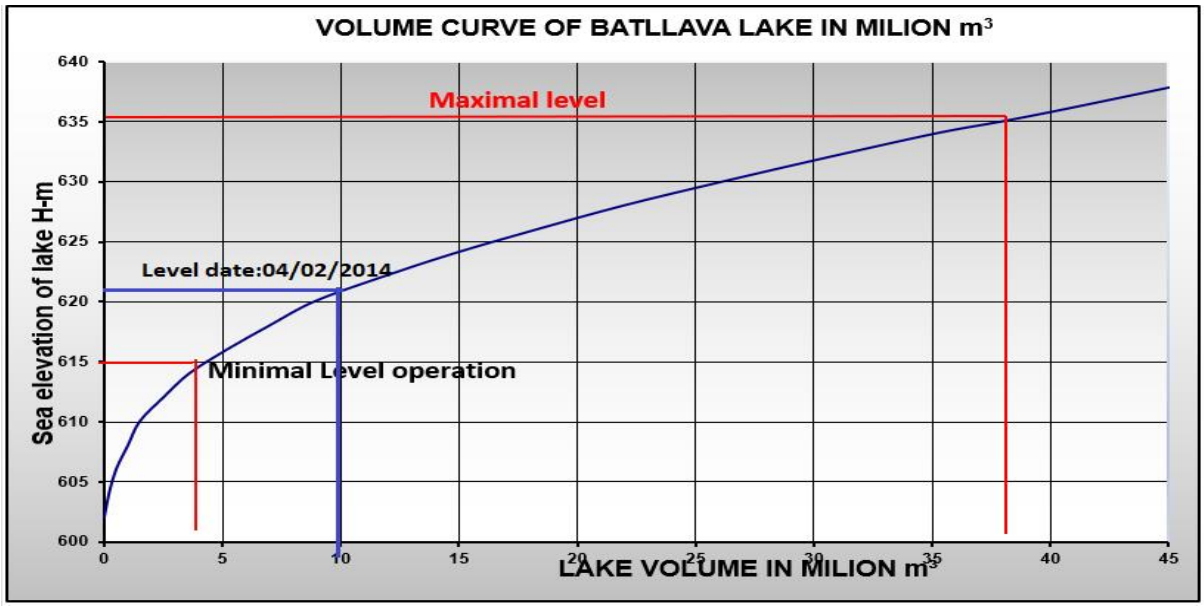
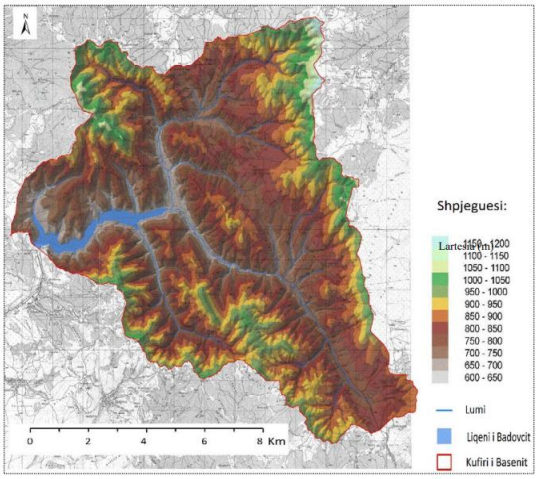
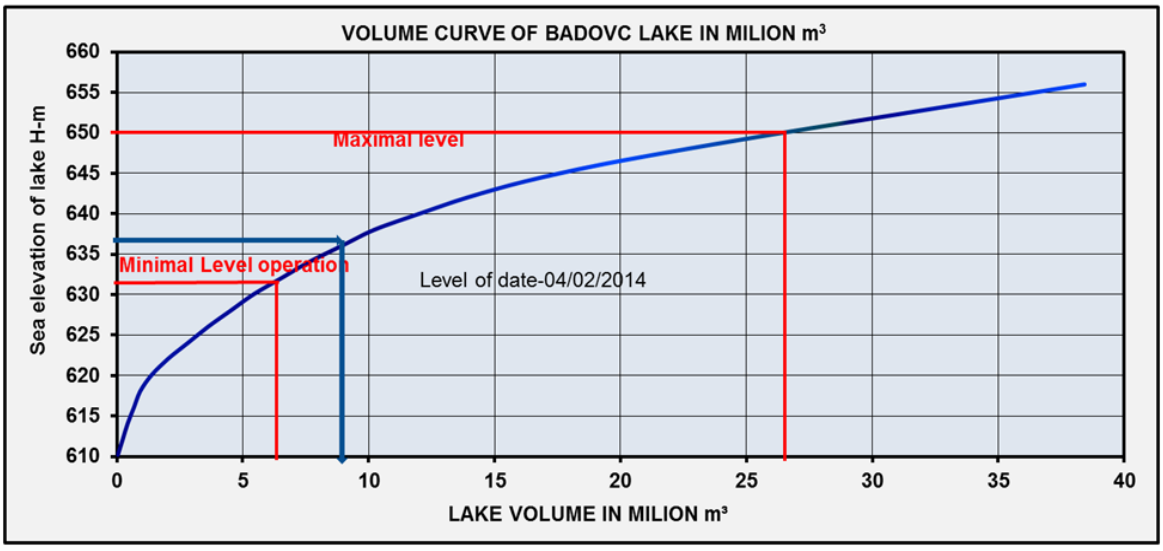


Figure 6. Badovc Lake_February-2014



Graph 2 Volum Curve of Badovc Lake



Analysis of precipitation statistics for Prishtina (1926 – 2014) confirms that a severe or extreme meteorological drought of 4-6 months duration can be expected 21% of the time, or once every five years on average. 4-6 months of severe/extreme precipitation deficit will cause depletion in surface water resources, possibly leading to the potential failure of water supplies if the resources are not better managed.

It should be noted that the two SPI-6 precipitation periods April-September 2013 and October 2013-March 2014 had values of -1.17 and -1.36 respectively (fig. 5). Since a Severe Drought technically starts only when SPI = -1.5, then the drought sequence in Kosovo was no more than a Moderate Drought. In spite of this all the reservoirs were brought to the point of failure through inadequate monitoring and inadequate understanding of precipitation versus reservoir supply-demand dynamics by the RWCs. This raise concerns if Kosova was to be faced with an extended period of Severe Drought!

Figure 7. Monthly, bimonthly, quarterly, semi-annual and annual SPIs for Prishtina

H Year	SPI-1 Oct	SPI-1 Nov	SPI-1 Dec	SPI-1 Jan	SPI-1 Feb	SPI-1 Mar	SPI-1 Apr	SPI-1 May	SPI-1 Jun	SPI-1 Jul	SPI-1 Aug	SPI-1 Sep	SPI-2 Oct-Nov	SPI-2 Dec-Jan	SPI-2 Feb-Mar	SPI-2 Apr-May	SPI-2 Jun-Jul	SPI-2 Aug-Sep	SPI-3 Oct-Dec	SPI-3 Jan-Mar	SPI-3 Apr-Jun	SPI-3 Jul-Sep	SPI-4 Oct-Jan	SPI-4 Feb-May	SPI-4 Jun-Sep	SPI-6 Oct-Mar	SPI-6 Apr-Sep	SPI-12 Oct-Sep
2002	-99	-99	-99	2.12	-0.92	-3.06	-0.17	-0.62	-1.24	0.09	-0.36	0.49	-99	-99	-2.28	-0.73	-0.76	0.01	-99	0.57	-1.48	-0.03	-99	-1.78	-0.48	-99	-0.94	-99
2003	1.36	-0.04	-1.34	1.23	0.85	0.85	0.18	-0.44	-0.06	0.79	0.63	0.49	1.01	0.16	1.01	-0.35	0.43	0.58	0.41	1.45	-0.45	0.73	0.89	0.37	0.55	1.14	0.32	0.89
2004	-0.46	1.33	-0.64	-0.01	0.22	0.72	0.28	0.98	0.24	0.49	1.05	-0.66	0.63	-0.64	0.52	0.87	0.37	0.39	0.23	0.28	0.86	0.44	0.12	0.86	0.39	0.24	0.75	0.61
2005	-0.42	-0.30	1.13	0.18	1.26	1.17	0.96	-0.70	0.21	-0.16	1.30	-0.27	-0.70	0.90	1.52	0.88	-0.09	0.74	0.03	1.29	0.12	0.46	0.00	1.03	0.39	0.75	0.35	0.65
2006	-0.19	-0.85	-0.65	0.65	-0.50	-0.14	-1.02	0.64	-1.19	-1.73	-0.32	-0.69	-0.88	-0.88	-0.58	-0.88	-2.04	-0.74	-1.17	-0.15	-0.79	-1.36	-0.86	-0.50	-1.68	-1.14	-1.61	-2.06
2007	1.21	1.85	-0.74	-0.57	-1.92	1.77	-1.63	0.15	1.64	0.81	-0.48	0.21	2.08	-1.13	0.79	-0.80	1.52	-0.25	1.65	0.29	0.62	0.17	1.43	-0.07	0.78	1.47	0.39	1.18
2008	-0.15	-0.12	1.54	0.91	0.60	1.38	-0.93	-0.03	1.16	-0.33	0.40	-0.90	-0.37	1.68	1.26	-0.68	0.54	-0.28	0.54	1.44	0.24	-0.45	0.83	0.38	0.10	1.23	-0.32	0.53
2009	0.66	0.56	0.93	1.20	1.71	0.68	1.04	0.49	0.84	0.79	-0.19	-0.42	0.90	1.43	1.53	0.94	0.97	-0.50	1.15	1.65	1.30	0.01	1.56	1.58	0.28	1.97	0.68	1.73
2010	0.77	1.06	1.66	-0.54	-0.47	-0.27	-0.55	0.19	-1.03	0.35	-1.75	-0.12	1.17	1.05	-0.66	-0.29	-0.43	-0.95	1.76	-1.04	-0.94	-0.55	1.55	-0.71	-0.91	1.00	-1.11	-0.14
2011	-0.05	-2.64	0.74	1.93	0.27	-1.03	0.19	1.07	-2.54	0.43	-1.64	-1.07	-1.40	1.90	-0.54	0.89	-0.83	-1.68	-0.69	1.02	-0.09	-0.88	0.47	0.32	-1.57	0.05	-0.83	-0.67
2012	0.26	-0.75	0.41	-0.44	0.08	-0.25	-1.43	-0.11	-0.39	-0.22	-1.45	0.56	-0.40	-0.07	-0.27	-0.99	-0.53	-0.30	-0.21	-0.64	-1.24	-0.42	-0.48	-0.98	-0.58	-0.67	-1.17	-1.42
2013	0.36	-0.26	-1.54	-1.05	-2.49	0.68	3.90	0.32	-99	-99	-99	-99	-0.04	-2.13	-0.42	3.12	-99	-99	-0.73	-1.07	-99	-99	-1.20	2.29	-99	-1.36	-99	-99
2014	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99

The situation was only rescued by an extraordinary occurrence of extreme surplus precipitation in April that averted a catastrophe. In fact, April 2014 has been registered as the wettest month in the recorded hydro-meteorological history of Kosova, since 1927 with 227 mm precipitation, which, expressed in Standardized Precipitation Index, was 3.90. This means, that the chance of getting this value in April was 1 in 2000. Normal precipitation for the month of April would be 51 mm. This is a massive fluctuation from only 8 weeks earlier, in February 2014. Complacency that this was always going to happen has already rapidly set in.

In order to avoid contentment and possible future failures, important lessons must be learned from the recent crisis. Precisely the same issues were encountered in 2007, and no action was taken to learn from that experience, with the consequence that almost the same lack of preparedness occurred six years later.

After the droughts of 2013-2014, the Regional Water Company has drawn up drought management plans.

The Inter-Ministerial Water Council (IMWC) with the drought management working group drew

10 lessons and 10 recommendations for the steps to be undertaken in the future to monitor and mitigate droughts in the drinking water supply sector.[14]

[14] Drought Management Working Group_Lessons and Recommendations.

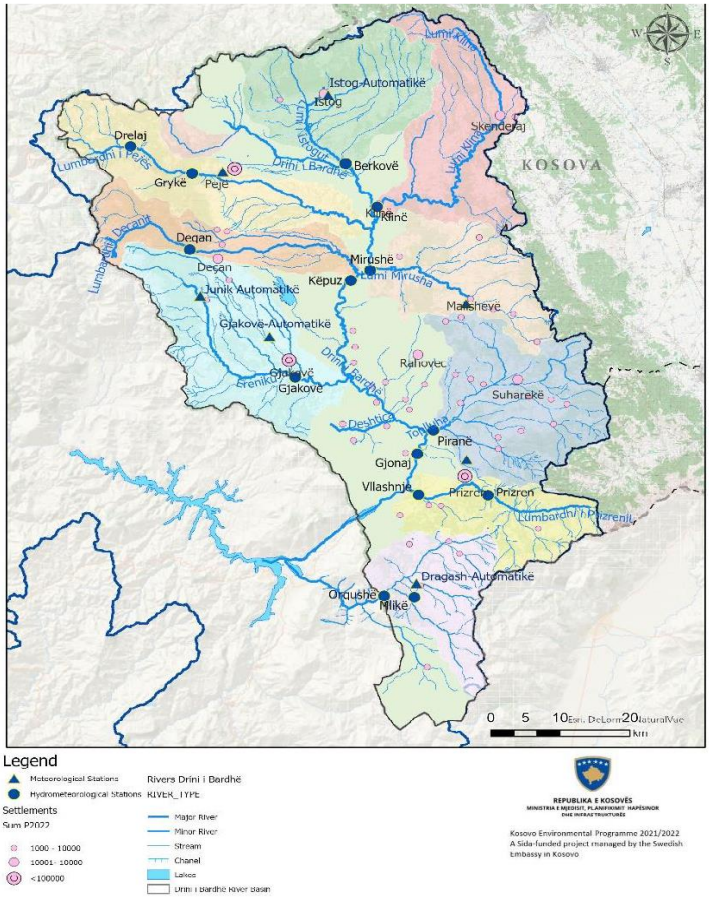
3. DROUGHT MONITORING

Drought is characterised by severity, the affected area, duration, and timing. Drought monitoring involves observing indicators and indices that evaluate changes in a region's hydrological cycle. Indicators which are used to describe drought conditions are variables such as precipitation, temperature, streamflow, ground and reservoir water level, soil moisture and snowpack.

There are three main methods for monitoring drought and guiding early warning and assessment:

1. Using a single indicator or index,
2. Using multiple indicators or indices,
3. Using composite or hybrid indicator.

Figure 8. Hydrological and meteorological monitoring network in River Basin Drin



Monitoring rainfall and water quantity (meteorological and hydrological parameters) is one of the most important elements of effective drought and water scarcity management. The purpose is twofold, as:

- To provide early warning of expected droughts so that contingency measures can be prepared, including early communication with operational stakeholders and citizens in general;
- To determine the exact onset, severity and duration of the water deficit period so that adequate response measures can be implemented in a timely manner

3.1. Existing Monitoring Systems, Potential Use for Drought Monitoring

The responsible body for hydrological and meteorological monitoring elements and phenomena is the Kosovo Hydrometeorological Institute, which is part of the Kosovo Environmental Protection Agency. Hydro-meteorological monitoring system in river basin Drini i Bardhe has 7 meteorological stations, 14 hydrological stations (fig.1), also, has 18 precipitation stations. The existing monitoring system can be used for drought monitoring. For drought monitoring, 10 stations can be used from the existing monitoring network in the River Basin Drini I Bardhe. For droughts monitoring and early warning Kosovo used SPI (Standard Precipitation Index), which was regularly published in the "Hydrometeorological Yearbooks".[15][16]

3.2. Existing Indicators and Threshold Values for Meteorological, Agricultural and Hydrological Drought *(table view, Survey – Section 2)*

Meteorological drought is defined as extended time period of precipitation scarcity in reference to long-term period (climatological mean). Meteorological drought can have different time scales – from shorter deviations to normal, most commonly connected to agricultural drought (typically 2-4 months) to longer deficits that cause hydrological drought (typically 6 months and beyond).

To determine meteorological drought the following indices are used:

- SPI (Standard precipitation index) for accumulation periods 1,2,3,4,6 and 12 months,
- Percent of normal precipitation,
- Consecutive dry days (for different thresholds).

[15] Hydrometeorological Yearbook 2017-2018 https://ihmk-rks.net/?page=2,89,12
[16] https://ihmk-rks.net/uplds/docs/Vjetari_final_2020-al.pdf

Table 13. Main meteorological drought indicator and classification scheme of the drought indicator

Main drought indicator in use for:	Description of classification scheme of the drought indicator (different levels of drought)
Meteorological drought	
SPI (Standard precipitation index) for accumulation periods 1,2,3,4,6 and 12 months	Symbol / Moisture conditions / Value ECD – Exceptional drought – SPI ≤ -2.326 EXD – Extreme drought – -2.326 < SPI ≤ -1.645 SD – Severe drought – -1.645 < SPI ≤ -1.282 MD – Moderate drought – -1.282 < SPI ≤ -0.935 MD – Minor drought – -0.935 < SPI ≤ -0.524 N – Near normal – -0.524 < SPI < +0.524 SIM – Slightly increased moisture – +0.524 ≤ SPI < +0.935 MIM – Moderately increased moisture – +0.935 ≤ SPI < +1.282 CIM – Considerably increased moisture – +1.282 ≤ SPI < +1.645 EXW – Extremely wet – +1.645 ≤SPI < +2.326
Percent of normal precipitation	minor drought- 11%-25% ≤ than the normal amount moderate drought- 26-50% ≤ than the normal amount severe drought- 50% ≤ than the normal amount extreme drought- 50 %-75% ≤ than the normal amount
Consecutive Dry Days (CDD)	maximum number of consecutive dry days per time period with daily precipitation amount of less than 1 mm.

Hydrological drought- is defined as lack of water in the hydrological system, manifesting itself in abnormally decreased quantity of surface waters and abnormally decreased level of groundwater. The state hydrological network includes 35 hydrometric stations, with continue monitoring of water level, water temperature.

Table 14. Main hydrological drought indicator and thresholds

Main drought indicator in use for:	Monitoring approach / Methodology (indices, thresholds)
Hydrological drought	
SPI (Standard precipitation index) for accumulation periods 4,6 and 12 months	Symbol / Moisture conditions / Value ECD – Exceptional drought – SPI ≤ -2.326 EXD – Extreme drought – -2.326 < SPI ≤ -1.645 SD – Severe drought – -1.645 < SPI ≤ -1.282 MD – Moderate drought – -1.282 < SPI ≤ -0.935 MD – Minor drought – -0.935 < SPI ≤ -0.524 N – Near normal – -0.524 < SPI < +0.524 SIM – Slightly increased moisture – +0.524 ≤ SPI < +0.935 MIM – Moderately increased moisture – +0.935 ≤ SPI < +1.282 CIM – Considerably increased moisture – +1.282 ≤ SPI < +1.645 EXW – Extremely wet – +1.645 ≤SPI < +2.326

surface water	Comparison of discharge values in low-flow period with long-term characteristics from the low-flow part of the duration curve (M-day discharge – mainly Q330d, Q355d, Q364d)
groundwater	//

Agricultural drought is defined as insufficient quantity of soil water for normal development of agricultural plants. It is caused by precipitation deficit and also by increased loss of water due to evaporation and plant transpiration (commonly assessed together by introducing the term "evapotranspiration"). Agricultural drought can be monitored locally by conducting soil moisture measurements. There are also many drought indices developed to specifically target agricultural drought, such as Palmer drought severity index. Currently, the indicator that is most frequently applied for drought monitoring and also contains the influence of evapotranspiration is Standardised Precipitation and Evapotranspiration Index (SPEI) which has the same statistical properties as SPI. One of the challenges in agricultural drought monitoring by application of indices is the estimation of evapotranspiration. The Hydrometeorological Institute of Kosovo does not prepare a routine evapotranspiration assessment, but the assessment of evapotranspiration was conducted by individual researchers for any specific location or specific lakes. HMIK monitoring Evaporation only in a meteorological station. HMIK has monitored evaporation only in a meteorological station, but doesn't have monitoring of transpiration. The agricultural drought will be monitored only by monitoring meteorological drought. It is necessary to raise human and professional capacity in KHMI to create opportunities for the assessment of evapotranspiration in a routine way from each monitoring station.

Table 15. Main agricultural drought indicator and thresholds

Main drought indicator in use for: Water body/ River basin	**Monitoring approach / Methodology (indices, thresholds)**
Agricultural drought	
Soil moisture measurement	//
SPI (Standard precipitation index) for accumulation periods 1,2,3,4,6 and 12 months	Symbol / Moisture conditions / Value ECD – Exceptional drought – SPI ≤ -2.326 EXD – Extreme drought – -2.326 < SPI ≤ -1.645 SD – Severe drought – -1.645 < SPI ≤ -1.282 MD – Moderate drought – -1.282 < SPI ≤ -0.935 MD – Minor drought – -0.935 < SPI ≤ -0.524 N – Near normal – -0.524 < SPI < +0.524 SIM – Slightly increased moisture – +0.524 ≤ SPI < +0.935 MIM – Moderately increased moisture – +0.935 ≤ SPI < +1.282 CIM – Considerably increased moisture – +1.282 ≤ SPI < +1.645 EXW – Extremely wet – +1.645 ≤SPI < +2.326
Precipitation deficit	//

4. DROUGHT IMPACTS AND RISKS

4.1. Identification of type of impacts

Drought is a prolonged period of abnormally low rainfall that leads to water shortages, resulting in negative impacts on various sectors and ecosystems. Assessment of drought-related impacts and risks is essential for effective planning, management and mitigation strategies. Here are some key points regarding drought impacts and risk assessment:

Impacts on agriculture

Drought significantly affects agriculture, leading to reduced crop yields, livestock losses and increased susceptibility to pests and diseases. It may result in reduced food production, increased food prices and economic difficulties for farmers about which we do not have much information.

Water supply and quality

Drought reduces the availability of water in rivers, lakes, and groundwater, affecting the supply of water for domestic, industrial, and agricultural purposes. It can also lead to water quality issues, as low water levels concentrate pollutants and degrade water bodies. The freshest cases are the operation at the minimum levels of the drinking water reservoirs in Lake Batllava, Badovci, and Perlepnice in the years of 2002, 2007, 2014, 2022. These years' rainfall is of high intensity and floods are occurring in many parts of the country. Fortunately, we have a good situation and the lakes since May and June continue to have overflow.

Ecosystems:

Drought affects natural ecosystems, including forests, wetlands and rivers. This can lead to increased fire risks, habitat loss and biodiversity decline. Drought also affects aquatic ecosystems, causing fish die-offs and reduced water quality.

Socio-Economic Impacts:

Drought affects various sectors of the economy, including energy production, tourism and hydropower generation. Energy production in Kosovo mainly depends on coal reserves and with industrial water Termoekletrana Kosova A and Kosova B are supplied with industrial water from Lake Ujman (Gazivoda) through the Iber Lepenci irrigation channel. Sofar we have had no problems regarding energy production because of droughts.

Human health:

Drought can have indirect effects on human health. This can lead to increased dust and air pollution, as well as reduced availability of water for sanitation and hygiene, contributing to the spread of disease. Food shortages caused by drought can also lead to malnutrition and related health problems.

4.2. Existing collection and Assessment of Drought Impacts

Based on the results of the survey of the relevant institutions, it seems that there are no reports or sufficient data on the impact of the drought on the environment, this is because Kosovo lacks a National Drought Management Framework.

An effective drought management framework (as its foundation) has a continuous and reliable monitoring system for critical hydrometeorological parameters. This includes precipitation levels, high mountain snowpack, river flows, groundwater levels, and lake storage capacity levels. All these variables should be continuously monitored and reported to the appropriate agency with responsibility for national drought monitoring.

4.3. Existing Risk Assessments and Products Available

Based on the results of the survey of the relevant institutions, it seems that there are no reports or sufficient data on the impact of the drought on the environment, this is because Kosovo lacks a National Drought Management Framework.

In recent decades, there has been a growing emphasis on the concept of vulnerability within the fields of hazards, disasters, and global climate change. Although a number of definitions of vulnerability have been proposed, the most recent definitions include variants of three factors:

- Exposure
- Sensitivity
- Adaptability

Together, these three factors account for the vulnerability of a given area to drought.

Risk Assessment:

Drought risk assessment involves evaluating the likelihood and potential consequences of drought events. It helps in identifying vulnerable areas, populations, and sectors, enabling the development of appropriate mitigation and adaptation strategies. Here are some key steps in drought risk assessment:

Hazard Identification: Assess historical drought events and their characteristics, including duration, intensity, and spatial extent, using historical climate data and drought indices.

Vulnerability Assessment: Identify vulnerable systems and populations exposed to drought, such as agriculture, water resources, ecosystems, and socioeconomic sectors. Evaluate their sensitivity and capacity to cope with drought impacts.

Exposure Analysis: Determine the geographical areas and populations at risk of drought. Assess the spatial extent and intensity of drought conditions using remote sensing, climate models, and ground-based observations.

Impact Analysis: Evaluate the potential impacts of drought on various sectors, including agriculture, water resources, ecosystems, and human health. Quantify the economic, social, and environmental consequences of drought events.

Risk Evaluation: Combine information from hazard identification, vulnerability assessment, exposure analysis, and impact analysis to assess the overall drought risk. Identify areas and sectors with the highest risk levels to prioritize mitigation and adaptation measures.

Mitigation and Adaptation: Develop and implement drought management plans and strategies based on the risk assessment findings. These may include water conservation measures, drought-resistant crop varieties, early warning systems, and improved water resource management. By conducting comprehensive drought risk assessments, policymakers, resource managers, and communities can make informed decisions and take proactive measures to minimize the impacts of drought events and build resilience against future droughts.

By conducting comprehensive drought risk assessments, policymakers, resource managers, and communities can make informed decisions and take proactive measures to minimize the impacts of drought events and build resilience against future droughts.

5. MITIGATION, PREPAREDNESS AND RESPONSE MEASURES

5.1. Existing Drought Measures

A drought is a period of abnormally dry weather that lasts long enough to produce a serious hydrological imbalance, causing, for example, crop damage and shortages in water supplies. The severity of drought depends on the degree of lack of moisture, its duration and the size of the affected area.

Drought can be defined in four ways:

- *meteorological* - when an area has less rainfall than normal. Due to climatic differences, what is considered a drought in one country may not be a drought in another,
- *agricultural* - when the amount of moisture in the soil no longer meets the needs of a certain crop,
- *hydrological* - when surface and underground water supplies are below normal,
- *socio-economic* - when water supply is unable to meet human and environmental needs it can disrupt the balance between supply and demand.

Droughts have two components - climate (reduced rainfall) and demand (water use). To respond to drought, governments tend to focus much more than their activities on reducing water demand. Many

of the measures are focused on management, determined by existing resources and determining priorities in relation to the reallocation for different uses.

The possible effects of climate change can worsen its frequency, duration and intensity, and therefore, must be taken into account in drought management.

Drought management can occur at three levels:

1. Local/municipal,
2. At River Basin (district)/regional level,
3. State Government/Line Ministries.

All these levels have their specific roles in drought management, depending on the mandate and responsibilities defined by law.

Drought planning at the local level in many areas appears to be given a low priority because of the randomness of droughts, limited resources for planning, limited jurisdiction. The focus of most actions is to reduce daily water demand, and local governments are usually responsible for reducing water demand within their jurisdictions.

The mandate and responsibilities of the River Basin Management Authority among others, include,

- planning and implementation of MPLs,
- Measurement and monitoring,
- Licensing and granting permits for water use,
- Enforcement and
- Allocation of water to users.

The River Basin Management Authority for Drini i Bardhë includes a water balance chapter for River Basin Drini i Bardhë. On the basis of the results of the balance, a water management policy document can be drawn up in which:

- water use priorities in the catchment are defined,
- environmental flow requirements are defined, and
- restrictions on the introduction of new water users and water withdrawal are stated.

For this, it is necessary to have a clear definition of drought - and each of its types - meteorological, hydrological, agricultural, socio-economic. Additionally, the effects of drought on each individual user (water supply, environmental environment, agriculture, industry, etc.) must be defined and calculated in sociological and economic terms.

It is necessary to define drought actions in order to be able to predict, identify, announce the conditions of that end, to act on its changes and mitigation, as well as to minimize its negative effects.

The central government has a role in:

- Planning (national plans for the prevention and reduction of similar sites) and, in principle, directing and monitoring all plans at the national level;
- Adjustment:

  - Regulations at national and regional/local level:
  - Organizational: mandates and responsibilities of different participants.
  - Licensing – approval of plans, etc. (including low flows, environmental environment, etc.)
- Funding – the programs of various participants in the sector, investments in the protection of defenders and funds, of direct assistance to victims of this situation and to farmers in real life.
- Coordination: between interested parties.

In conclusion, the drafting of a national plan for the prevention, mitigation and protection of drought, including the institutional and organizational structure and mechanisms for the provision of timely, sustainable and equitable assistance is required.

PLANNING TOOLS

In case of drought, there are some key questions:

- How does a country know when there is a drought?
- If there is a drought, who is the problem?
- How is the public informed?
- How will the current allocations and uses of water be modified?
- Ensuring compliance?

To answer one of the questions, you need all five plan tools:

- identification of drought actions,
- designation of the governmental authority,
- public notice,
- reduction of water uses and income maintenance, and
- monitoring the compliance of individuals with water-to cope with the lack of water related to this.

Identification of drought indicators

Because of the difficulty of identifying when droughts start and end, drought-specific indicators should be used to decide when to implement a water management plan. When such indicators are identified, water users can formulate contingency plans and make decisions about future economic investments. Drought indicators should be accurate and sensitive to little, if any, subjective decision making.

A variety of such actions can be used, including:

- precipitation
- Palmer index (drought severity index),
- in streams, water source(s) discharge
- of the historical connection on the current and found needs for water,
- rate of subsidence or intrusion of salt water,

- potential for irreversible adverse effect on fish and wildlife, and
- reservoir or groundwater conditions in relation to the number of remaining days of water supply

Designation of Governmental Authority

Determining an agency or government agency that has specific authority to plan for this condition ahead of time is one of the critical aspects of ensuring water information management during drought. For a water management plan to be effective, the agency for which it must have stated authority has authority to have and use the water.

If he gives discretionary authority, his foreign instructions must be given. Failure to adequately set boundaries for others can create situations where administrators push groups of individuals into conflict.

Notice to the public

When drought conditions activate the implementation of the water management plan, the public must be notified. The notice must contain information about the provisions to limit use, when the conservation measures take effect, the availability of variances, and the procedures for obtaining a variance. The exact notification procedure can be developed to reflect local conditions and stakeholders.

Limitation of water use and revenue maintenance

A prioritization system of water use categories should be established before this happens so that each individual knows, before an item, in which order water restrictions apply. If industries and commercial enterprises are aware, in advance, the procedures to be undertaken to reduce water availability, they can create their own emergency plan for those reductions; for example, they can organize alternative sources of water or realize reductions in or not produced.

The reduction in water use will lower the income of water suppliers. Reduced income at a time when costs are higher because of the expenses incurred to cope with this. This can be solved by adding an ad-hoc supplement for users, or other government mechanisms needed, to ensure the continuity and sustainability of the operation of some water.

Compliance Monitoring of Water Users

Experience has shown that water use reductions of more than 20-25 percent cannot be achieved with a voluntary conservation requirement. There is no general agreement but mandatory conservation regulations or water rate increases and drought surcharges are the most effective ways to reduce water use to a volume less than that obtained by voluntary conservation.

One could argue that the availability of enforcement mechanisms is the important feature of the plan and that their application is rare. Much of the monitoring of clients for compliance comes from peer

group pressure, but service providers and inspectors can be empowered to issue warnings and fines. This can be an effective method to effectively monitor a service area under drought conditions.

DROUGHT RESPONSE

Drought response involves a range of actions and strategies aimed at mitigating the impacts of drought and managing water resources effectively. Here are some key elements of drought response:

Drought Monitoring and Early Warning Systems: Implementing robust monitoring systems and early warning mechanisms is crucial for timely detection of drought conditions. This includes monitoring meteorological data, hydrological indicators, and water availability to provide early alerts and enable proactive response measures.

Water Conservation and Demand Management: Promote water conservation practices and implement demand management strategies to reduce water consumption. This can include public awareness campaigns, water-saving technologies, and regulations on water use in sectors such as agriculture, industry, and households.

Drought Contingency Planning

Develop and implement drought contingency plans at various levels, such as national, regional, and local. These plans outline measures to be undertaken during different stages of drought, including water allocation priorities, restrictions, and alternative water sources.

Efficient Water Allocation: Establish fair and transparent mechanisms for water allocation during drought periods. Prioritize water use for critical sectors such as drinking water supply, health services, and essential agriculture, while ensuring equitable distribution among different users.

Diversification of Water Sources: Explore and develop alternative water sources to reduce reliance on rainfall-dependent sources during drought. This may include increasing water storage capacity through reservoirs and dams, implementing rainwater harvesting systems, and promoting wastewater reuse and desalination.

Agricultural Adaptation: Support farmers with agricultural practices and technologies that enhance resilience to drought, such as improved irrigation systems, drought-tolerant crop varieties, soil moisture conservation techniques, and crop diversification.

Ecosystem Management: Implement measures to protect and restore ecosystems that provide important water-related services, such as forests, wetlands, and riparian zones. This can help to maintain water quality, regulate water flow, and preserve biodiversity, contributing to drought resilience.

Emergency Response and Relief: Establish emergency response plans to provide immediate assistance to affected communities during severe droughts. This may include providing emergency water

supplies, food aid, livestock support, and health services to mitigate the humanitarian impacts of drought.

Stakeholder Engagement and Collaboration: Foster collaboration among various stakeholders, including government agencies, local communities, water utilities, NGOs, and academia. Engage stakeholders in decision-making processes, share information, and coordinate efforts to develop effective drought response strategies.

Long-Term Planning and Resilience Building: Integrate drought response measures into long-term planning and development processes. This involves considering climate change projections,

implementing sustainable water management practices and investing in infrastructure and technologies that enhance resilience to future drought events. Drought response requires a comprehensive and multi-sectoral approach, combining preventive measures, preparedness, and emergency response actions. By adopting proactive strategies and building resilience, communities and governments can better cope with the challenges posed by drought and minimize its negative impacts.

6. COMMUNICATING DROUGHT WITH PUBLIC

*Table 16. **Existing communication before, during and after drought event***

Timing	Level	Drought communication activities
Before drought	**To public**	General information on the current situation is available in the usual distribution channels (television news, newspapers, online). Public Communication Division dkp.mmph@rks-gov.net https://www.ihmk-rks.net
During drought	**To public**	General information on the current situation is available in the usual distribution channels (television news, newspapers, online). Public Communication Division dkp.mmph@rks-gov.net https://www.ihmk-rks.net Specific information on the restriction of drinking water use and/or the need for emergency supply is distributed to the public by regional water companies, emergency agencies and municipalities. News from world agencies about the water crisis in Pristina: https://www.wikiwand.com/en/Water_in_Pristina https://www.google.com/amp/s/amp.dw.com/en/half-a-million-in-kosovo-facing-water-shortage/a-17352442 https://www.ksl.com/article/28286074/lack-of-snow-leaves-kosovo-with-a-drought https://www.google.com/amp/s/www.foxnews.com/world/winter-drought-leaves-kosovo-with-shortages-of-drinking-water.amp https://www.sandiegouniontribune.com/sdut-lack-of-snow-leaves-kosovo-with-a-drought-2014jan08-story.html
After drought	**To public**	General information on the current situation is available in the usual distribution channels (television news, newspapers, online). The public is notified from the areas where the emergency water supply has been established that the restriction has already been eliminated. It appeals to save water and use it as rationally as possible. Then the Government should start activities for the improvement of drinking water sources with the priority of building new reservoirs.

7. WEAKNESSES AND GAPS IN DROUGHT MANAGEMENT IN KOSOVO

7.1. Weaknesses and Gaps of Legislation and Institutional Set Up

In terms of weaknesses and gaps in current legislation for drought management we find that a national umbrella document targeting drought and drought management directly is missing. Drought issues are dealt within several different documents addressing other environmental topics, Climate Change and water, hence covering drought only partially and insufficiently.

Table 17. Weaknesses of national legislation and institutions

Weaknesses of national legislation and institutions	Field addressing
- Missing the existing national umbrella document for drought management, - Drought management is only partly and insufficiently regulated by different laws or regulations, - There is no national drought management plan, etc.	Legislation
Weak cooperation among relevant sectors that are involved in drought management.	Interinstitutional cooperation
Suggestion for improvement: - To improve the national legislation with the definition of drought and water scarcity (in similar way as for flood) and with integration of sectoral policy into integrated system; - Clearly determine the institution's responsibilities related to drought management and communication before, during and after the drought events. - Specific sectors /fields of drought management require special emphasis on their improvement, of professional and human capacity, as in the hydrometeorological institute, especially in early warning system for drought and drought monitoring, and RBDA (river basin district authority) in RBMP including drought management [LL1] - To strengthen existing partnership between policy makers and stakeholders, and connect with other institutions and regional initiatives to gain extra knowledge and good practices. - To develop and adopt a national strategic document on drought management. It shall coverstrategic view on drought issue, set long-term goals and a manner of achieving them, and define a matrix of drought timeline and corresponding course of institutional actions.	

7.2. Weaknesses and Gaps in Drought Monitoring

Drought monitoring is divided into meteorological and hydrological drought monitoring, groundwater level monitoring and finally soil drought monitoring. Since 2014, meteorological drought has been monitored at 29 stations evenly stations distributed across the territory of Kosovo. The basic drought indices are used for drought monitoring is SPI. Regarding drought monitoring in Kosovo existing many gaps and weaknesses that need to be improved, we do not have the early warning system and not are defined the threshold for some of indicators, etc.

For more see the table below.

Table 18. Weaknesses and gaps in national drought monitoring

Weaknesses and gaps in national drought monitoring
- Drought monitoring is done only through the SPI monitoring, - threshold for some of the drought indicators are missing, - Lack of early warning system for drought, currently only SPI is used for monitoring and prediction, - We are not partners of any European network of drought observations, - The human and professional capacity are very limited, insufficient to monitor the drought. - No systematic and regular collection of drought impacts to complement drought monitoring**.**
Suggestion for improvement: - A regularly operating drought monitoring system should be established, - the threshold for some of indicators should be determined, - systematic collection of drought impacts in agriculture, water supply, energetics, and other sectors (if applicable) should be established. Records of impacts should have (as precise as possible) temporal and spatial attributes (when and where exactly the drought impacts appear) and degree of drought impacts in prescribed scale - HMIK should be in charge of preparing and updating list of drought indices and their thresholds that explain to highest possible degree occurrence and variability of drought impacts.

7.3. Weaknesses and Gaps in Impacts and Risk Assessment

Impact identification and risk assessment is needed to assist decision makers in making better decisions and developing a plan for the effective preparation and timely response to drought. Decision makers commonly take action by selecting among alternatives. Analysis of the consequences of each alternative allows choosing the best among others, taking into account occurred conditions. Currently, we have information which sectors are affected from drought, but do not have any assessment for damage from drought. Gaps and weaknesses for drought impact and assessment are given in the table below.

Table 19. Weaknesses and gaps of impact and risk assessment

Weaknesses and gaps of impact and risk assessment

- Missing data on impacts and risk assessment for affected sectors by drought and damage values.
- Institutional responsibilities for assessment of drought damage are not clearly defined, the municipalities don't prepare any report after the drought event, about the damages.
- Lack of hydrological drought assessment is based on annual, monthly and daily hydrological characteristics. They are presented in tables below an example annual and monthly mean flow characteristics to scale the drought levels
-

Colour	% Qr/Qa	Scale
	0 - 40	Very Dry
	40 - 70	Dry
	70 – 90	Under Normal
	90 - 110	Normal
	110 - 130	Over Normal
	130 - 160	Wet
	Above 160	Very Wet

- **Qr: reference flow for period 30 yeas**

% Qma	Scale
0 - 20	Extremely Dry Month
20 - 40	Dry Month
40 – 60	Substantially Under Normal Month
60 - 80	Under Normal Month
80 - 120	Normal Month
120 - 160	Above Normal Month
160 - 200	Substantially Wet Month
Above 200	Extremely Wet Month

Qma: long-term average monthly flow from the reference period of 30 years

Groundwater level and flow rate of springs	Significantly lower than the long-term average (1981 – 2010) ($<\phi_{10\%}$, $<Q_{10\%}$)	Lower than the long-term average (1981 – 2010) $\phi_{10\%}$ - $\phi_{40\%}$ $Q_{10\%}$ - $Q_{40\%}$	Corresponding to the long-term average (1981 – 2010) $\phi_{40\%}$ - $\phi_{60\%}$ $Q_{40\%}$ - $Q_{60\%}$	Higher than the long-term average (1981 – 2010) $\phi_{60\%}$ - $\phi_{90\%}$ $Q_{60\%}$ - $Q_{90\%}$	Significantly higher than the long-term average (1981 – 2010)

					(>$\phi_{90\%}$, >$Q_{90\%}$)
Value	1 – dry	2 - slightly dry	3 - normal	4 - slightly above average level/abundance	5 - above average level/ abundance

- Lack of groundwater drought assessment categories, in table below presented an example

Explanations:

1 – groundwater level (quantile value less than and equal to $\varphi_{10\%}$) and flow rate of springs (quantile value less than and equal to $Q_{10\%}$) is significantly lower than the long-term average (drought).

2 – groundwater level (quantile value less than and equal to $\varphi_{40\%}$) and flow rate of springs (quantile value less than and equal to $Q_{40\%}$) is lower than the long-term average.

3 – groundwater level (quantile value less than and equal to $\varphi_{60\%}$) and flow rate of springs (quantile value less than and equal to $Q_{60\%}$) is equal to the long-term average.

4 – groundwater level (quantile value less than and equal to $\varphi_{90\%}$) and flow rate of springs (quantile value less than and equal to $Q_{90\%}$) is higher than the long-term average.

5 – groundwater level (quantile value greater than $\varphi_{90\%}$) and flow rate of springs (a quantile value greater than $Q_{90\%}$) is significantly higher than the long-term average (moisture

Suggestion to improve:

- Should be available data on drought impacts and damages assessment for affected sectors and easily accessible.
- Should exist a national portal for drought where the data of impact assessment and damages by drought can be reported

7.4. Weaknesses and Gaps in Drought Response

When it becomes likely that drought related problems will significantly impact the lives of country residents, the responsible institutions will act with or through other state agencies and will:

1. 1.review unmet needs identified by responsible institutions or drought response community, (if it is established) and lead agencies.
2. identify and recommend means to meet those needs.

3. ensure inter-agency or institutions coordination; and
4. recommend to the Governor a drought emergency declaration be issued.

To achieve these four steps/requests, Kosovo currently has deficiency and gaps in the drought response system(see table below).

Table 20. Weaknesses and gaps in drought response

Weaknesses and gaps in drought response
- We do not have a response system from the effects of droughts well as a state drought Coordinator which should coordinate the acts between the Emergency Management Agency and respective institutions. - Also, regarding the response to drought, there are unclear responsibilities between institutions. - Activities that are being implemented in our country are the feasibility study to build the dumps (water reservoir) that will be contributed to respond or mitigate the drought effects.
Suggestion to improve: - *To establish the Drought Response Committee, which will co-chair by State drought coordinator and by director of emergency management agency*

8. Way forward (findings from analysis for completion of other project actions)

8.1. For preparation of the Draft Action plan (AP)

Initially, it is necessary to find the political will for the elaboration of such a document that would sufficiently consider mutual synergies and cross-sectoral aspects. Following this, we recommend establishing an interdepartmental expert commission for AP preparation, nominating representatives of relevant ministries, departmental organizations and the scientific community. The action plan should focus both on the consequences of drought and water scarcity.

When preparing the AP, follow best practices and divide the work on the AP into individual consecutive steps, described e.g. in Drought Management Guidelines, developed by the World Meteorological Organization and the Global Water Partnership Central and Eastern Europe. This approach was used in the Slovak Republic and conducted by the Ministry of the Environment. Therefore, it is recommended to be used as background for development of the Action Plan in Kosovo, with respecting the conditions in the Kosovo.

Use supporting domestic legislation for the creation of AP, e.g., "Water act" (as it was used in Slovakia), National Communication on Climate Change, Adaptation strategy on adverse impacts of Climate Change, available departmental strategies as well as documents at the local level: Urban planning, or Land-use planning, Adaptation Strategies for Cities or Regions.

When hierarchizing the measures, we recommend following classification preventive, operative and crisis measures.

Each of these categories of measures will have its own priorities, at the same time, it is necessary to determine responsibilities, deadlines and estimated financial resources for each measure. The developed version of the AP needs to be submitted to interdepartmental approval and to be commented on by the public, NGOs and important stakeholders, etc. The final version of the document will be approved by the government.

It is necessary to undertake measures to coordinate the implementation of the Action Plan to combat drought, establish a control mechanism for its implementation and a deadline for discussing a possible update of the AP, taking into account new knowledge, the progress of the Climate Change and other important circumstances. As previously mentioned, all impacted sectors have to be involved when defining the measures to cope with drought issue.

8.2. For selection of the programme of measures

The program of measures is a basic element of the Action Plan for drought and water scarcity. Its main goal is to reduce the adverse consequences of drought and water scarcity on human health, the environment, cultural heritage and economic activity. Depending on how the measures are related to the period before the onset of the drought, during its duration and also during its extreme manifestations, we can classify the measures as preventive, operational and crisis measures.

An important part of the program of measures are preventive measures, the implementation of which can mitigate the effects of drought without spending additional financial resources. Their division by individual sectors is important. Effective prevention and a synergistic effect in mitigating the consequences of drought and water scarcity cannot be conducted without close cooperation of the departments that will implement the measures within their scope. Basically, we can divide them into measures in agriculture and forestry, urban landscape and water management with a connection to the need for water in industry and energy sectors. The measures and their priority will be adapted to the conditions of a specific country. Measures in the field of drought research and education are also recommended for preventive measures.

Operational measures should be focused on effective monitoring of drought for its individual categories, i.e., meteorological, soil and hydrological drought. The aim of the measures is to predict the future development of drought. The measures include, on the one hand, the improvement of the

monitoring of climatological and hydrological variables, the use of satellites, modelling tools, etc. On the other hand, they include the prediction of the duration and estimation of the further development of the drought using seasonal forecasts and statistical tools.

Crisis measures include improvement, or eventually building of effective crisis management in the field of drought and water scarcity. It includes the preparation of crisis plans and also the establishment of crisis commissions in the relevant hierarchy from central to district, or local. It is especially important to manage situations with long-term drought, for which it is necessary to set appropriate measures.

8.3. For capacity building activities and dialogues with stakeholders in Kosovo

Capacity building covers a relatively wide range of professional areas. Within this activity, it is planned to organise the **National Dialogue and Training workshop**. It affects, but to a lesser extent, experts focused on drought monitoring and forecasting, but this activity can also be included in the field of education and research. It mainly concerns the adoption of methodologies and work procedures suitable for supporting drought management in terms of accuracy and timeliness of drought analyses and forecasts. A much wider group consists of people from areas that have to manage drought in daily practice. These are managers in the field of water, but also many economic sectors that are affected by the drought. Most of them are in agriculture or forestry, but partly also in industry and energy. Specialized workshops, which can be national or regional, have the greatest potential for capacity-building activities. Direct contact with stakeholders, the possibility of expert discussion and a targeted selection of topics are important in them. Furthermore, the use of media is also effective, the publication of special brochures for raising awareness among farmers and foresters or managers in the water sector is also important.

For stakeholders, among whom we include farmers, foresters, environmentalists, water companies, industries dependent on water supplies, representatives of cities, similar means of communication can be successfully used for the period before the drought, during the drought and after it ends. The establishment of a specialized website for drought monitoring and forecasting is also proven. Targeted, timely and information is essential in this communication. Such website may operate on the Hydrometeorological Institute and on the Ministry of Environment.

8.4. To develop a drought platform to communication with the public

The first step when implementing this activity will be the establishment of communication between GWPCEE and SHUKOS on the form of platform. It will be important to decide, whether it will be separate simple one, or as a part to already existing system. Next step will be to develop the structure where information and data related the drought management will be delivered and stored with access to professional and general public.

It is expected that at least the documents from following areas will be delivered: legislation and strategic documents, reports on monitoring systems (hydrology, groundwater, meteorology, climatology and remote sensing systems) and early warning systems. Such documents will be collected from Kosovo sources, Slovakia, and Western Balkan region, however, it is recognized the documents can be gathered from other parts of the World. Similar system is now developing in Armenia, where GWPCEE plays an essential role, and it can also be used as an example.

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