



# Strategy for enhancement of the hydrometeorological services in Kosovo 2022-2032

Action Plan for Strategy implementation 2022-2032

# *Enhancement of the hydrometeorological services in Kosovo*

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## **ABBREVIATIONS**

<b>KHMI</b>	Kosovo Hydrometeorological Institute
<b>ANSA</b>	Air Navigation Services Agency
<b>ECMWF</b>	Centre for Medium-Range Weather Forecasts
<b>EFAS</b>	European Flood Awareness System
<b>EMA</b>	Emergency Management Agency
<b>EU</b>	European Union
<b>FMI</b>	Finnish Meteorological Institute
<b>FLAWS</b>	World Bank Project
<b>GIZ</b>	The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
<b>GCA</b>	Global Commission of Adaptation
<b>GoK</b>	Government of Kosovo
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IWRM-K</b>	Swiss project, Integrated Water Resources Management in Kosovo
<b>KEPA</b>	Kosovo Environmental Protection Agency
<b>KHMS</b>	Kosovo Hydro-meteorological Service
<b>MCH</b>	Meteorological, Climatological and Hydrological
<b>MESPI</b>	Ministry of Environment, Spatial Planning and Infrastructure
<b>MESTI</b>	Ministry of Education, Science, Technology and Innovation
<b>MFLT</b>	Ministry of Finance, Labour and Transfers
<b>NWP</b>	Numerical Weather Prediction
<b>QA/QC</b>	Quality Assurance / Quality Control
<b>QMS</b>	Quality Management System
<b>RBRA</b>	Regional River Basin Authority
<b>SOP</b>	Standard Operating Procedure
<b>SPO-OMP</b>	Strategic Planning Office, Office of the Prime Minister
<b>SHUKOS</b>	Water Supply and Sewerage of Kosovo
<b>UN</b>	United Nations
<b>WMO</b>	World Meteorological Organization

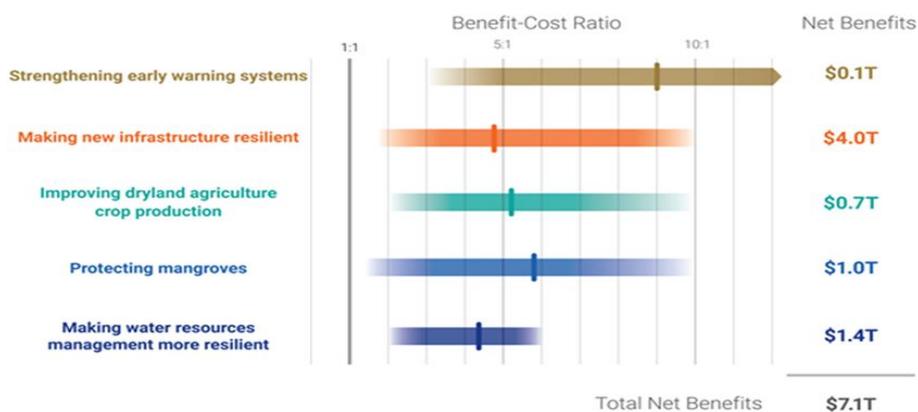
**KHMI Strategic Plan up to 2032**

**Chapter 1**

**1.1 Executive Summary**

The Globe, Europe and Kosovo is already negatively affected by the climate change, and these impacts will increase in future. In South-East Europe and Kosovo, increased number of more severe meteorological and hydrological events has occurred in recent years. These severe natural disasters include for example heavy precipitation events causing floods and landslides, droughts that have increased the severity of forest fires and consequently increased air pollution levels and related health impacts, prolonged heat and cold waves with negative impacts to the health of people and severe thunderstorms and hailstorms. These natural disasters have had significant impacts: human lives have been lost, property and infrastructure damaged, and the functioning of key sectors impaired thus causing economical loses to the societies.

The scientific evidence, as summarized by the Intergovernmental Panel on Climate Change states that the climate change increases the frequency and intensity of weather and climate and air extremes (IPCC, 2014). Some of the extremes are prone to last longer in the future, especially the heat waves, droughts and heavy precipitation. Due to this, there is increasing need for communities to increase the preparedness in order to improve their climate resilience. World Meteorological Organization (WMO) has stated that improved weather, climate and early warning services are one of the most cost-efficient measures for the climate change adaptation to increase the societies climate resilience (WMO, 2020). Based on the Global Commission on Adaptation (GCA, 2019) the cost-efficiency of improved early warning services is 1 to 9. In other words, the socioeconomic benefits of improved weather, climate and early warning services are nine time bigger than the investments needed for the improvements.



*Figure 1 Benefit-Cost Ratio of different climate adaptation measures, by GCA (2019)*

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Kosovo Hydro-Meteorological Institute (KHMI) operates under the Ministry of Environment, Spatial Planning and Infrastructure (MESPI) as a constituent part of Kosovo Environmental Protection Agency (KEPA) organizational structure. Based on the Law No. 06/L-035 “Law on hydrometeorological activities”, hydro-meteorological activities in Kosovo are under the responsibility of KHMI. These responsibilities include creation and development of an air, meteorological and hydrological monitoring system, telecommunication and analytical system, and forecasting system, ensuring continuous operation of air monitoring, meteorological and hydrological system, follow-up and forecast air, weather, climate, meteorological and hydrological natural disasters, which altogether comprises the hydrometeorological early warning system.

This hydrometeorological strategic plan for the next 10 years is derived in order to have a clear vision on the development of the meteorological and hydrological services and activities of Kosovo and the responsible institution on focus, KHMI. A clear need for further development of Kosovo’s institutional capacity of hydrometeorology is identified. The strategy for the hydrometeorological sector is focusing on KHMI being a service provider to government, public and private sector on the most crucial issues needed to be developed to enhance the Kosovo’s climate resilience. The developed strategy comprises capacity development plans as well as capital investment plans for the sector for the next 10 years for building up a modern governmental service being able to efficiently contribute to a reduction of the country’s vulnerability to natural hazards and to ensure the public safety and mitigate the risks of climate change to the different key economic sectors. The focus in this hydrometeorological strategy is on the development of KHMI.

***The main purpose of this strategy is: increased capacity of KHMI to produce weather, water, air quality and climate services and early warnings for citizens and different sectors of the society and economy of Kosovo.***

*Indicator for success is:* Government authorities and stakeholders acknowledge that the service from KHMI, have improved in terms of contribution to national climate adaptation and reducing risks for loss of life and properties.

The following vision and mission up to 2032 is proposed for KHMI:

**KHMI Vision: To be a national hydro-meteorological service that is efficient, effective and customer oriented**

**KHMI Mission: To provide reliable and timely weather, water, climate and air quality information and services for the safety of the citizens and key-economic sectors of Kosovo**

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The key overall objective of this strategy is: **Reduced risks for the loss of life and property caused by severe weather and climate events in the Kosovo societies contributes to the economic development.**

Recommended specific objectives to address the problems by 2032 are:

- Complete legal and organizational transformation of KHMI
- Improve observation and other infrastructure
- Improve data management and IT systems
- Improve forecasting and service delivery
- Enhance cooperation models with important stakeholders and customers
- Built professional capacities in hydrometeorology

## **Chapter 2**

### **2.1 Introduction**

The Hydrometeorological Institute of Kosovo (<http://KHMI-rks.net/?page=2,1>) operates under Law No. 06/L-035 “Law on Hydrometeorological Activities”. The institute is subdivided into five main sections which are air monitoring, hydrology, meteorology and climatology, and water and soil quality monitoring. These sections are in general closely interrelated in terms of methodologies and techniques and technical devices employed. The Institute is responsible for planning, building, operating, and maintaining the state-owned meteorological, hydrological (water quantity and quality), and air quality networks. The duties comprise systematic measurements, observations, and probing within these networks, analysing probes and retrieved/recorded data and deduce recommendations for government and public on this basis. The institute is also in charge of setting up and operating numerical models as required within its different sections. It is also involved in cross-border cooperation related to their fields of work. The Air Navigation Service Agency (ANSA) also contributes meteorological data to the meteorological section of the Institute. The same holds true for the other sectors as agriculture, emergency sectors, environment and water companies in the country with respect to other hydrometeorological data.

The strategy is to be derived in order to have a clear vision on the development of the meteorological and hydrological services/activities of Kosovo and responsible institutions on focus, the KHMI. The need for such a strategy is formulated in the documents:

- Law on hydrometeorological activities (Law No. 06/L-035)<sup>7</sup>, specifically article 19;
- Climate change strategy 2019-2028 and action plan on climate change 2019-20218, strategic objectives 3 (development of mechanisms and improving current disaster risk mitigation measures, in the sectors of economic importance that are particularly vulnerable to climate change) and 5 (capacity building of central and local stakeholders to integrate climate change issues and adaptation to development processes).

These issues are also tackled in other additional laws and documents such as:

- Kosovo water law (Law No. 04/L-147 article 9), particularly on monitoring the quality and quantity of surface and groundwaters (replacing the role of the Regional River Basin Authority referred to in the Law);
- Law on air protection (Law No. 2004/30)<sup>10</sup>, particularly air quality monitoring;

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- Administrative instruction on limited values of emissions of polluted materials into soil (Administrative instruction of GRK No. 11/2018)<sup>11</sup>, specifically articles 15 and 16 of the regulation on soil quality monitoring activities.

Kosovo as an aspiring country to join the United Nations (UN) also supports the implementation of the climate and disaster risk reduction related agreements and declarations in general, e.g. the “Paris Agreement”, the “2030 Agenda for Sustainable Development” and the “Sendai Framework for Disaster Risk Reduction 2015-2030. In this context, a clear need for further support to Kosovo’s institutional sector of hydrometeorology is identified. The aim is to develop a strategy for the sector focusing on being a service provider to government, public and private enterprises on crucial issues related to the sector. The developed strategy shall comprise capacity development plans as well as capital investment plans for the sector up to 2032 for building up a modern governmental service being able to efficiently contribute to a reduction of the country’s vulnerability to natural hazards. The main focus in this context shall be on KHMI.

Taking the above requirements as well as Kosovo’s aim to join WMO as a full member (article 23 of the “Law on hydrometeorological activities”), Kosovo intends to follow WMO’s<sup>12</sup> long-term goals:

- Enable better access to improved hydrological services, forecasts, and early warnings for drought, flood, and water resources monitoring, management, and planning;
- Facilitate a transboundary exchange of hydrometeorological and water resources data;
- Facilitate a connection to international information systems for monitoring and research in the field of meteorology and hydrology with respect to climate change as well as monitoring air quality, water quality and quantity and soil quality;
- Issue regular reports on the hydrological and meteorological states of the country in general.

KHMI has already made steps forward in achieving the long-term goals of WMO. Over the years many international donors have supported KHMI in the development of its capacities. For example, recently, The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in the context of its project “Climate Change adaptation through transboundary flood risk management” supports KHMI on this path. Up to now the GIZ support was limited to the White Drin (Drini i Bardhë) Basin. However, there is a need to further extend this support to the other river basins of the country. This, in particular, holds true with respect to setting up the strategy that KHMI can follow while implementing, improving, and expanding its services, to meet the National strategies and responsibilities as well as the international strategies and agreements.

## Chapter 3

### 3.1 Background

Kosovo is already negatively affected by the climate change, and these impacts will increase in future. Increased number of more severe meteorological and hydrological events has occurred in recent years. These severe natural hazards include for example heavy precipitation events causing floods and landslides, droughts that have increased the severity of forest fires and consequently increasing air pollution levels and related health impacts, prolonged heat and cold waves with negative impacts to the health of people and severe thunderstorms and hailstorms. These natural hazards have had significant impacts: human lives have been lost or endangered, property and infrastructure damaged, and the functioning of key sectors impaired thus causing economic losses to the communities. The climate change and related likely increase of flood risk poses an even greater threat to livelihoods, economy, and health of the riparian population of the river basins of Kosovo, in particular, rural risk areas often inhabited by low-income and vulnerable population. Floods in Kosovo usually occur in spring and autumn and most of its territory is subject to flood risk. These floods affect crop fields in Kosovo almost every year causing considerable economic and ecological damages. Also, the extended heat waves during summer have serious impacts, for example the extended wildland fires over the whole Balkans deteriorates the air quality over Kosovo and risk the life of citizens and loss of property.

The scientific evidence, and the Intergovernmental Panel on Climate Change has summarized that the climate change increases the frequency and intensity of weather and climate extremes in the future, especially the heat waves, droughts, and heavy precipitation (IPCC, 2014). Due to this, there is increasing need for communities to increase the preparedness in order to improve their climate resilience.

The “Paris Agreement” adopted in 2015, the UN “2030 Agenda for Sustainable Development” adopted in 2015, and the “Sendai Framework for Disaster Risk Reduction 2015-2030” adapted in 2015 set the basic objectives and guidance for governmental policy making and actions to increase the resilience to climate change impacts. Kosovo as an aspiring country to join the United Nations also supports the implementation of these agreements and declarations in general.

Hydro-meteorological activities and services in Kosovo are under the responsibility of KHMI as stipulated by the law. These responsibilities include implementation and development of a meteorological and hydrological monitoring system, telecommunication and analytical system, and forecasting system, ensuring continual operation of meteorological and hydrological system, follow-up

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and forecast weather, climate, natural meteorological and hydrological emergencies, which in other words is, the hydrometeorological early warning system.

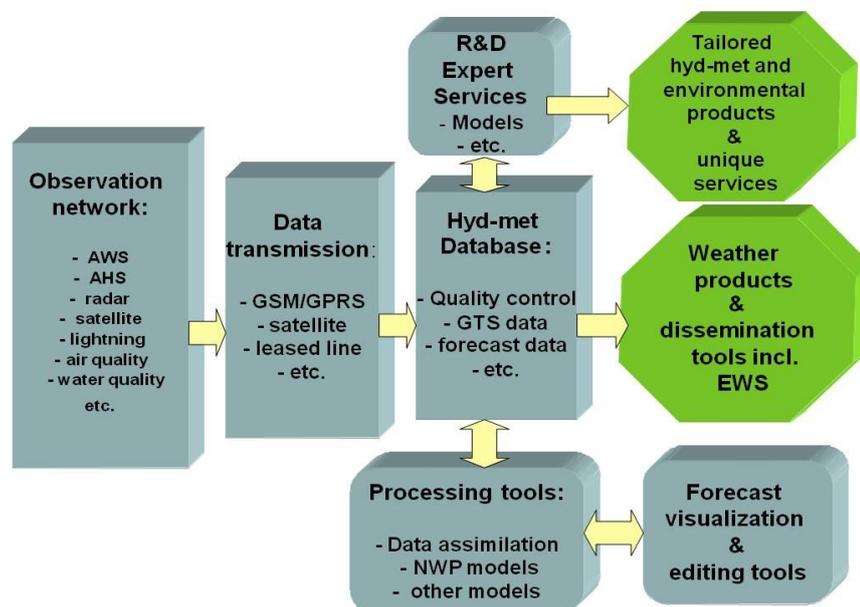
The following table includes the systems and functions of any NHMS, including KHMI.

*Table 1 Systems and functions that any NHMS needs to operate and do in order to produce the hydrometeorological services they are required to produce*

<p><b>1. Hydrological and meteorological</b></p> <p><b>Observation systems</b></p> <ul style="list-style-type: none"> <li>- Meteorological and hydrological surface observation networks</li> <li>- Upper air sounding station(s)</li> <li>- Weather radar(s)</li> <li>- Lightning detection network</li> </ul>	<p><b>2. Observation data management</b></p> <ul style="list-style-type: none"> <li>- Quality Control</li> <li>- Data telecommunications, processing and archiving</li> <li>- Development and maintenance of Data base for all station data</li> <li>- Archiving metadata on observation systems</li> </ul>
<p><b>3. ICT and Data processing</b></p> <ul style="list-style-type: none"> <li>- Post processing of observations and NWP data into service products</li> <li>- ICT infrastructure, High power computing, servers and workstations,</li> <li>- Numerical weather prediction, Hydrological modelling</li> <li>- Forecast verification</li> <li>- Data &amp; product delivery to customers</li> </ul>	<p><b>4. Dedicated services</b></p> <ul style="list-style-type: none"> <li>- Public weather services</li> <li>- Aeronautical services</li> <li>- Early warning services</li> <li>- Hydrological services</li> <li>- Air quality services</li> <li>- Agricultural information services</li> <li>- Climate services</li> </ul>
<p><b>5. Support activities and structures</b></p> <ul style="list-style-type: none"> <li>- Calibration of sensors</li> <li>- Station maintenance;</li> <li>- Technical experts on observation instruments and network design</li> <li>- On-line monitoring and control system(s) for each technology</li> <li>- Customer liaison officers (customer feedback, development of cost recovery services)</li> <li>- Research &amp; Development projects (cost recovery from projects)</li> <li>- Training &amp; Education</li> <li>- Governance for QMS/SOPs</li> <li>- DG's Office &amp; Administration: Communications, Accounting, Public relations, International Affairs, Personnel Management etc.</li> <li>- An organization structure to provide leadership and support to interconnect the activities above</li> </ul>	

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The functions of the table above can be expressed as a service provision flow chart or “the value chain” of NHMS as follows in the Figure 2. In hydrometeorological service production it is fundamental to first make real-time observations on the current conditions, which is shown in the far left in the figure. Then, through different systems and steps, shown as separate boxes in the picture, and by integrating the forecast data and functions into the production flow, weather products, early-warning services and other end-user products are created and disseminated (far right in the figure). Poor quality or lack of any of these systems (boxes) will reduce the quality of the end-user services or even set an obstacle for the production. Therefore, it is critical that all elements and their current capabilities and development needs are considered in the strategy.



*Figure 2 Flow chart of the service provision in NHMS's, with relevant functions for service production.*

Currently the KHMI cannot fully fulfil its responsibilities and implement the related activities in a level that is needed to improve the safety of citizens of Kosovo or meet the requirements by the key economic sectors. Moreover, due to the climate change and increased hazardous weather-related natural hazards the need for these services is increasing and the gap of KHMI current capabilities to provide these services is also increasing. Currently, KHMI is unable to secure all the time and in all weather conditions the timely and quality provision of weather, water and climate information and early warnings to the public and stakeholders. The KHMI hydrometeorological service delivery capacity is limited due to multiple reasons, for example the current institutional arrangement does not allow independency and cost recovery to be able to further develop the capabilities and the sustainability of services, the number and capacity of current staff is not adequate, the operation and maintenance of observation network and other infrastructure is not sustained due to limited budget and human resources, some of the priority

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observation systems are not existing at all to be able to monitor continuously the evolvement of dangerous weather conditions throughout the whole territory of Kosovo, the data and information systems are not adequate to be able to provide real time information with sufficient quality to the users, KHMI does not have 24/7 operational forecasting centre to enable updated information and warnings and situational picture of dangerous events all the time in all weather conditions, forecasting and service delivery process is outdated and manual and thus does not provide possibility for real-time data delivery nor automated dissemination of tailored information based on the stakeholder needs, and all the new modern dissemination means are not fully utilized to enable efficient and real time information dissemination to the end-users.

More detailed assessment is given in Annex II.

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### **3.2 Mission, vision and objectives**

Vision:

**To be a national hydro-meteorological service that is efficient, effective and customer oriented**

Mission:

**To provide reliable and timely weather, water, climate and air quality information and services for the safety of the citizens and key economic sectors of Kosovo**

The main purpose of this strategy is: **increased capacity of KHMI to produce weather, water, air quality and climate services and early warnings for citizens and different sectors of the society and economy of Kosovo.**

Indicator for success is: Government authorities and stakeholders acknowledge that the service from KHMI, respectively have improved in terms of contribution to national climate adaptation and reducing risks for loss of life and properties.

The key overall objective of this strategic plan is: **Reduced risks for the loss of life and property caused by severe weather and climate events in the Kosovo societies contributes to the economic development.**

Specific objectives:

- Complete legal and organizational transformation of KHMI
- Improve observation and other infrastructure
- Improve data management and IT systems
- Improve forecasting and service delivery
- Enhance cooperation models with important stakeholders and customers
- Built professional capacities in hydrometeorology

It is advised to secure that the objectives set for hydrometeorology are in-line and coordinated with other relevant national strategies in Kosovo.

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Specific objectives by 2032 are described by actions needed as below:

### **Complete legal and organizational transformation of KHMI**

- KHMI has *independent* organizational status as an *executing agency*: incl. budgeting, decisions on organization, staffing and commitments/agreements
- KHMI has possibility for cost recovery, incl. commercial activities and related revenues
- KHMI salaries are competitive and the loss of staff to private sector is minimal
- KHMI number and competence of staff has increased and meet the needs of sustainability and new operations: sufficient number of forecasters for 24/7 operations, dedicated staff for customer relation, management, finance & HR and IT; new recruited staff has sufficient basic education; KHMI has operational continuous training programme in place; KHMI has established at least one long term twinning partnership with more advanced NHMS

### **Improve observation systems and observation IT infrastructure:**

- Current surface observation network has been modernized: 90% of stations providing real-time data with better quality, maintenance of station has sustained with increased O&M budget
- One (c- or x-band) weather radar to cover the area of Kosovo operational (a preliminary study it is necessary before purchase of the weather radar)
- Local Lightning Detection network (min 4 sensors + central server) operational
- New KHMI building in use and hosts 24/7 forecasting centre & modern IT infra
- KHMI has enhanced IT infrastructure to secure operations of new systems and real time data transfer: servers, LAN, communication, etc.

### **Improve data management and IT systems**

- KHMI has operational modern integrated data management system: all data sources in one integrated system, incl. capability to host both real & climate data. Historical climate and hydrological data recovered and available from data base.
- Observation data is quality controlled: incl. real-time QC1 and Human Quality Control, all data sources has associated meta data
- All data is stored in one integrated centralized system: observations, model and other data
- KHMI has capability to deliver real-time observation data to stakeholders and customers

### **Improve forecasting and service delivery**

- KHMI operates 24/7 forecasting centre: incl. 24/7 weather, hydro and AQ forecasts and early warnings and situational awareness and customer services

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- Number and competence of KHMI forecasters sufficient to operate 24/7 forecasting centre, minimum: 6 forecasters and 2 hydrologists. New staff meet the WMO minimum competence requirements.
- KHMI forecasting processes and tools has been modernized: modern forecasting workstation and production system, with possibility for automated/Semi-automated production and dissemination. KHMI warnings process enable disseminated with CAP format.
- KHMI has capacity to disseminated tailored customer-specific products to stakeholders and end users: KHMI web site modernized, new mobile application, improved use of social media, new customer portal to serve clients
- KHMI stakeholder and customer relation process has been enhanced: at least one dedicated customer relation specialist and new customer process operational.

### **Enhance cooperation models with most important stakeholders and customers**

- KHMI cooperation with stakeholders and customers are based on legal responsibilities and clear written agreements
- KHMI new cost recovery process in use and enable revenues
- Improved cooperation and information exchange (real time) with neighbouring countries and relevant EU organization

### **Built professional capacities in hydrometeorology**

- Education and competency requirement are properly taken into consideration within KHMI requirement process
- KHMI has operational continuous training programme in place
- KHMI has established at least one long term twinning partnership with more advanced NHMS
- Providing short professional courses for existing staff
- Specification of qualifications in the field of hydrometeorology (offering scholarships)
- Inclusion as an elective subject in the pre-university curriculum
- KHMI has the right to client training/education

## **3.3 Main actions**

Main actions needed to achieve the objectives of the strategy and related indicators are presented in the table 4. Actions are defined for short term (1 to 3 years), medium term (4 to 6 years) and long term (7 to ten years) time frame.

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*Table 2 Timetable of specific objectives and indicators*

<b>Specific Objectives</b>	<b>Indicators</b>		
	<b>Short term, 1-3 years</b>	<b>Medium term, 4-6 years</b>	<b>Long term, 7 -10 years</b>
Complete legal and organizational transformation of KHMI	KHMI has status as independent executing agency Cost recovery possible KHMI salaries increased by 5 % KHMI 4 new staff members	KHMI Salaries increased by 15 % KHMI 12 new staff members twining partnership	KHMI organization and staff resources enable 24/7 operations KHMI 16 new staff members KHMI has continuous program for competence development
Improve observation system and other infrastructure	25 % of observation stations upgraded and providing real time data	50 % of observation stations upgraded and providing real time data Local Lightning Detection System operational	75 % of observation stations upgraded and providing real time data Weather radar operational New KHMI HQ building with modern IT infrastructure
Improve data management and IT	New integrated data management system, 50% of data integrated into the system Real-time data dissemination piloted with one end-user	New integrated data management system with full QC and META data, 75% of data integrated into the system	All data stored in new integrated data management system Stakeholders and end users receive real time quality-controlled data
Improve forecasting and service delivery process and tools	KHMI use more information sources for forecasting Forecaster's capacity to utilize new forecasting tools enhanced through capacity building measures	New modern forecasting system and warning tools implemented Kosovo exchange warnings in CAP format New KHMI webpage with attractive products operational Citizens and priority stakeholders receive real-time information and tailored products	24/7 forecasting and situational awareness centre operational for weather, flood and air quality and early warnings KHMI Mobile application for forecasts and warnings operational KHMI customer portal for information and product dissemination operational

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			Most stakeholders receive real-time information and tailored products
Enhance stakeholders and end users' cooperation	Cooperation with priority stakeholders based on written agreements Cost recovery principles agreed, cost recovery mechanism piloted by one customer	Cooperation with 50% stakeholders based on written agreements Cost recovery costing principles available 5% of the budget covered by external funding Basic data exchange agreement available and data exchange operational with 3 neighbouring countries	Cooperation with 100% stakeholders based on written agreements Cost recovery system operational, 10% of the budget covered by external funding Data exchange agreement available and data exchange operational with most important neighbouring countries and most important EU organizations
Built professional capacities in hydrometeorology	Education and competency requirement are properly taken into consideration within KHMI requirement process; Short professional courses for existing staff started; Specification for qualifications in the field of hydrometeorology completed (scholarships)	Long-term Twinning partnership established with at least one advanced sister NHMS; KHMI has the right to client training/education endorsed	Operational continuous program for competence development in place; Hydrometeorology included as an elective subject in the pre-university curriculum

### **3.4 Implementation, monitoring and reporting arrangements**

The monitoring mechanism will correspond to the principles set out in Administrative Instruction (GRK) No. 07/2018 on Planning and Drafting Strategic Documents and Action Plan, in the Manual for Planning, Drafting and Monitoring of strategic documents and their action plans.

MESPI as responsible line ministry, KEPA as the main agency and KHMI as the competent governmental institution for conducting the hydro-meteorological activities are responsible for coordinating and monitoring the implementation of the Strategy of the Hydrometeorological Services

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in Kosovo and for taking action, if necessary, to ensure the timely and effective implementation of the activities set out in the Action Plan.

The authority responsible for the preparation of reports is KHMI. Progress reports to be prepared:

- Annual Report
- Periodical and sectorial reports

*Table 3 Implementation management structure*

<b>INSTITUTION</b>	<b>RESPONSIBILITY</b>
MESPI	<ul style="list-style-type: none"> <li>• Undertake legal and statutory changes to adopt the new KHMI functions and responsibilities and financial rearrangements</li> <li>• Establishes an effective monitoring and reporting mechanism</li> </ul>
KEPA	<ul style="list-style-type: none"> <li>• Ensures timely and efficient implementation of the actions attributed to it</li> <li>• Supports KHMI in collecting, processing and reporting data on the implementation of the Strategy</li> <li>• Reports MESPI regarding strategy implementation challenges</li> </ul>
KHMI	<ul style="list-style-type: none"> <li>• Ensures timely and efficiently actions attributed to it</li> <li>• Provides periodical reports on progress implementation of the strategy and action plan</li> </ul>
Office of Strategic Planning	<ul style="list-style-type: none"> <li>• Assist MESPI to put into function respective structures and mechanisms to coordinate policies and provide them with support in the performance of their functions</li> <li>• Integrates the progress of the strategy in the national reporting for submission to the Strategic Planning Commission</li> </ul>

### **3.4.1 Monitoring and reporting**

As indicated above, monitoring is a distributed task between the responsible institutions involved. MESPI, with the support of the Office of Strategic Planning at the Office of the Prime Minister (SPO-OMP), will establish the necessary reporting guidelines and templates to ensure that there is comprehensive data and information to draft the following reports required for the implementation of Strategy and Action Plan. Detailed instructions are provided in the Manual for Planning, Drafting and Monitoring of Strategic Documents and their Action Plans.

This Strategy has a validity of 10 years. The Action Plan is valid for 10 years and will be gradually updated and expanded, following a cycle of mid-term evaluation and re-planning.

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*Table 4 Proposed reports for the Strategy implementation monitoring*

<b>Monitoring/Reporting</b>
Annual report on the implementation of the Strategy and Action Plan
Mid-term evaluation of the strategy and Action Plan
Strategy Evaluation, review and up-date

## **Chapter 4**

### **4.1 Cost benefit analysis**

It is no doubt that the weather, climate and water related information and services are of the outmost importance in central and local governmental levels and in many areas of communication, like policy formulation, agrometeorological risk assessments, budgetary forecast, transportation, traffic operation, security and even crime prevention. Hence, a major challenge for any national Hydromet authority is the development of monitoring systems for accurate and longer-term forecast services. As published in the Alliance for Hydromet Development report (2021), an estimated 23,000 lives per year could be saved and potential annual benefits of at least US\$ 162 billion could be realized by improving weather forecasts, early warning systems, and climate information – known as Hydromet.

World Meteorological Organization has stated that improved weather, climate and early warning services are one of the most cost-efficient measures for the climate change adaptation to increase the societies climate resilience (WMO, 2020). Based on the Global Commission on Adaptation (GCA, 2019) the cost-efficiency of improved early warning services is 1 to 9. In other words, the socioeconomic benefits of improved weather, climate and early warning services are nine time bigger than the investments needed for the improvements.

Benefits of KHMI services are significantly larger than the capital and operational costs needed to modernize, produce and deliver them further development of the water monitoring programs.

As a public service, the KHMI is expected to deliver socioeconomic benefits to the welfare of Kosovo society. By comparing the costs and benefits of project options over time an understanding of the relative value of the planned investments can be generated. Like in most of the countries, the KHMI services do not generate economic and social value unless users benefit from decisions informed by the information provided. Generating data, as one of the main KHMI services, shall serve to the decision-making at all levels as a core value. The more data produced by the KHMI is available and accessible, the more socioeconomic value it can deliver. By using the data, either from the decision-makers, or civil society or citizens, the more value it can be delivered by the KHMI.

Among other services that the KHMI provides is the weather forecast, as the only official governmental source of information for the weather in Kosovo. Highlighting the fact that there are certain weather-related impacts that are unavoidable, but also, it should be acknowledged that there are also some weather-related impacts that could potentially be avoided with better information or behaviour changes. Here one finds the value of weather information, which is related to avoiding impacts, facilitating more efficient response, or realizing new opportunities. The following are the steps that cross through the weather value of chain and it goes from weather conditions, to monitoring observation, modelling and

## ***Enhancement of the hydrometeorological services in Kosovo***

forecasting, dissemination, interpretation and information use to become economic value. Ultimately value of information is a function of the ability of decision makers to receive, understand, and act on information on uncertain future events.

In practical terms, the use of data and information from the weather services may avoid the economic loss of certain fields like agriculture, or it could be less costly for materials, energy or repair, and thus value added goes up. In the same way, weather services can also enable exploitation of new opportunities in sales and additional value added, generated through a new product or service.

The quantification of the total social costs and social benefits of a policy or a project, is usually done in money terms. The costs and benefits concerned include not only direct pecuniary costs and benefits, but also externalities, meaning external effects not traded in markets. These include external costs, for example, pollution, noise and disturbance to wildlife, and external benefits such as reductions in travelling time or traffic accidents. Benefit–cost analysis is often used to compare alternative proposals. If the total social benefits of an activity exceed total social costs, this can justify subsidizing projects that are not privately profitable. If the total social costs exceed total social benefits, this can justify preventing projects even when these would be privately profitable (Black et al., 2012; from cost–benefit analysis).

For example, the intense rains during the period of 06 -11 January 2021 caused flooding in almost the entire territory of the Republic of Kosovo<sup>1</sup>, with 1407 houses damaged and 4027.4 hectares of agricultural land, bridges, roads, facilities affected, thus causing a damage of 15,585,295.19 €.

Therefore, to optimize investment benefits, the KHMI modernization must therefore focus on service delivery and ensuring that KHMI users can productively use its services and this can be achieved by enhancing legal, operational and financial scope.

In addition to that, the agrometeorology and early warning combined with a developed monitoring and response mechanisms to the weather, can provide many development benefits to farmers by helping them to reduce economic losses and better protect their assets, or fairly help them to make decisions that contribute to their own economic self-sufficiency and sustainability.

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<sup>1</sup> Report on Floods, period 06-11 January 2021, Regiona River Basin Authority (ARPL), 2021

## ***Enhancement of the hydrometeorological services in Kosovo***

### **4.2 Budgetary impact of strategy implementation**

The budgetary impact of the implementation of the strategy is two-dimensional. On the one hand, infrastructural modernization requires nonrecurring investment funding and on the other hand, new organization, additional staffing and operation and maintenance of the modernized infrastructure requires additional annual funding. The following table gives an estimate on the nonrecurring investment costs required for the full implementation of the strategy. A prior professional and detailed evaluation shall be done on these investments and support from donors and government it is needed for the strategy implementation.

*Table 5 Estimated nonrecurring investment funding needed for the implementation of the strategy*

<b>Item</b>	<b>Estimated costs (€)</b>
Acquisition of a weather radar	2 000 000
Hydrometeorological observation network modernization	750 000
Acquisition of a lightning detection network	500 000
Improvement of data management system and general ICT	1 000 000
Acquisition of a forecaster workstation and forecast production system	1 000 000
Construction of a new building for KHMI	to be confirmed later
Capacity building and training of staff	1 000 000
<b>TOTAL (excluding the new KHMI building)</b>	<b>6 250 000</b>

## **Chapter 5**

In order for the KHMI to ensure a proper management of functional responsibilities and scope of work, as determined in the entire legal framework, and stated in the WMO guidelines, it is mandatory that a development approach toward the KHMI and hydrometeorological service of Kosovo, with specific emphasis on the financial allocation and budget forecast is endorsed by the Government of Kosovo. In light of legislation changes, the optimal solution for hydrometeorological services in Kosovo is to undertake legal statutory changes that enable KHMI to operate as an executive agency within the MESPI with clear competences, budgetary independence and increase of investments in order to fulfil its operational and structural legal functions, increase the budget and multiply the investments in order for KHMI to fulfil its legal responsibilities competences, enhance staff capacities, and infrastructure. Moreover, in this strategy document, it is suggested that KHMI will hire at least 12 new staff members and increase the salaries of the staff with 10 % by the end of the strategy period. In addition, the modernized infrastructure and observation network demands additional annual operation and maintenance funding. This means that the Government of Kosovo must multiply the level of budget allocations and financing, following the guiding value of KHMI budget allocations to be at least around EUR 500,000 / year, which is in line also with the Kosovo National Water Strategy 2017-2036. The current annual budget of KHMI is approximately EUR 280,000. From the added annual EUR 220,000, approximately EUR 75,000 would be targeted to increased personnel costs and the rest would be allocated to operation and maintenance of the modernized infrastructure. The needed increased budget can be partly covered by the increased revenues from cost recovery services from the beginning of mid-term period of the strategy. The revenues from cost recovery services will most likely increase steadily throughout the ten years period of implementation of the strategy.

### **5.1 Action Plan of the Strategy for development of Hydrometeorological services**

The following table provides an estimate of the major milestones and actions for development and implementation of the strategy. However, it is essential that a more detailed action plan is made in the early phase of the implementation of the strategy.

## Enhancement of the hydrometeorological services in Kosovo

*Table 6 Implementation plan and milestones of the strategy*

		The key overall objective of this strategic plan is: <b>Promotion of economic development and reduced risks for the loss of life and property caused by severe weather and climate events in the Kosovo societies.</b>													
		Indicator for success is: Government authorities and stakeholders acknowledge that the service from KHMI, respectively have improved in terms of contribution to national climate adaptation and reducing risks for loss of life and properties.													
Specific objectives	Indicators	Action	Responsible institution	Time Frame											Costs
				2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	EUR
		Acceptance of the strategy by government of Kosovo	<b>General Secretary, Cabinet of the Minister, SPO/OPM</b>												
		Detailed action plan for implementation of the strategy	<b>KHMI/ SPO-OPM</b>												
<b>KHMI legal and organizational transformation</b>	<p><b>Short term:</b> KHMI has status as independent organization Cost recovery possible KHMI salaries increased by 5 % KHMI 4 new staff members</p> <p><b>Medium term:</b> KHMI Salaries increased by 10 % KHMI 8 new staff members</p> <p><b>Long term:</b> KHMI organization and staff resources enable 24/7 operations KHMI 12 new staff members</p>	<p>KHMI acting as an independent executive agency</p> <ul style="list-style-type: none"> <li>- Amendment of KHMI law of IHMK and other regulations</li> <li>- Detailing of budget, organizational scheme, and agreements</li> </ul>	GoK												
		<ul style="list-style-type: none"> <li>- Cost recovery enabled (incl. commercial activities and related revenue and correlated with legal changes to the status of IHMK)</li> </ul>	MESPI in cooperation with MFLT												

## Enhancement of the hydrometeorological services in Kosovo

		KHMI salaries increased (correlated with legal changes to the status of IHMK)	MESPI in cooperation with MFLT			by 5%			by 10%					75 000 / year (2032)	
		KHMI new staff members - Competence and professionalism of staff should be increased	MESPI			4 new staff members			4 new staff members				4 new staff members		
		Building of 24/7 operations	KHMI, MESPI											250 000	
<b>Improvement of observation system and other infrastructure</b>	<p><b>Short term:</b> 25 % of observation stations upgraded and providing real time data</p> <p><b>Medium term:</b> 50 % of observation stations upgraded and providing real time data</p> <p>Local Lightning Detection System operational</p> <p><b>Long term:</b> 75 % of observation stations upgraded and providing real time data</p> <p>Weather radar operational</p> <p>New KHMI HQ building with modern IT infrastructure</p>	Observation stations upgrade to provide real time data (data shared with interested entities and parties)	KHMI, MESPI			25% upgraded			50% upgraded				75% upgraded	750 000	
		Acquisition of lightning detection system (checking possibilities with ANSA)	KHMI, MESPI, donors (e.g. FLOWS)												500 000
		Acquisition of weather radar	MESPI, donors												2 000 000
		KHMI new HQ building	MESPI, donors												tbc

## Enhancement of the hydrometeorological services in Kosovo

<b>Improvement of data management and IT Systems</b>	<b>Short term:</b> New integrated data management system, 50% of data integrated into the system Real-time data dissemination piloted with one end-user	Development of integrated data management system	KEPA, KHMI, RBDA, donors (e.g. IWMR-K)			50% data integration				75% data integration QC developed				100% data integration	1 000 000	
	<b>Medium term:</b> New integrated data management system with full QC and META data, 75% of data integrated into the system  <b>Long term:</b> All data stored in new integrated data management system Stakeholders and end users receive real time quality-controlled data	Develop and extend real time data dissemination to stakeholders and customers	KHMI			piloted						operational				
<b>Improvement of forecasting and service delivery process and tools</b>	<b>Short term:</b> KHMI use more information sources for forecasting Forecaster's capacity to utilize new forecasting tools enhanced through capacity building measures	Improvement of information sources - IHMK operates 24/7 forecasting center	KHMI												50 000	
		Forecasters' capacity building	KHMI, donors												200 000	
	<b>Medium term:</b> New modern forecasting system and warning tools implemented Kosovo exchange warnings in CAP format New KHMI webpage with attractive products operational Citizens and priority stakeholders receive real-	Acquisition of forecast system and warning tools	MESPI, donors (e.g.FLOWS)													1 000 000
		Development of CAP formatted warnings	KHMI													
		Update and maintenance of KHMI webpage	KHMI													

## Enhancement of the hydrometeorological services in Kosovo

	time information and tailored products  <b>Long term:</b> 24/7 forecasting and situational awareness centre operational for weather, flood and air quality and early warnings KHMI Mobile application for forecasts and warnings operational KHMI customer portal for information and product dissemination operational Most stakeholders receive real-time information and tailored products	Development of new KHMI Mobile application and Customer Portal to serve clients	KHMI, MESPI												
		Development of tailored production for customers and stakeholders	KHMI						Citizens and priority stakeholders						Customer portal completed
<b>Enhanced stakeholders and end users' cooperation</b>	<b>Short term:</b> Cooperation with priority stakeholders based on written agreements Cost recovery principles agreed, cost recovery mechanism piloted by one customer  <b>Medium term:</b> Cooperation with 50% stakeholders based on written agreements Cost recovery costing principles available 5% of the budget covered by external funding Basic data exchange agreement available and data exchange operational with 3 neighbouring countries	Written agreements with stakeholders (e.g ANSA, etc)	HM service beneficiaries, regional/international HM services			Priority stakeholders			50% of stakeholders				100% of stakeholders		
		Development of cost recovery mechanism (correlated with KHMI legal changes)	KHMI, MESPI in cooper. with MFLT		Principles agreed	piloted		Principles available	Income 5% of budget		Operational		Income 10% of budget		100 000
		International data exchange with neighbouring countries (NHMS) and EU organisation (included EEA, WMO, UNEP)	International HM services organizations					Basic data exchange agreement	operational - 3 neighboring countries		Data exchange agreement			operational - most important neighbouring and EU countries	50 000

## Enhancement of the hydrometeorological services in Kosovo

	<p><b>Long term:</b> Cooperation with 100% stakeholders based on written agreements          Cost recovery system operational, 10% of the budget covered by external funding          Data exchange agreement available and data exchange operational with most important neighbouring countries and most important EU organizations</p>													
<b>Built professional capacities in hydro-meteorology</b>	<p><b>Short term:</b> Education and competency requirement are properly taken into consideration within KHMI requirement process;          Short professional courses for existing staff started;          Specification for qualifications in the field of hydrometeorology completed (scholarships)</p>	Development of competency requirements, qualifications and program.	KHMI, MESPI, donors			competency requirements and qualifications completed							Program for continuous competence development completed and operational. Pre-university curriculum subject developed.	100 000
	<p><b>Medium term:</b> Long-term Twinning partnership established with at least one advanced sister NHMS;          KHMI has the right to client training/education endorsed.</p>	Staff capacity building and professional courses	KHMI, International Partners			Professional short courses operational								100 000
	<p><b>Long term:</b> Operational continuous program for competence development in place;          Hydro-meteorology included as an elective subject in the pre-university curriculum</p>	Building of Twinning partnership	KHMI, MESPI											
		Client training/education	KHMI						Client training and education procedures developed and endorsed					50 000

## Chapter 6

### Annexes

#### Annex I Methodology

The regional project “Climate Change adaptation through transboundary flood risk management” funded by the German Federal Ministry for Economic Cooperation and Development (BMZ) and implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, has the objective to strengthen the adaptation to climate change through cross border flood risk management in the Western Balkans. It focuses on the Drin River Basin area and supports institutions at national and local level in the four countries of Albania, Kosovo, Montenegro, and North Macedonia.

The project is comprised of three main fields of activities:

1. Further implementation of EU flood Directive. Building upon the existing experience the project will support generation of pilot experiences on generating flood hazard and risk maps and replication of the hazard and risk mapping process in other parts of the Drin-Buna Basin and as well in other risk areas of the country.
2. In parallel, the Project will support the Drin Basin countries on delivering effective and timely “end to end” early warnings. In addition to the refinements of the second version of the forecasting model (PANTA RHEI), the project will contribute on increasing the capacities of the national, local and regional decision makers on the warning chain, roles, responsibilities, alert dissemination to better cope with disaster events. Simulation exercises in vulnerable communities will be carried out.
3. Furthermore, the project will support the partner institutions at local and national level, on strengthening their capacities to better address and coordinate flood risk management. Systematic exchange of expertise, among different level actors (local, national and regional) and as well at transboundary level on flood risk management together with expert advice on implementation of the EU flood directive will be in the focus of the project. Flood risk management measures will be implemented.

The project also includes activity to support Kosovo in drafting the strategic plan for hydrometeorological sector that contains a vision and plan for developing its hydrometeorological activities and services up to 2032. This, in general, will contribute to the safety and wellbeing of people, sustainable development, and environmental protection within Kosovo and its neighbouring countries.

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Specific objectives in line with the main objective are as follows:

- Contributing to Kosovo's progress in the EU accession by aligning the hydrometeorological sections of KHMI and its services according to European Union (EU) and WMO standards;
- Enhancing the technical and institutional capacities of KHMI to meet the standards set by WMO on improving the service of hydrometeorological institutions;
- Contributing to KHMI to connect with international hydrometeorological services with respect to forecasting, monitoring, and research in the fields of meteorology and hydrology particularly in connection to climate change as well as monitoring air, water, and soil qualities;
- Improving the state of data and information exchange of the four main sections of KHMI with the EU and WMO in accordance with their standards.

For the activity three consultants were recruited by GIZ to support KHMI to develop the strategic plan: one international expert from the Finnish Meteorological Institute and two local experts from Kosovo.

Within the supporting consulting assignments, a great deal of attention was given to formalize the strategy so that the KHMI has a clear vision and actions that needs to be taken for the sustainable utilization and development of its infrastructure and services. It is essential that the activities planned are in line with the near- and long-term needs of the Kosovan society. It must be emphasized that the strategy includes defining a sustainable model for KHMI to operate and develop its infrastructure, staff resources and services. This also includes finding and proposing new sources for sustainable income. Therefore, the strategy is related also to the overall service production infrastructure of the KHMI and these components and systems are a part of this assignment as well.

The consulting assignment to support the strategic plan have encompassed a range of activities from desk studies, expert missions and reporting to stakeholder meetings and round-table discussions. The Also key actors in the field and representatives from stakeholders have supported the strategy planning work.

A short summary of the consultants' activities:

- A present situation assessment, inc. desk review on the responsibilities and activities of the Institute, in close cooperation with international and the local consultants.

This activity was delayed due to the covid restrictions in Kosovo and internationally since on-site assessment mission was possible only in September 2021, also the Kosovo authorities worked remotely and thus the data collection was also delayed.

The questionnaire to collect present situation data was prepared and answers analysed.

Local consultants conducted the assessment on stakeholders and legal framework. The draft reports were prepared by local consultants and finalized based on feedback.

The on-site mission was carried out Sep 2019 the KHMI HQ and its different sections were

## ***Enhancement of the hydrometeorological services in Kosovo***

visited, and staff members interviewed. Selected typical hydrological and meteorological observation sites were visited and technical staff responsible for operation and maintenance of stations interviewed.

- Internal and external stakeholders of the hydrology and meteorology sections were identified and documented in internal and external stakeholder maps.

Stakeholder meetings have been conducted during the on-site mission Sep, 2021 and within the remote stakeholder working group consultation meeting Nov 2021 and in person on February 2022.

- Participation of stakeholders was facilitated in all stages of the assignment through different workshops/ meetings in cooperation with international and local consultants

Stakeholder consultation was facilitated during the on-site mission to Kosovo Sep 2021 and during the first workshop (Nov 2021) and second on (February 2022) of stakeholder working group. During the on-site mission several meetings were held with priority stakeholders, inc. MESPI, KEPA, EMA and ANSA

The composition of stakeholder working group to support the strategic plan development includes representatives from:

1. Kosovo Hydro meteorological institute / Head of WG;
2. Kosovo Environmental protection Agency / member
3. Law department –MESPI/member;
4. Division for budget and finance -MESPI/member;
5. Division for human resources -MESPI/member;
6. Department for European integration and politics coordination -(MESPI)/member;
7. River Basin District Authority-MESPI/member
8. Department of environmental protection and water-MESPI/member;
9. Office of strategic planning /member;
10. Emergency Management Agency-MIA/member;
11. Meteorological department- (ANSA)/member;
12. Ministry of Agriculture, Forestry and Rural Development;
13. Ministry of Education, Science, Technology and Innovation
14. Ministry of Finance and Economy;
15. Kosovo Water and Sewerage Association (SHUKOS)/member
16. Kosovo Security Force

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### **Annex II Other agencies that acquire competencies in hydrological, meteorological services and Disaster Risk Management**

MESPI is overall responsible for policy development, implementation and monitoring and enforcement related to the environment. KEPA falls under MESPI, whereas KHMI is tasked with the collection of hydrological, meteorological and environmental data including air quality and the Directorate of the State of the Environment responsible for environmental monitoring fall under KEPA, however there are four other relevant governmental authorities that acquire competences in the field these areas of operation, as described in the following text.

#### **River Basin Districts Authority**

As established by law<sup>2</sup>, the River Basin Districts Authority, has an executive role for water resources management for all four basins. Among duties and responsibilities of the RBDA are to:

- Collect data needed for resource determination, quantities and features of waters;
- Undertake necessary measures for the preservation of surface and underground waters;
- Compile estimates for each water basin;
- Provide management with parts of the international basin, in the territory of Kosovo;
- Manage and maintain the register of water protected zones;
- Develop plans for managing the waters for basin;
- Compile and implement the program of monitoring and measures;
- Attend to implementation of the measures for protection from harmful water impacts in the Basin;
- Collect, process and attend to the data on observing the waters;
- Collect and process data for registry of water facilities and equipment;
- Establish, prepare and attend to the registry of pollutants in the basin;
- Propose expropriation of land in which there are underground waters, necessary for Public supply;
- Collect funds from the compensation, contributions, budget, grants;
- Performs financial-administrative tasks in the relevant basin;
- Apply technical methods for the preservation of waters; and
- Perform additional tasks, determined by sub-legal act by the ministry.

RBDA prepares River Basin Management Plan, recommends to the Government the measures for implementing the National Water Strategy and action plans for river basin management. Such measures include waters, environment and nature protection, fisheries, drinking water, recreation and bathing.

#### **Kosovo Inter-ministerial Water Council**

By the Law on Waters<sup>3</sup>, the Inter-ministerial Water Council is established too. This is a coordinating and decision-taking body that examines the systematic issues of water, the harmonization of the different needs and interests, and proposes measures for the development, utilization and protection of

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<sup>2</sup> Law No. 04/L-147 on Waters of Kosovo

<sup>3</sup> Law No. 04/L-147 on waters of Kosovo

## ***Enhancement of the hydrometeorological services in Kosovo***

water resources and system of Kosovo. It consists of five members, chaired by the Prime Minister and four-line ministers responsible for water resources, water services, finance and irrigation. Inter-ministerial Council provides opinions and recommendation for:

- Proposal for laws and other sub-legal acts relating to the regulation of matters of the water field in general;
- The implementation of laws and other sub-legal acts relating to water management;
- Drafting and approval of the national water strategy;
- Policy development in the field of water;
- Resolving the financial policy in the water field.

Inter-ministerial Water Council prepares the annual reports and reports to the Government and Assembly of the Republic of Kosovo.

### **Air Navigation Service Agency**

ANSA is an independent public authority in charge of air navigation services in Kosovo including air traffic services, communication, navigation and surveillance services, meteorological services for air navigation, and aeronautical information services.

ASHNA shall ensure safe, continuous, smooth, and effective air navigation by performing functions of an air navigation service provider, airspace management, and air traffic flow management pursuant to the Law on Civil Aviation into force, and the Regulations pursuant to the Agreement on the Establishment of a European Common Aviation Area.

Meteorological services for aviation in Kosovo are performed by ANSA that was established by Law on Air Navigation Services Agency<sup>4</sup> and certified by the Civil Aviation Authority to whom ANSA is accountable, for providing air navigation services including aeronautical and meteorological services. The data and meteorological reports from aeronautical meteorological services are part of the Hydro-meteorological Information System, managed by KHMI. In the other side the KHMI cooperates with the meteorological service provider of air traffic in accordance with the functions set forth in the law and with the agreement of cooperation with the meteorological service provider of air traffic

### **Emergency Management Agency**

The main organization in Kosovo that is responsible for Disaster Risk Management, established by Law<sup>5</sup> is the Agency for Emergency Management, within the Ministry of Internal Affairs. AME's scope is to support citizens and first response teams to ensure joint action, in building and maintaining the necessary capacity for preparation, defence, response and recovery from all types of hazards.

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<sup>4</sup> Law No. 04/L-250 on the Air Navigation Services Agency, Article 14.2

<sup>5</sup> Law No. 04/L-230 on the Agency for Emergency Management, 2014

## ***Enhancement of the hydrometeorological services in Kosovo***

Agency performs the technical management and protection of natural and other disasters, particularly

- elaboration of proposals for development projects and research;
- elaboration of the proposal for the program and the national plan;
- taking care of the organization and functioning of monitoring, warning and alarm system;
- planning, establishment, operation and maintenance of the unique system of communication,
- information and definition of the technical conditions for integration of other system
- elaboration of risk assessment and technical documents to defense planning, rescue and assistance and direction and coordination of measures for prevention and mitigation of consequences;
- monitoring and reporting of risk and giving instructions to confront them
- development of draft national emergency response plans in cooperation with Ministries and Government Agencies
- organizing, equipping and training of central defence, rescue and relief structures, and other
- protection, rescue and aid structures, as well as creating conditions for functioning of organizational structures of the Integrated Emergency Management System
- supervising and coordinating the organization of Structure for Protection Rescue and Aid (SPRA) and other services.
- curriculum preparation, organization and implementation of training and empowerment in the field of protection, rescue and relief;
- classification of resources for protection, rescue and relief
- creation and maintenance of national material reserves for cases of natural and other disasters.
- creation and maintenance of national material reserves for natural disasters and other calamities;
- prepares and distributes publications to inform the community on the field of emergency readiness and develops notifications for media.

Within the scope of its work, EPA is responsible for international cooperation with organizations of the same field and with other foreign institutions, including the exchange of experiences and knowledge with alike agencies and organizations with purpose of enhancing the skills and performing duties in the field of emergency.

## Enhancement of the hydrometeorological services in Kosovo

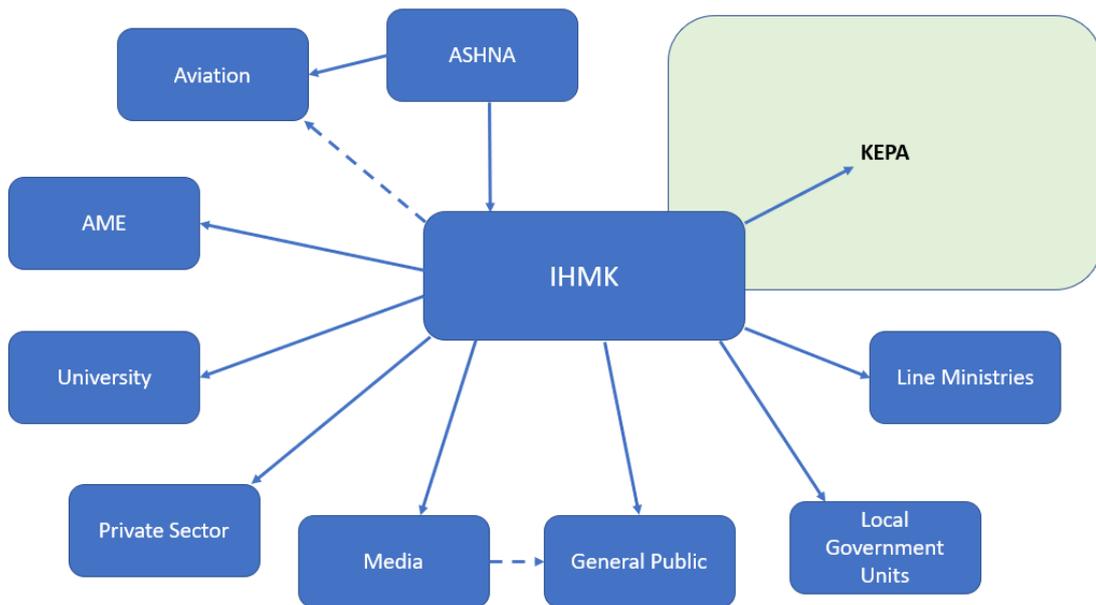


Figure 3 Users of the services of KHMI

### Annex III Assessment of KHMI current capacities and proposed actions

#### KHMI new legal structure and statutory changes

Apart from the legal statutory and structural changes, further development of KHMI services should include institutional strengthening and capacity building; modernization of observation, Information Technology and forecasting infrastructure; and enhancement of service delivery system.

By doing this the KHMI institutional basis will be strengthened, legal and regulatory framework enhanced and capacity of staff developed alongside the modernization of the observation network, IT, data management and hydromet forecasting infrastructure and facilities; and, most importantly, improvement of hydromet and early warning service delivery to the population and weather-dependent sectors.

Therefore, and subsequent to the WMO endorsements, the KHMI shall be re-structured into a governmental executing agency within MESPI, and maintain the recommended functions:

- Observations
- Forecasting services
- Climate services
- Research and development
- Information systems (information technology (IT) and communications)
- Finance and administration
- Research

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Based on the above we conclude that the KHMI in its operation, except the need for continuous capacity building, it requires scientific and technical progress and innovation in main areas of work like: observation, modelling, forecast, data collection and monitoring, information technology and decision support.

Taking into consideration the existing KHMI legal structure, as a subsidiary institution to a ministerial agency, that impose limitation toward sustainable development as the main governmental hydrometeorological representative organization, in addition to the lack of financial administration as one of the main functions, recommended by the WMO, we consider that the legal provisioning with regard to those limitation shall change, allowing the KHMI to seize the capacity of governmental executing agency that reports to the MESPI.

In light of legislation changes, however, there are three optimal solutions for KHMI:

- 1) Legal statutory changes that enable KHMI to operate as an independent executing agency within the MESPI with clear competences, budgetary independence and increase of investments in order to fulfil its operational and structural legal functions.
- 2) Legal statutory changes that enable KHMI to operate as Department within KEAP with clear competences, budgetary independence and increase of investments in order to fulfil its operational and structural legal functions.
- 3) Increase the budget and multiply the investments for KHMI to fulfil its legal responsibilities competences, enhance internal staff capacities and continues within the existing legal structure as a part of KEPA.

**In light of legislation changes, the optimal solutions for hydrometeorological services in Kosovo is to undertake legal statutory changes that enable HMIK to operate as an executive agency within the MESPI with clear competences, budgetary independence and increase of investments in order to fulfil its operational and structural legal functions, increase the budget and multiply the investments in order for HMIK to fulfil its legal responsibilities competences, enhance staff capacities, and infrastructure.**

Apart of all solutions, a research department within the KHMI is required to fulfil the scientific tasks of the institution. Article 6 of the Law on Hydrometeorological Activities qualifies the KHMI as the main national institution, scientific and professional in the field of meteorology, hydrology, climate, air, water and soil. Such structure will also liaise and coordinate scientific research in the field of meteorology and hydrology out of the KHMI with other research institutions and universities. The

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Research Department will take charge of scientific work e.g., on atmospheric processes and the phenomena for the perfection of the methods of weather analysis and forecast, estimation of possible climate changes under the influence of natural and anthropogenous factors in the frame of interests of national economy and environment protection.

Also, the future cooperation mode, for the cooperation between KHMI and main stakeholders, especially with ANSA should be deepened and based on clear written agreements (see scenario analysed in Table 8, option 2).

### *Legislation changes*

Statutory changes shall be embedded into the existing legal framework, including the following:

- Law No.06/L-035 on Hydrometeorological Activities to remove the references made to the secondary legislation of the Regulation No.01/2015 for Services to the Environmental Protection Agency of Kosovo and its institutions, which is not in compliance with best practices, affecting KHMI statutory changes.
- Apply the changes to the Regulation No.01/2015 for Services to the Environmental Protection Agency of Kosovo and its institutions, to include the KHMI new statutory legal structure as a governmental agency
- Apply the changes to the MESP Regulation No 05/2017 on internal organization and job systematization in the Ministry of Environment and Spatial Planning

### **KHMI organization and staffing**

According to the current law, KHMI is a separate institution of the state administration. This means it is established by a law, its duties and responsibilities are defined by the law, it is part of the MESPI and represents Kosovo in international meteorological and hydrological organisations. Nevertheless, in practice KHMI is not currently an independent organisation. KHMI is a part of KEPA within MESPI, as one of seven KEPA`s departments. KHMI is funded through KEPA budget, and the staffing is also regulated by the KEPA. The annual budget allocated through KEPA for KHMI is very limited and mainly oriented in covering staff costs. Budget for O&M and investments is not sufficient to secure sustainable operation in a longer term. Besides the KHMI is supported also by grants through several international donors. This funding is quite often dedicated for investments and technical assistance. The cost recovery is not currently possible for KHMI. Moreover, if there would be any cost recovery, the income could not be used for KHMI itself, since KHMI does not have its own budgetary powers.

## Enhancement of the hydrometeorological services in Kosovo

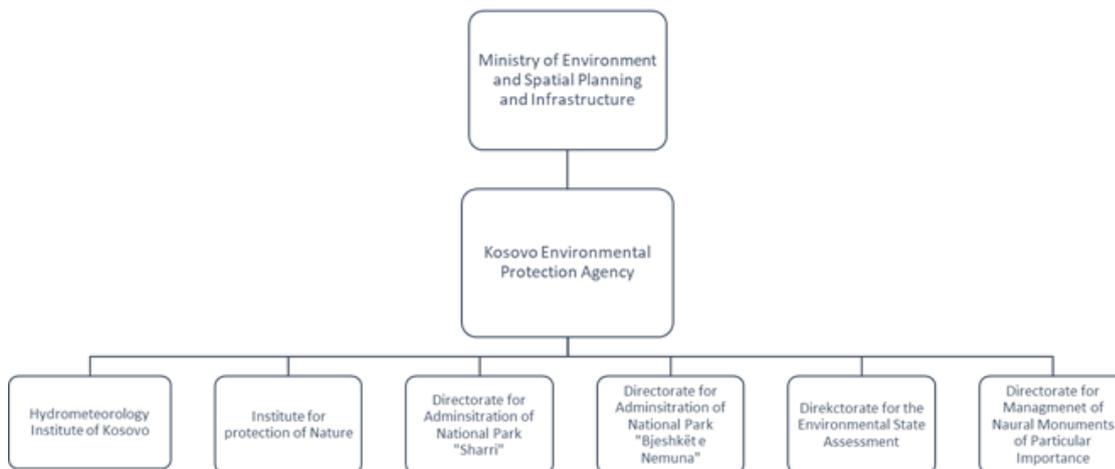


Figure 4 Organogram of KEPA

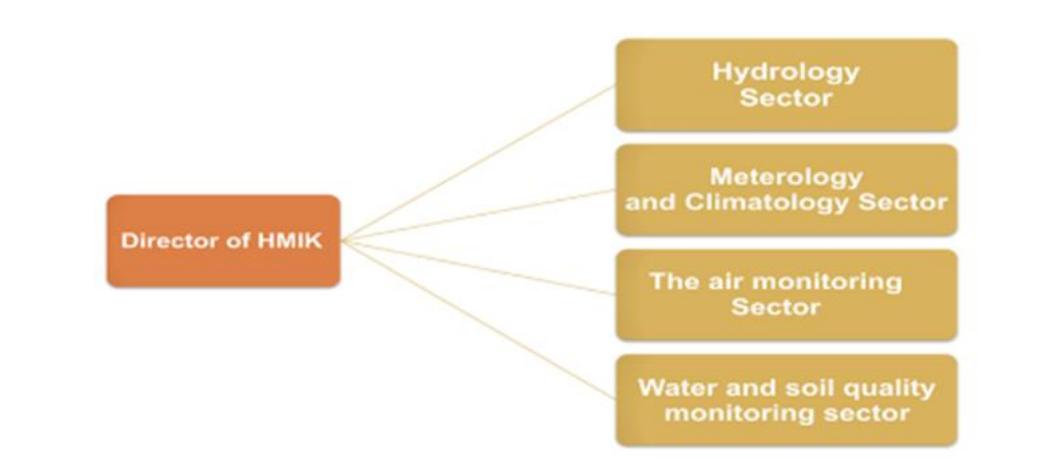


Figure 5 KHMI organization

KHMI has currently relative low number of staff (17) considering the responsibilities defined also by the law. Total number of allocated staff positions by KEPA is 19, but currently two positions are not occupied.

Currently KHMI has no educated meteorologists (e.g. for example university degree in meteorology). Nevertheless, it must be stated that the KHMI officer responsible for meteorology and forecasting have long term work experience and local expertise. Also, the current hydrologists do not have hydrological education (e.g. university degree in hydrology), nevertheless the 4 officers working for hydrology field have gained a lot of practical expertise from the long work career. In addition, there is one junior staff for hydrology.

## **Enhancement of the hydrometeorological services in Kosovo**

Environmental Department/air sector, and water and soil quality monitoring sector are relatively well resourced (compared to hydrology and meteorology) having total 6 staff members. Currently there is only one management position in KHMI (i.e., the director) and no dedicated staff for example for finance, human resource or research and development.

Due to budget limitation and not having the status of an independent agency, the salaries of staff are not competitive. These has led to increased, and partly already realized, risk for losing staff for example to the private sector with better salaries. All personnel contracts are under KEPA, and not directly under KHMI. KHMI does not have currently powers or possibilities to hire own employees as the staff strategy and budget is decided by KEPA.

### **KHMI staff structure**

*Table 7 Staff resources of KHMI including the positions and education*

Notes: X\*- Is PhD of Geography Department but have lot of experience in hydrology; x - is physicists but have lot of experience in meteorology; x- is engineer ,but have lot of experience in hydrology;

2 - means, 1 person for hydrology sectors and 1 for meteorology sector

*Distribution of the SHS staff by branch and level of education. Tech = Technicians, Obs = observers, BS=BSc, MS=MSc, PD=PhD.*

Notes: X\*- Is PhD of Geography Department but have lot of experience in hydrology; x - is physicists but have lot of experience in meteorology; x- is engineer ,but have lot of experience in hydrology;

2 - means, 1 person for hydrology sectors and 1 for meteorology sector

In total are 17 staff and two

Branch	Field of education														T O T		
	T e c h. & O b s	M e t e o r o l o g i s t s			H y d r o l o g i s t s			E n g i n e e r			C h e m i s t , P h y s i c i s t s			O t h e r			
		BS	MS	PD	BS	MS	PD	B S	M S	P D	B S	M S	P D				
Administration																	<b>1</b>
Met. sector	2x												x	x			<b>5</b>
Hydrol. sector	x															X*	<b>5</b>
Air monitoring sect	x													2x			<b>3</b>
Water and soil quality monitori.	2x													x			<b>3</b>
Finance & accounting	-	-	-	-	-	-											<b>0</b>
Organizational service																	
Internat. unit																	
R&D + GIS																	
Measurements and observations																	
IT & communication									x	x							<b>2</b>
Household div																	
Garage																	
<b>TOTAL</b>																	<b>17</b>

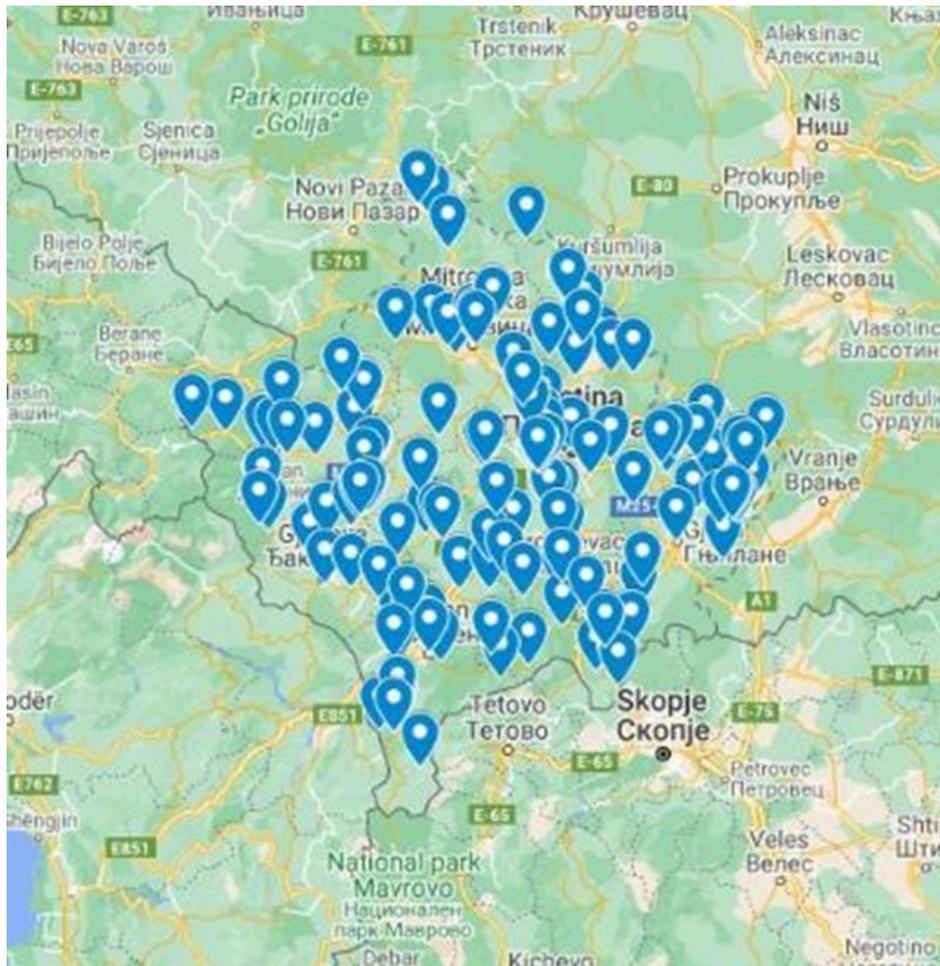
### **Observation systems**

KHMI current hydrological, meteorological and air quality observation network is relatively big and the coverage quite good considering the size of the Country. Observation network mostly fulfils for example the WMO requirements for meteorology and hydrology observation site density. For the

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hydrology KHMI has total 34 precipitation measurement points (nine meteorological stations and 25 rain gauges, 5 of them recording) and total 27 flow measurement posts, covering all the major river basins. Total 10 of flow measurement stations are online with automatic data transfer.

Within the meteorological observation network KHMI has 12 SYNOP station (4 manual), 4 agrometeorological stations (all manual), 30 rainfall (18 manual, 12 automated) and 4 climate stations.



*Figure 6 KHMI observation network*

Meteorological and hydrological network is currently mixed manual and automated. The data is partly available real-time, but only for internal users in KHMI. Nevertheless, currently no real time data is available for external users (other institutions, end-users or public). Real-time data is only visualized in KHMI web.

Automated Meteorological and hydrological stations are integrated into the European Flood Awareness System (EFAS) network, and the data transferred automatically from the KHMI stations to EFAS-database. KHMI is an official partner of EFAS.

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KHMI has central Meteorological, Climatological and Hydrological (MCH) database MHC that is mainly used for climatological purpose. The observation data is stored/archived in addition to MCH database, in Excel and MySQL. There is automatic data transfer system from the automated stations to MCH database and manually operated stations can import data manually to MCH database. No real-time quality control (QC) is in use and the manual quality control (HQC) is implemented only partially. These lead to risk for dissemination of obvious erroneous observation values to users.

Currently KHMI does not have among others weather radars, sounding stations or local lightning location network. The visibility measurements are currently done manually. KHMI does not have calibration laboratory for meteorological or hydrological measurements. The field observations are only checked against the field reference.

For air quality KHMI has network of total 12 fixed automated stations within 9 municipalities providing real-time data and one mobile air quality laboratory for campaign measurements. In addition, KHMI have air quality calibration laboratory, and PM-samplers and chemical laboratory for chemical analysis of samples. KHMI has outsourced the supply of spare parts and maintenance of AQ observation network by contract with private company. The Air Quality forecasting system and Air Quality Portal to disseminate the real time observation information and forecasted data to the users and public have been established by donor funded project. Nevertheless, there is risk for not sustaining the portal and forecasting system due to insufficient budget allocated for these important tasks.

The KHMI network has been established gradually over the years both with investments by international donors and governmental budget. During recent years the donor funding has been quite important in modernization of the network. The maintenance of observation network is currently mainly outsourced to private companies. Nevertheless, the allocated budget for operation and maintenance is not sufficient and there is also some insufficiency in the available spare part stock. This has led to increased risk for malfunctions, long downtime of observation due to malfunction, and finally poor quality and loss of data.

During the field visits to the observation some specific issues were noted, for example KHMI is still using mercury sensors in meteorological observation stations. These mercury sensors should be changed for non-mercury as soon as possible. In precipitation measurements there is no wind shields. During the wintertime there is also snow fall and especially during the windy conditions absence of wind shield can lead to erroneous precipitation values. Thus, it is recommended to install wind shields.

During the visit to the KHMI laboratory it was noted that especially for the emission measurements there is a rather big stock of, partly outdated, equipment and consumables. These equipment and

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consumables are currently unused due to staff shortage. The emission measurements cannot be conducted at the moment due to this.

The satellite receiving station in KHMI HQ is currently not operational due to change of channel in EUMETSAT. This problem should be fixed as soon as possible. Also, some other measurement systems, especially laboratory instruments are not in efficient use currently due to staff shortage and insufficient operational budget (for example the AQ mobile lab, samplers for PM, laboratory instruments).

Generally, it is recommended to continue the automation of observation system, incl. the whole value chain stations, data acquisition, data management, QA/QC, data processing and dissemination to end-users), increase the operational budget for operation and maintenance, to secure sufficient availability of spare parts, increase the number of competent observation staff and to enhance the QA/QC process to secure the quality of the observation data.

### **Forecasting process and systems**

The weather forecasting capacities, process and service delivery is currently one of the main bottlenecks of the KHMI overall capacity to provide the required services for the benefit and safety of the society of Kosovo. For example, according to the WMO, 2019 the key tasks of any NHMS, both developed and developing, are defined as follows:

”The main purpose of meteorological and hydrological services is to enable the public and economic sectors to make appropriate decisions when faced with weather, climate, and hydrological hazards. Regardless of the level of development, the NMHS and its partners need to be able to:

- Make meteorological and hydrological observations.
- Combine this information with products generated by the WMO community - generally in the form of gridded numerical products, which assimilate observations from everywhere into numerical weather prediction systems.
- Make accurate and timely forecasts and warnings relevant to their national users.
- Disseminate this information, using diverse means to match different sectors of society. This information has to be useful to the users if it is to support appropriate behaviours, especially during extreme weather events.”

Currently the KHMI doesn't meet these requirements. It has only one weather forecaster and consequently the weather forecast service is not operated on a 24/7 basis. Moreover, the only forecaster works only part-time, is responsible also for observations and works from Ferizaj, which is an observation station distant from Prishtina and KHMI Headquarters. This is a significant risk for the

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safety of the society of Kosovo: What if a severe weather event, threatening life and property, occurs during the night time or in the weekend, and it would require instant issuing of weather warning?

The actual weather forecasting process of KHMI is completely manual and it is based on viewing information from multiple data sources, most of them freely available in internet, such as European Storm forecast Experiment (ESTOFEX), Windy, Meteoalarm and neighbouring countries' weather radar websites. However, KHMI has the EUMETSAT Dawbee workstation and web access to the ICON- weather model (ICOsahedral Nonhydrostatic) output fields. The latter is running by the DWD (Deutscher Wetterdienst) in Germany in 7-kilometre grid, which can be considered relatively good for weather forecasting purposes in the geographical domain of Kosovo. However, KHMI is lacking access to other relevant weather forecast model data, most notably to the ECMWF (European Centre for Medium Range Weather Forecasts) forecast model data. Moreover, KHMI is lacking integrated weather forecaster workstation with actual model data ingested, which would enable thorough and modern weather forecasting and data visualization process.

### **Forecast services and products**

Traditionally, in Kosovo, the public sector has been the major customer and end-user group of hydrometeorological and environmental data and services. However, globally, as the quality and local accuracy of weather forecasts have significantly improved, over the past few decades, the service demand for more end-user-specific and online products for public and different economic sectors has been strongly increasing, especially in developed countries. Due to their socioeconomic development, these countries (and their economic and leisure activities) have also become more weather- and climate-dependent. Weather forecasts have high priority (and interest) in media and especially different TV channels have several weather programs per day. The Internet has become a very important part of the dissemination system of weather and climate information, and weather forecasts and time series of national weather radar composite pictures and precipitation forecasts, as well as online lightning data, are shown not only on web pages of NHMSs but also on private weather services and media. Moreover, the rapid development of mobile phones has made the mobile weather applications perhaps the most popular dissemination channel.

Examples from developed industrial countries with advanced NMHSs, and by WB, UNISDR, WMO and other country assessments show that different economic sectors and the national economy as a whole can benefit significantly from adequate hydrometeorological information. This requires that the information be delivered in a way that is understandable to the users, and that customers know how to use this information to support their decision making.

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The weather service production process is currently in KHMI completely manual and therefore the service capacity is also limited. It is impossible to increase the number of daily products even if the number of customers would increase significantly. It also limits KHMI's product portfolio for example (modern) detailed graphical products are impossible to create manually and require automated forecast production systems.

The main dissemination channel in KHMI for the weather forecasts is its website with only basic products. The products are mainly textual, simple tabular, map and meteograms with predefined locations. The current product portfolio of KHMI is not user-friendly and attractive. Updating of the website is completely manual. The weather forecaster that works outside of KHMI HQ in an observation station, delivers the information to an IT expert in HQ who then will update the forecasts manually to the KHMI website and other systems, such as emails or social media. There are no tailored products made by the needs of the end-users.

The website of KHMI is not very popular and it requires update and clearer products. In Facebook KHMI has approximately 2000 followers. As a comparison FMI Twitter account (FMI has no Facebook account) has 183 000 followers in a 5,6 million people country. There is also a television weather presentation from KHMI in a governmental TV-channel once a week. However, KHMI doesn't receive any payment from this service. Some tv-channels in Kosovo use data from other international sources due to insufficient service quality and capability of KHMI.

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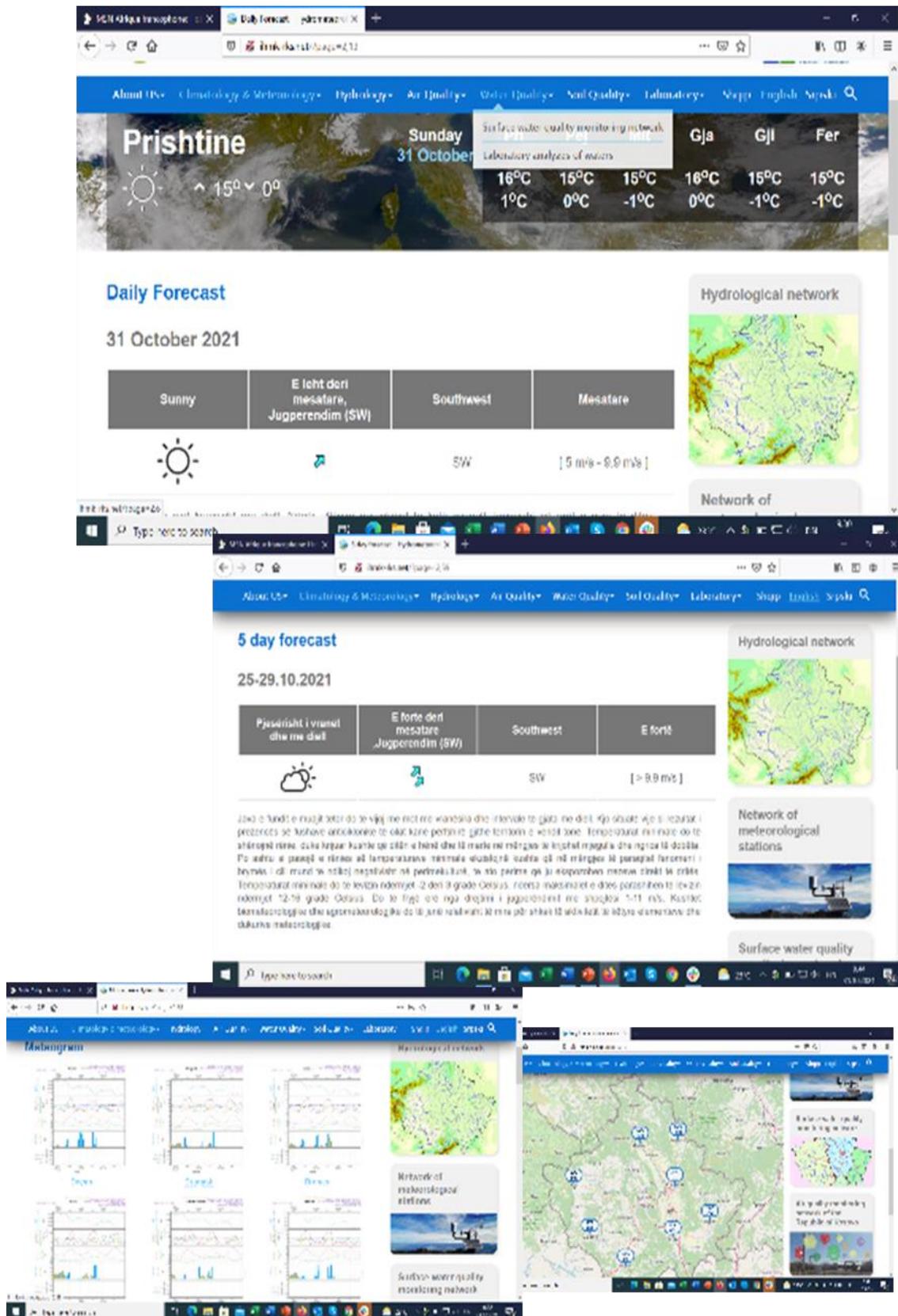


Figure 7 KHMI website, example of products

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### **Air Quality monitoring and forecasting**

KHMI operates also national air quality monitoring network and related air quality laboratories in Kosovo. KHMI has also air quality forecasting system. All the real time air quality information and air quality forecasts are available and disseminated to the citizens via dedicated website. The air quality monitoring and forecasting system and water and soil quality monitoring was not assessed in detailed in this work since the focus was in hydrometeorology.

More detailed information on KHMI air quality monitoring and forecasting system can be found here:

0. [https://www.ammk-rks.net/repository/docs/Raporti\\_p%C3%ABr\\_gjendjen\\_e\\_ajrit\\_n%C3%AB\\_Kosov%C3%AB\\_per\\_vitin\\_2020\\_\(final\\_web\\_alb\).pdf](https://www.ammk-rks.net/repository/docs/Raporti_p%C3%ABr_gjendjen_e_ajrit_n%C3%AB_Kosov%C3%AB_per_vitin_2020_(final_web_alb).pdf)
1. <https://airqualitykosova.rks-gov.net/>
2. [https://www.eea.europa.eu/data-and-maps/figures/overall-data-reporting-performance-of?fbclid=IwAR0-vIFjVvq6UxTSAQ\\_J6mV80AQapi5x2oHNgQxdpOt7q56q2pObViLLgeU](https://www.eea.europa.eu/data-and-maps/figures/overall-data-reporting-performance-of?fbclid=IwAR0-vIFjVvq6UxTSAQ_J6mV80AQapi5x2oHNgQxdpOt7q56q2pObViLLgeU)
3. <https://www.ammk-rks.net/?page=1,7,602>
4. <https://www.ammk-rks.net/?page=1,7,599>
5. <https://airindex.eea.europa.eu/Map/AOI/Viewer/>

For soil monitoring more information can be found: <https://www.ammk-rks.net/?page=1,24>

### **Warning services**

Currently KHMI has the mandate to issue weather warnings for the territory of Kosovo. However, the phenomena that are given warnings are limited only to flooding. Together with the limited operating hours of the weather forecasting, this is a major gap in the services of KHMI and creates a significant risk for human and economic losses. The current warnings are issued only in text format. This format can be somewhat informative but not very appealing or does not raise enough interest for large audiences and it is not in a suitable or optimal format for television and social media, which are the major modern information channels. Currently, modern weather services also distribute their warnings in map format, which is a more efficient and quicker way to reach the general public in case of a severe weather event.

The warnings that are issued are delivered to Emergency Management Agency and Prime Minister's Office. Only after that the warnings are published to the general public. This process is slow and creates a futile lag and potentially life-threatening situation for the citizens of Kosovo in severe weather events.

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### **Assessment of the current level of service delivery**

Currently the stakeholder and client relations are under responsibility of one person only, the director of KHMI. In order to expand the customer portfolio and enable continuous customer liaison KHMI should hire a dedicated customer relations person. However, prior to any activities targeted to increase the customer portfolio, the KHMI should be able to receive the income for the customers to its own budget (instead of going to KEPA budget). This would create better incentive also for KHMI to improve its customer services, quality of end-user products and revenue.

The main stakeholders of KHMI are the Emergency Management Agency (EMA) and Air Navigation Services (ANSA). According to the EMA the cooperation with KHMI is “Long & good and cooperation is a must” and also “flood forecast the most important”. This is positive and shows that the services of KHMI are valued in EMA. The biggest needs for development to enhance future services are according to the EMA:

- Climate data,
- Weather warnings,
- Database and data management,
- Real time data,
- Data dissemination to end-users,
- Legal framework: overlapping responsibilities, clear mandates and responsibilities, data policy

The ANSA is an aviation weather service provider in Kosovo. It is a separate institute from KHMI, however it is under the same ministry, Ministry of Environment, Spatial Planning and Infrastructure. Having two different institutes with the responsibility for weather forecasting in Kosovo doesn't seem to be an optimal arrangement, and the current institutional arrangement under the same Ministry could facilitate some kind of a merger of these institutions. There seems to be at least partly overlapping work between KHMI and ANSA, especially as ANSA already issues weather warnings to the aviation sector in Kosovo and makes other aviation weather forecast products. The general weather services being at the same time responsibility of IHMK by the current law. The ANSA has an operational 24/7 forecast office, which is currently missing from KHMI. There is also a risk for spending money for expensive overlapping systems and equipment if both institutes are developed separately without proper coordination and optimization. There is a huge potential for cost savings and improvement in hydro-meteorological services in Kosovo if the cooperation between KHMI and ANSA is enhanced. Most likely, the biggest benefits are gained in case their merger is considered.

The following table shows three different scenarios for organizing the hydro-meteorological services in Kosovo with estimated effects. The scenario number 1 can be called “business-as-usual” scenario where

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KHMI and ANSA will remain as separate institutes and the cooperation remains limited or almost non-existent. Both institutes are completely responsible for acquisition and operation of their systems as well as staff resources and management. In scenario 2 the institutes are still separate, however major effort is made in improving their operational cooperation. Most importantly all technical systems, such as observation equipment and forecast systems and data are shared between the institutes and they both operate and use the same systems. Moreover, both real-time and historical data is shared between institutes in full extent. Forecasting, service delivery and management processes are still separate in this scenario. In scenario 3 the institutes are fully merged into one organisation.

The option 2 “IHMK and ASHNA separate institutions with deep cooperation” was recommended and proposed by the working group as bases for the strategy.

*Table 8 Three different scenarios for organizing hydro-meteorological services in Kosovo with estimated effects*

<b>KHMI and ANSA separate institutes – no/limited cooperation</b>	<b>Effects</b>
<ul style="list-style-type: none"> <li>• Own, separate observation systems and networks</li> <li>• Own, separate forecasting systems</li> <li>• Own staffing</li> <li>• No/limited observation and model data sharing</li> </ul>	<ul style="list-style-type: none"> <li>• Major part of investments to meteorological infrastructure need to be done twice. In case recommendations on renewing of observation and forecast systems provided in chapter IV followed, approximate additional acquisition cost to Kosovo at least between 5-10 MEUR.</li> <li>• Double maintenance costs for all systems.</li> <li>• Maximum increase in need for staffing (forecasters, maintenance personnel, management etc)</li> <li>• Lack of full data access for both institutes. Decrease in service and forecast quality.</li> <li>• No requirement for new contracts or arrangements between institutes.</li> </ul>
<b>KHMI and ANSA separate institutes – Deep cooperation</b>	<b>Effects</b>
<ul style="list-style-type: none"> <li>• Shared observation systems and networks</li> <li>• Joint integrated forecasting systems</li> </ul>	<ul style="list-style-type: none"> <li>• Only single investment required for meteorological infrastructure. Saved costs both in investments and O&amp;M.</li> </ul>

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<ul style="list-style-type: none"> <li>• Separate staffing, excluding meteorological system maintenance and IT</li> <li>• Operational real-time data sharing</li> <li>• Shared or joint integrated meteorological database system (incl. Observation, remote sensing and model data)</li> </ul>	<ul style="list-style-type: none"> <li>• Improved redundancy of shared systems.</li> <li>• Backup arrangements possible between institutes</li> <li>• Slight increase in need for staffing. Own forecasters and management needed. Joint maintenance and IT staff possible.</li> <li>• Improved forecast and service quality with full data access for both.</li> <li>• Development of cooperation model required. Additional cost of planning and implementation of cooperative model.</li> <li>• Updated contractual arrangements between institutes required.</li> </ul>
<b>KHMI and ANSA merged institutes</b>	<b>Effects</b>
<ul style="list-style-type: none"> <li>• All functions and systems under the same institute</li> <li>• Possible still two forecasting locations (airport and HQ of KHMI), or in the future only one forecasting centre to serve both users.</li> </ul>	<ul style="list-style-type: none"> <li>• Only single investment required for meteorological infrastructure. Saved costs in investments and O&amp;M.</li> <li>• Improved redundancy of systems</li> <li>• Backup arrangements possible between offices</li> <li>• Minimum increase in need for staffing. Even decrease of staffing possible.</li> <li>• Improved forecast and service quality with full integrated data management</li> <li>• Planning and development of organization of new institute required</li> <li>• Update of legal framework needed.</li> </ul>

## ***Enhancement of the hydrometeorological services in Kosovo***

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