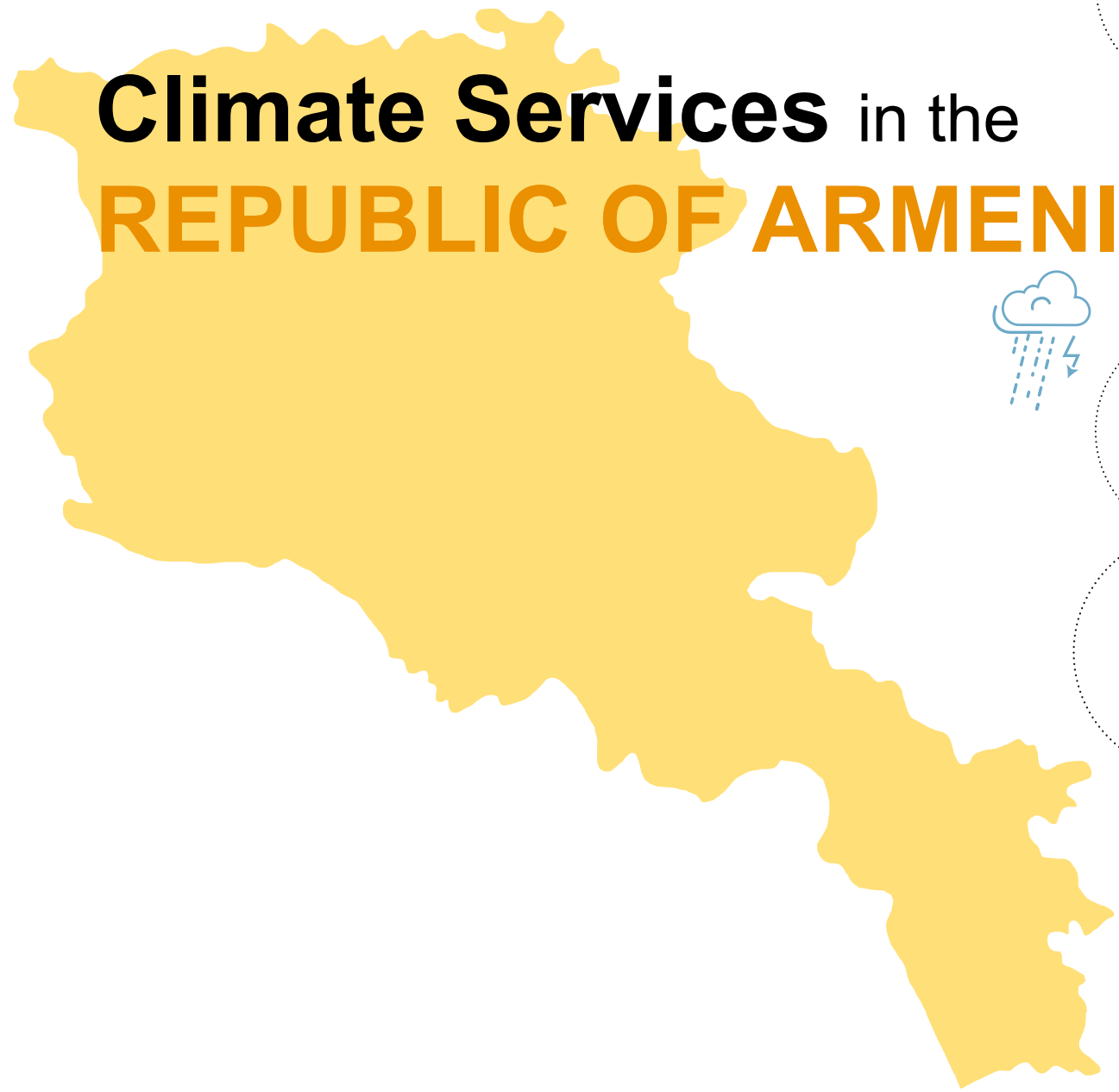
Baseline analysis and summary of online consultations for the National Framework for

# Climate Services in the REPUBLIC OF ARMENIA



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GFCS GLOBAL FRAMEWORK FOR CLIMATE SERVICES

GFDRR
Global Facility for Disaster Reduction and Recovery

REPUBLIC OF ARMENIA
MINISTRY OF ENVIRONMENT

zoï environment network

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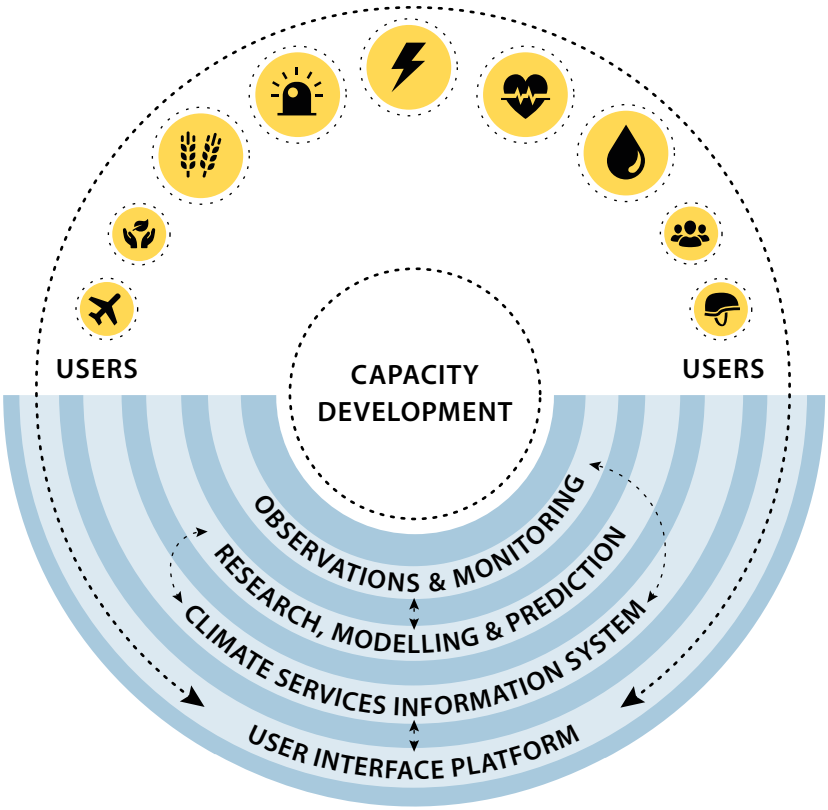
# 1 Introduction

The vision of the Global Framework for Climate Services (GFCS)[1] is to enable better management of the risks of climate variability and change and adaptation to climate change through the development and incorporation of science-based climate information and prediction into planning, policy and practice on the global, regional and national scales. Climate observations, along with complementary socioeconomic and other data, must be effectively integrated to develop and provide users of climate services – farmers, public health officials, disaster risk reduction managers, water resources administrators and others – with information that will help them minimise losses due to climate variability and change and to manage natural and human systems effectively.

**Figure 1.1**
**Functional components (pillars) of the Global Framework for Climate Services**




Source: modified from WMO, 2018

1 https://gfcs.wmo.int/

The GFCS accelerates and coordinates the technically and scientifically sound implementation of measures to improve climate-related outcomes. With its broad participation and reach, the framework enables the development and application of climate services to assist decision-making at all levels in support of addressing climate-related risks. The GFCS focuses on developing and delivering services in five priority areas that address issues basic to the human condition and present the most immediate opportunities for benefitting human safety and well-being. These are: agriculture and food security; disaster risk reduction; energy; health; and water.

## Box 1.1
## Pillars of the Global Framework for Climate Services

### OBSERVATIONS AND MONITORING

Effective climate services require observations of various types, of adequate quality and quantity and at the right place and time. Both surface-based and space observations are needed for physical and chemical climate variables of the atmosphere, land and oceans, including hydrologic and carbon cycles and the cryosphere. In addition, delivering useful climate services also requires the availability of socioeconomic, biological and environmental data.

### RESEARCH, MODELLING AND PREDICTION

During the past few decades, national and international investments in climate observations, research and modelling have resulted in significant progress in experimental and practical climate prediction and projection. Systematic conversion of existing climate knowledge into practical solutions requires a change in how climate research is conducted. In order to meet the diverse needs for climate services, professional networks should be developed to unite climate researchers and practitioners in the field.

### CLIMATE SERVICES INFORMATION SYSTEM

The information system is the principal mechanism through which information about climate – past, present and future – is archived, analysed, modelled, exchanged and processed. It produces and delivers authoritative climate information products through operational mechanisms, technical standards, communication and authentication. Its functions include climate analysis and monitoring, assessment and attribution, prediction (monthly, seasonal, decadal) and projection (centennial scale).

### USER INTERFACE PLATFORM

The user interface platform offers structured means for users, researchers and climate service providers to interact and ensure that user needs are met. The objective of the user interface platform is to promote effective decision-making in view of climate considerations. The need to make climate-related decisions will be the driver for providers and users to develop more useful climate information.

### CAPACITY DEVELOPMENT

The GFCS aims to develop the capacity of countries to apply and generate climate information and products relevant to their particular concerns. Since many countries lack policies, institutions or human resources to enable them to take advantage of new or existing climate data and products or to establish a national dialogue on these issues, the capacity development component can be seen as a foundation that links and supports the other four pillars.

Source: adapted from www.wmo.int/gfcs/

The GFCS is promoted and facilitated by the World Meteorological Organization (WMO) in cooperation with the GFCS Partner Advisory Committee. The World Bank has supported the conceptualisation and establishment of a National Framework for Climate Services (NFCS) in Armenia through the National Disaster Risk Management program financed by the Japan–World Bank Program for Mainstreaming Disaster Risk Management in Developing Countries. Modernizing Weather, Climate and Hydrological Services: A Road Map for Armenia prepared as part of this project[2] recommended the conceptualisation and development of an NFCS among important steps to modernise weather, climate and hydrological services in the country.

The NFCS work started in December 2019 with the support of Zoï Environment Network, a Switzerland-based international non-profit organisation specialising in environmental information, communication and capacity-building, and has been carried out in close cooperation with Armenia's Hydrometeorology and Monitoring Center under the Ministry of the Environment. A mission to Yerevan in January 2020 kicked off the NFCS conceptualisation with face-to-face meetings with key national and international players in hydrometeorology and climate information in Armenia, introduced the GFCS concept, approach and activities to be carried out, and discussed in a preliminary way the perspectives of various stakeholders concerning the provision, delivery and use of climate services in Armenia and ways to enhance them in the future.

Following the kick-off mission, Zoï proceeded along two tracks: putting together a baseline study of the current status of hydrometeorological and climate information and services in Armenia; and acquiring a user perspective through interviews with those who use these services for various purposes and to varying degrees at a selection of governmental, non-governmental, business and academic organisations. In-depth interviews with 23 individuals in 15 organisations (Annexes A and B) produced the first cut of views and opinions about how well climate services are known, how much they are used and appreciated, and what gaps exist. The results may offer opportunities to better meet the needs of users in the future with a targeted NFCS design.

According to the GFCS standard approach,[3] the next step would have been a national consultation workshop, with a broad range of national, local and regional authorities, NGOs, academia, research and business organisations in order to bring together the producers and users of climate information. Discussions with national and international experts on the status quo and the way forward for climate services in Armenia would then pave way to NFCS design. This plan was made impossible, however, by the unfolding covid-19 pandemic, and was eventually replaced by a series of online consultations.

The online consultations took place in June and July 2020 via the Webex platform of the World Bank, organisationally and substantially supported by the Hydrometeorology and Monitoring Center. In order to allow room for an exchange of opinion, the consultations (Annexes C and D) were organised by thematic clusters, initially with a limited number of participants planned for each cluster discussion. The Interest was so strong, however, that each session was in reality attended by 40 to 60 persons. On the one hand this made already challenging online discussions even more difficult, as both participants and facilitators struggled with the lack of time and insufficient interactivity of the online mode. On the other hand, such a strong interest ensured broad participation across the various sectors, thematic groups and types of organisations, and in the end added many valuable insights to the discussions and findings.

This report combines these insights with the initial baseline study and the results of in-depth interviews, paving the way for the further development of the NFCS concept and action plan that are to follow.

2 World Bank Group, 2018

3 WMO, 2018

# 2 Hydrometeorology and climate services in Armenia

## INSTITUTIONAL AND LEGAL FRAMEWORK

Meteorological observations in Armenia started in 1843 in Gyumri and in 1844 in Yerevan. The Yerevan station initiated agrometeorological observations in 1921, and the country established its first specialised agrometeorological station in 1938. A meteorological service established in 1925 was later reorganised into a committee and a department under the Republican government. In 1962, the hydro-meteorological network reached its maximum number of posts, including 82 meteorological stations and 46 meteorological and 163 hydrological observation posts.

In 1992 the Department of Hydrometeorology and Control of Natural Environment was renamed as the Hydrometeorological Department under the Government of the Republic of Armenia, and the same year Armenia joined the World Meteorological Organization.

The 2001 Law on Hydrometeorological Activities[4] set the legal basis for hydrological and meteorological activities in the country and defined the role and responsibilities of the State Hydrometeorological Service. In 2002,[5] the Armenian State Hydrometeorological and Monitoring Service was established as a state-owned non-profit organisation and became the main institution responsible for monitoring meteorological and hydrological parameters in the country. In early 2020, the Service[6] was integrated into the Hydrometeorology and Monitoring Center, a state-owned non-profit organisation under the Ministry of the Environment of Armenia.[7]

Funding for hydrometeorological activities of national significance is provided from a dedicated line in the state budget, annually approved by the Government. The HMC can also provide paid services to legal and natural persons on a contractual basis.

## OBSERVATION NETWORK OF THE HYDROMETEOROLOGY AND MONITORING CENTER

Armenia's state hydrometeorological network currently provides observations on air, surface waters, soil, crops, pastures, the ozone layer, and ultraviolet radiation; maintains actinometric and upper air stations. The HMS also manages data inventory and storage.[8]

Meteorological observations are conducted at 47 meteorological stations (Figure 2.1) every 3 hours, 8 times a day for 24 parameters in accordance with the standards defined by the WMO. In addition, 12 agrometeorological parameters are measured at 41 stations, 6 actinometric parameters at 6 stations, and 4 aerological parameters at 1 station. One station measures ozone, and 34 stations track background gamma radiation.

Observation data from five stations are sent to the WMO and are used as inputs to global and

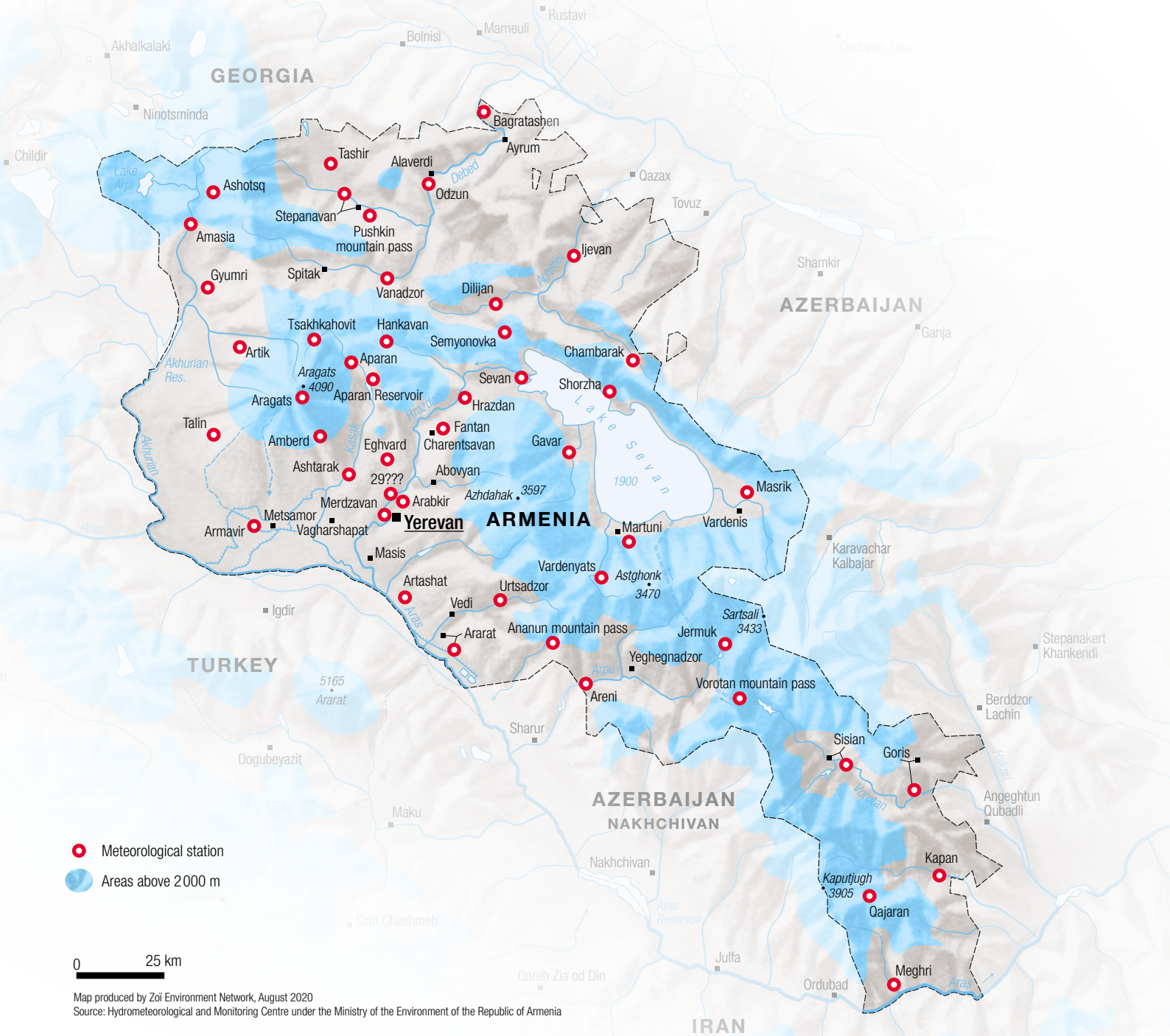
4 Law of the Republic of Armenia on Hydrometeorological Activities of 07.02.2001, amended on 23.03.2018 https://www.arlis.am/DocumentView.aspx?DocID=44182 (in English at http://www.cawater-info.net/library/eng/am_hyd_act.pdf)

5 Government Decree 1872-N of 28.11.2002 https://www.arlis.am/documentview.aspx?docid=10305

6 Besides hydrometeorology, the newly established HMC is also responsible for monitoring environmental quality and the state of forest resources.

7 Government Decree 81-N of 30.01.2020 https://www.arlis.am/DocumentView.aspx?docid=138543

8 This and the following sections present a snapshot of the HMC observation network and forecasting capacities. For more details see, e.g., World Bank, 2018.




Map produced by Zoï Environment Network, August 2020
Source: Hydrometeorological and Monitoring Centre under the Ministry of the Environment of the Republic of Armenia

## Figure 2.1
## National meteorological monitoring network

regional models. Four meteorological stations have been functioning over 100 years and have long time series. Ten observation stations are automatic. In 2020, the UNDP Disaster Risk Reduction Programme[9] will further modernise 23 weather stations in six regions: Ararat, Armavir, Aragatsotn, Vayots Dzor, Shirak and Lori. Data management software is currently being installed too.

The network includes six high-mountain and hard-to-access remote stations. One of the six, Aragats at 3,229 metres above sea level and established in 1929, is the only station in the Caucasus region located at such a high elevation with long time series of temperature and precipitation. In 2008, Aragats Station was included in the Global Climate Observing System (GCOS) Surface Network and since then, has been providing historical data and monthly updates to the network. The coverage of various elevation zones by the stations is not sufficient, however, as it does not include 2,500–3,000 m elevations, which comprise about 13 per cent of Armenia and where from the melt water from accumulated snow flows to reservoirs in spring.

Established in 1973, the Yerevan Upper Air Station is 1,134 metres above sea level, and is the only one of its kind operating in the Caucasus region. The station performs aerological, meteorological and radiation observations, and is part of GCOS Regional Basic Synoptic Network.

Ozone is monitored at the Amberd Meteorological Station, which is hard to access, and at the Yerevan Arabkir Meteorological Station. The observation results obtained from the Amberd Meteorological Station are processed and transmitted to the WMO World Ozone and Ultraviolet Radiation Centre.

Forty-one meteorological stations monitor agrometeorological conditions over meadows and pastures and the growth of 31 cultivated crops. They also provide agrometeorological parameters, including soil temperature, effective soil moisture, snow depth for fall cereals and soil freezing and melting status. Basic evapotranspiration measurements are made at five stations. The HMC conducts phenological observations covering the growth and development of crops, the dates of agricultural activities and the application of agro-technology.

Since the early 1990s, a lack of funding has resulted in instrumentation and technologies that are out of date and equipment in need of upgrades, and now the entire HMC network of meteorological observations is in urgent need of modernisation. Besides gradual automation, the network needs replacement of outdated anemometers and mercury thermometers at all stations.

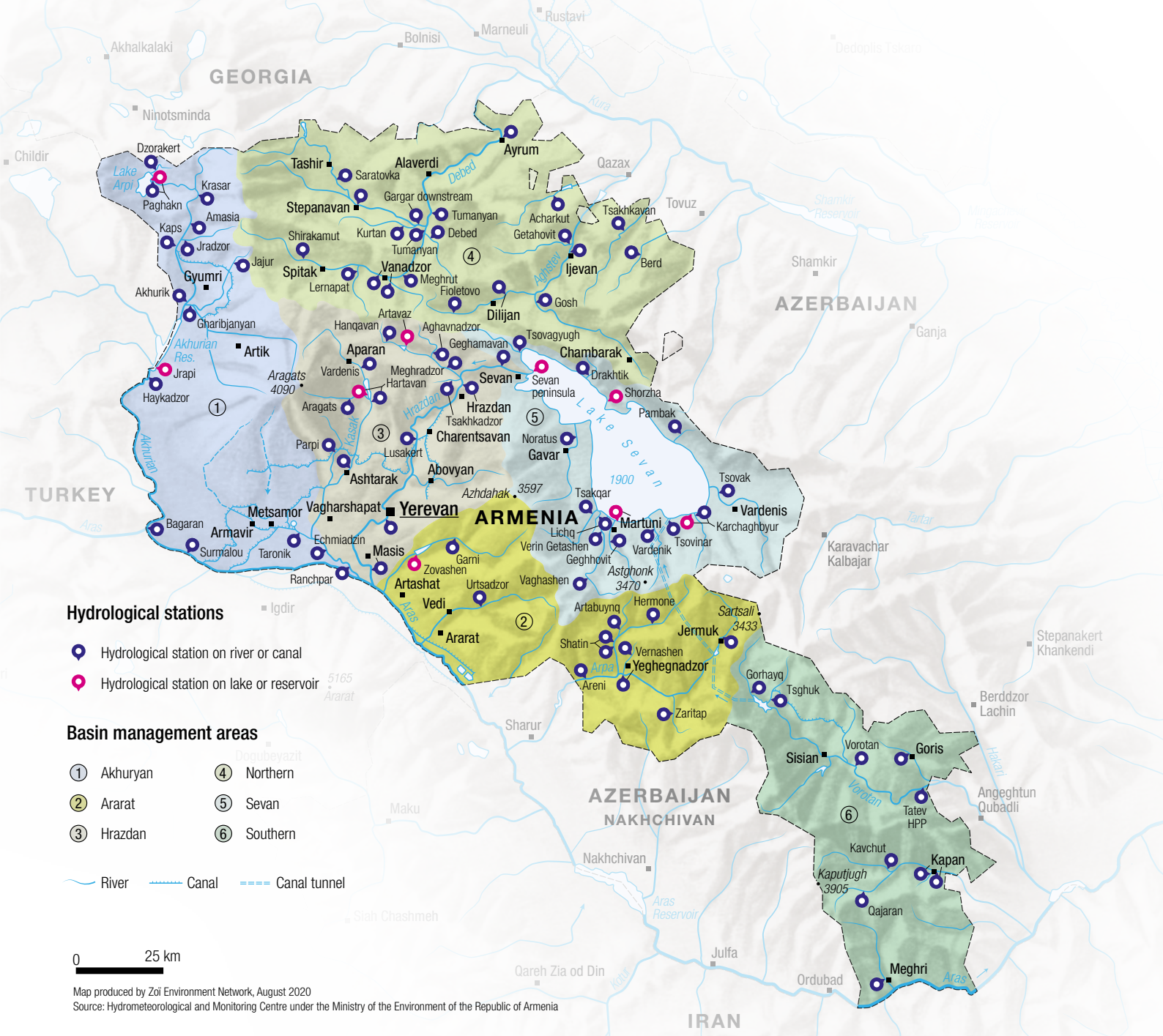
The international community, including UNDP and the EU, has recently provided considerable support for upgrading the network. Another potential source of help to upgrade the monitoring system (and climate services in the future) is the Green Climate Fund (GCF), although national priorities with respect to GCF are yet to be defined. The Environmental Project Implementation Unit under the Ministry of the Environment was accredited by GCF in 2019. In principle, this designation enables direct access to GCF resources for projects up to USD 10 million. There are about 11 other organisations (such as UNDP, the World Bank and GiZ) that have access to GCF and can receive funding to implement projects in Armenia.

Hydrological observations are performed at 93 gauging stations, including 84 on rivers, 5 on major reservoirs, and 4 on Lake Sevan (Figure 2.2). The monitoring network, however, does not cover all of Armenia's river basins. Hydrological stations measure water level (gauge or recorder), water temperature, ice phenomena and type, water evaporation (at 11 stations), and water flow (measured with flow velocity metres and floats).

About 60 posts report data daily, while others send only monthly summaries. Only 18 gauges are equipped with automated chart recorders for water level. Out of these, only three (Akuryan-Akhurik, Atarbekyan HPP Water Channel-Geghamavan, Arpa-Sevan-Tsovinar Tunnel) are in working order. All other chart recorders need to be repaired or replaced.

Two automatic hydrological posts are equipped for data transmission to the HMC via satellite, where access to data is provided at a password protected website. Two other automatic stations

9 According to the coordinator of the Disaster Risk Reduction Programme, UNDP Armenia.




## Figure 2.2
## National hydrological monitoring network

(at the Surmalu Araks River Station and the Ayrum Debet River Station) have transboundary importance and are capable of Global System for Mobile Communications data transmissions.

The EU Water Initiative Plus project provided support for rehabilitation and installation of modernised automated equipment at six hydrological observation posts in the Sevan Lake and Hrazdan River basins.[10] The project has also helped digitise all old data from hydrological observation posts, but there is no hydrological data management system for the digitised data, and the most common data storage is on Excel spreadsheets.

## FORECASTING PRODUCTS AND SERVICES

The HMC weather forecasts (Table 2.1) use actual observations at meteorological posts, the outputs of global and regional weather prediction models, radiosonde observations, and radar and satellite data.

Five-day weather forecasts are made publicly available on the websites of the Ministry of the Environment and the Ministry of Emergency Situations[11] and, to some extent, through social media.[12]

Long-term, including seasonal, forecasting still faces challenges in Armenia[13] as the application of regional downscaling techniques is limited due to the lack of skilled staff, the necessary software and high-performance computational hardware.

Agrometeorological forecasts, including crop yields, are made for important cash crops such as wheat, barley, apricots, grapes, onions, cabbage, tomatoes, potatoes and herbs. The HMC also conducts phenological forecasts such as the blossoming dates for grapes, apricots and peaches in the Ararat Valley and the fall wheat development stages. Data and forecasts in textual and visual form (graphics of ten-day forecasts, deviation from the norm, statistics) are disseminated through the websites of the Ministry of Environment and the Hydrometeorological Monitoring Center, email, SMS messages, radio and television. Information is also included in newsletters and yearbooks.

Hydrological forecasts are largely based on statistical methods rather than on detailed flow modelling, and come with relatively high uncertainty levels. The development of modern flow models requires much more detailed data – digitised hourly flows, measurements of snow water equivalent at different sites, and the breakdown of precipitation data into snow and rain. These inputs are especially important in forecasting floods and in planning the management of river basins.

Another factor limiting forecasting based on modern hydrological models are computer resources, including access of the HMC hydrology unit to modern geographic information technologies, tools for visualising data and satellite imagery. The technical level of the staff engaged in this section also needs to be enhanced.

10 Automated stations reduce errors to a minimum because data are transferred without human interference. The information is accessible at any time and the data are digitized and archived automatically, allowing for further use in various models, multi-year data analyses etc.

11 http://mes.am/hy/weather/

12 In addition to HMC presence in social media, its management regularly posts weather related updates on personal Facebook pages, some of which have more than 100,000 followers.

13 See e.g. World Bank Group, 2018.

## Table 2.1
## HMC forecasting products

| Type of Information | Users and demand |
|---|---|
| Emergency alerts | Government at large, Ministry of Emergency Situations, other sectors (road and transportation, agriculture) |
| Daily forecasts | General public through mass media and the Internet[14]<br>Ministry of Emergency Situations<br>Organisations with service contracts, strong sectoral demand for planning purposes (tourism, agriculture, public events etc.) |
| Short-term (up to 7 days) meteorological and hydrological forecasts | General public through mass media and the Internet (mobile applications)<br>Strong sectoral demand for planning purposes (tourism, agriculture, public events etc.) |
| Monthly meteorological forecasts | General public through mass media, specific sectors for planning purposes (e.g. agriculture, energy) |
| Seasonal meteorological forecasts | Organisations with service contracts, specific sectors (water management, agriculture) |
| Agrometeorological and phenological forecasts | Ministry of Economy, regional administrations, farmers, businesses |

All observation posts that carry out round-the-clock observations and have permanent means of communication transmit information about hazardous hydrometeorological phenomena such as frosts, drought, hailstorms, heavy rains and strong winds. Warnings about extreme weather are provided to the public through the website of the Ministry of Emergency Situations, email and mobile text messages, radio, television and press conferences.

## OTHER PROVIDERS OF CLIMATE INFORMATION AND SERVICES

The HMC is the key but not the only source of hydrometeorological and climate information in Armenia. Limited data are also collected and specific services are provided by a number of other governmental entities, private companies, non-governmental and other organisations (Table 2.2, Fig. 2.3).

The state-owned Electric Power System Operator under the Ministry of Territorial Administration and Infrastructure and the Jrar closed joint stock company operate hydrological observation posts. Those operating meteorological stations include the Ministry of Defence (which has its own meteorological department), the Armenian Nuclear Power Plant, the Armenia Renewable Resources and Energy Efficiency Fund (known as R2E2), private energy investors and engineering projects, several private tourist operators, institutes of the Academy of Sciences and the Center for Agribusiness and Rural Development. Information products and services of other providers outside of the HMC are as a rule focused on their respective sectors (water, energy, agriculture etc.) and users (farmers, energy or tourist operators etc.). The low level of integration between them and the HMC networks is a matter for future discussions.

14 A wide range of sources outside of Armenia also provides weather information online and through mobile phone applications.

## Table 2.2
## Hydrometeorological data and information products in Armenia

| | Information products | | | | Key users | | |
|---|---|---|---|---|---|---|---|
| | Obser-vations | Hydro-meteo | Climate | Sector-specific | General/ national | Regional/ local | Sectoral |
| **AUTHORITIES**[a] | | | | | | | |
| Hydrometeorology and Monitoring Center | ● | ● | ● | ● | ● | ● | ● |
| Water Committee under the Ministry of Territorial Administration and Infrastructure | | ● | | ● | ● | ● | ● |
| Jrar[b] | ● | ● | | ● | | | ● |
| Electric Power System Operator[b] | ● | | | | | ● | ● |
| Armenian Nuclear Power Plant | ● | | | | | ● | ● |
| Renewable Resources and Energy Efficiency Fund | ● | ● | | ● | | | ● |
| Research Institute of Spa Treatment and Physical Medicine under the Ministry of Health | | | | ● | ● | ● | ● |
| Ministry of Emergency Situations | | ● | ● | | | ● | |
| Ministry of Defence | ● | | | | | | ● |
| Zvartnots Aero-Meteorological Centre | ● | ● | | ● | | | ● |
| **RESEARCH AND DEVELOPMENT** | | | | | | | |
| A. Alikhanyan National Science Laboratory (Yerevan Physics Institute)[c] | ● | ● | | ● | ● | ● | ● |
| UNDP Climate Change Programme | | | ● | | ● | | |
| **BUSINESS** | | | | | | | |
| Geocom[d] | | ● | | ● | ● | ● | ● |
| Centre for Agribusiness and Rural Development[c] | ● | ● | | ● | | ● | ● |
| Solar / wind energy investors / projects | ● | ● | | ● | | | ● |
| Tourism / sports companies | ● | | | | | ● | ● |

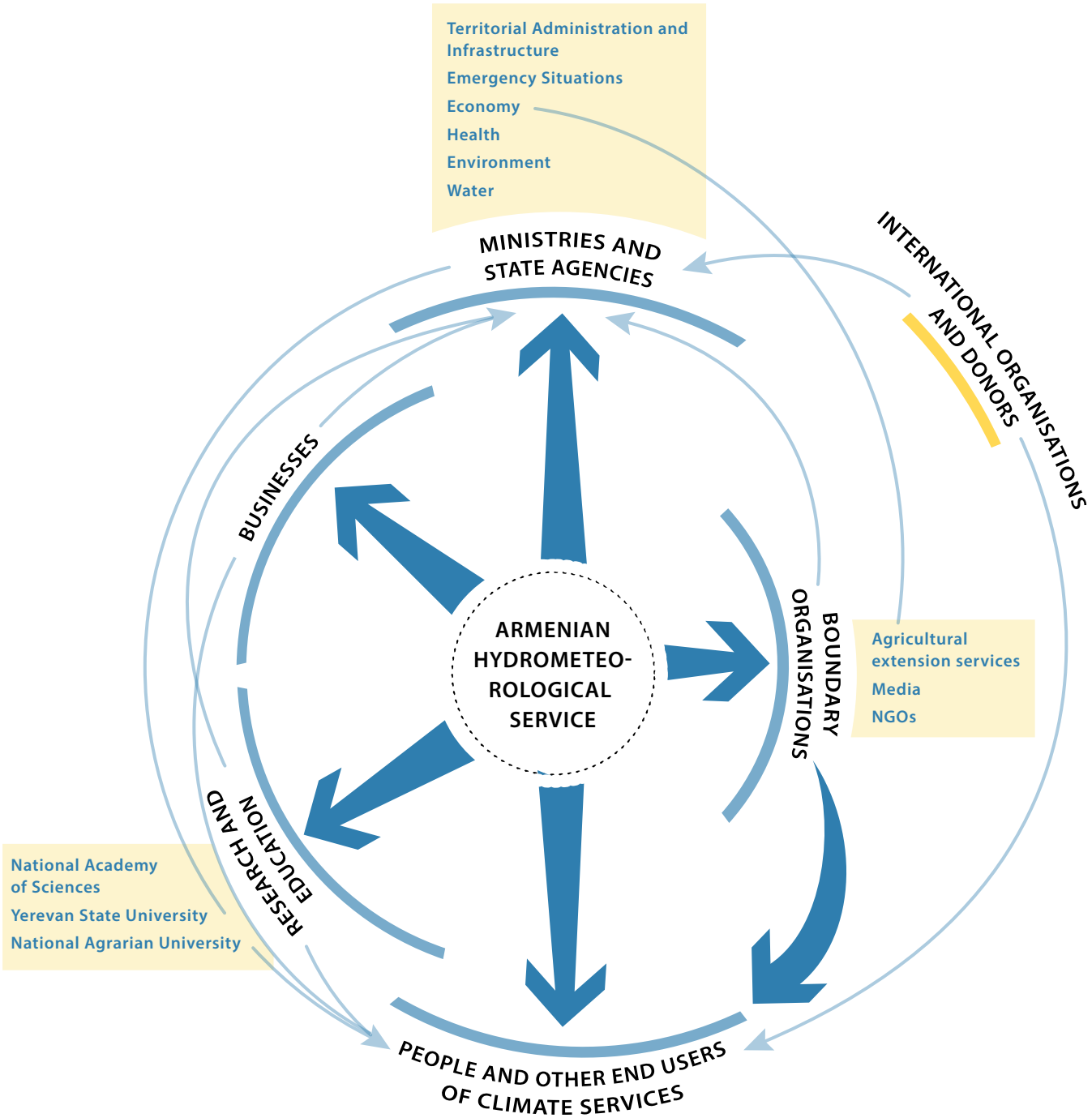
a Including entities acting on behalf of state authorities
b Closed joint stock company
c Foundation
d Limited liability company

Note: the table is based on discussions and consultations held in the course of the NFCS study as well as on other available sources. The list of information products and their producers is not exhaustive.

15 http://aamc.am/en_functions.htm

Zvartnots Aero-Meteorological Centre, a state-owned company under the Ministry of the Environment, provides meteorological information to civil aviation customers according to the requirements of the International Civil Aviation Organization.[15] Observations of wind, visibility, air temperature, relative humidity, atmospheric pressure and cloudiness are collected and processed with modern tools. Spatial location of clouds is observed with meteorological radar MPL-5. Observations on weather at Yerevan Zvartnots airport are sent by telegram to international banks of meteorological information, and data and forecasts from other airports worldwide are received in a similar way. The entire array of data produced by the Centre is archived for further climatological use.

## Figure 2.3
## Institutional landscape of climate services in Armenia



# 3 Needs, gaps and user perspectives

This chapter combines findings from the baseline analysis with stakeholder interviews conducted in February and March 2020 and with online thematic cluster consultations held in June and July 2020. It is organised by key GFCS sectors, and includes a box that displays the user-identified gaps and opportunities in climate services for each sector.

## WATER RESOURCES MANAGEMENT

The HMC has a key role in providing essential hydrometeorological data for the management and protection of water resources. The participants in interviews and online consultations all stressed that water-related services are highly valuable, and that the maintenance and improvement of the services are critical for a variety of users.

The HMC sends the Water Committee in the Ministry of Territorial Administration and Infrastructure free of charge five-day weather forecasts, air temperature for all cities, precipitation, snow depth, solar radiation data, the UV index, the state of the geomagnetic field, solar activity, and average river flow for the previous day in 47 Armenian rivers, as well as the volume of water in Akhuryan, Arpi Lake, Aparan, Azat, and Marmarik water reservoirs. Once a year the HMC provides information about the spring floods and reports on water levels in the main water reservoirs in March and April with updates in July. Drought monitoring is essential as an officially declared drought enables the Government to apply to the National Assembly for additional irrigation withdrawals from Lake Sevan.[16] The

**Box 3.1**
**User-identified gaps and opportunities in climate services for water management**

**OBSERVATIONS AND DATA**

- obsolete and out of date water monitoring infrastructure
- insufficient number of monitoring posts and gauging stations
- insufficient availability and use of remote-sensing data and field research
- limited data about snow cover
- lack of data comparability and exchange among observation networks
- insufficient availability and exchange of data for water balance calculations

**RESEARCH, MODELLING, FORECASTING**

- insufficient capacities for hydrological modelling and forecasting

**USER INTERFACE AND COMMUNICATION**

- difficult to find and access existing data; end users often not reached
- users at all levels unaware of existing data and access modalities
- users in the water sector not sufficiently aware of climate trends and impacts; respective data not easily available

16 Above 170 million cubic metres, according to 06.12.2019 amendment of the Law on Approving Annual and Complex Programs of Measures for Restoration, Protection, Reproduction, and Use of the Lake Sevan Ecosystem.

Water Committee noted the need for regularly calculated evaporation from water reservoirs and Lake Sevan, since the current approach treats evaporated water as withdrawals for irrigation. The current HMC data and modelling capacities are insufficient to provide long-term river flow forecasting, and modernisation of the HMC hydrological monitoring network is needed.

Jrar is the main bulk water withdrawal company transferring irrigation water to the water user associations that deliver irrigation water to farmers. It operates 14 reservoirs, and its field staff collects data on the volume and withdrawals of water. This information is not made accessible to the public, but is shared with the Water Committee and the Ministry of Territorial Administration and Infrastructure, but the company is willing to share data on request. Measurements at certain particularly important sites are done jointly with the HMC staff.[17] Jrar needs to upgrade its two posts on the Hrazdan River, and its post on the Araks river which is equipped for online data transfer. Disagreements about water measurements with the International Energy Corporation, owners of the Sevan-Hrazdan hydropower cascade, result from different measurement methodologies. Jrar has an agreement with the HMC for the provision of specific daily data (such as Lake Sevan water level and river flow data at specific gauging stations) on a paid basis.

The water user associations that allocate irrigation water to farmers in their respective regions need long-term forecasts of air temperature and precipitation. The water user association representative interviewed for this study was not aware that such information could be requested from the HMC, but expressed the willingness to pay for accurate information that would inform irrigation water allocation and management decisions.

The Water Resources Management Agency (WRMA) under the Ministry of the Environment maintains the State Water Cadastre information system. It receives data from the HMC through electronic mail every day at 12.00.[18] Further clarifications are made as needed, through email or over the phone. The Water Committee of the Ministry of Territorial Administration and Infrastructure is supposed to provide the State Water Cadastre with weekly data about water volume in major reservoirs, water flow in main canals and water losses from hydro-technical installations, and the State Committee of Real Estate Cadastre has similar obligations for forest and agricultural land use data, but their failures to provide the required data means that the State Water Cadastre remains incomplete. Similarly, the WRMA lacks sufficient information on the quantity and quality of groundwater and on the transboundary Araks River. In addition, the Inspectorate for Nature Protection and Mineral Resources provides no data for Ketchut Reservoir or for reservoirs used for energy production. According to the WRMA, connecting the SWC database to the databases of the Water Committee and the HMC, and granting access to the data of energy producers and the State Land Cadastre would improve the information base.[19] The agency also needs daily data on Lake Sevan water temperature at various depths, and on water transparency and quality.

GEOCOM, a private consulting company, produces geospatial datasets open to the public.[20] These data are mainly used by governmental organisations, including local governments, international organisations, other scientific research organisations and private companies. The EU Water Initiative Plus project contracted with GEOCOM and JINJ, another consulting company, to develop Sevan and Hrazdan River Basin Management Plans. These companies needed hydrological and meteorological data, and the HMC were partially satisfied the needs, but the companies believed that data availability and access modalities could be improved.

17 E.g. at the transboundary gauging station Surmalou-Araks, which is mainly for monitoring water in Akhuryan Reservoir used jointly by Armenia and Turkey on equal terms, in accordance with the interstate agreements. Due to modification of the riverbed, however, the automatic gauging station that was constructed with support from the World bank, is currently not operational.

18 A governmental decision defines which state agencies should provide the WRMA what information and in what format.

19 Indeed, in the framework of the Open Government Partnership initiative, there are already plans to update the State Water Cadaster (with the database server located at the Water Resources Management Agency of the Ministry of Environment) and to establish contacts between this database and databases of other interested organizations. Once completed, with some limitations, data will be available to the public: cf. Government Decree 1307-L of 15.11.2018 https://www.arlis.am/DocumentView.aspx?docid=126677 (in English at https://ogp.am/u_files/file/OGP_2018_2020_eng.pdf).

20 http://vgse.geology.am/

An area in urgent need of modernisation is the monitoring of snow cover, where remote-sensing data are required to assess snow depth, snow-melt and water equivalent in snowpack within river basins. Users also noted the overall lack of the use of remote sensing and drone-borne observations, as well as the unfortunate halt to research expeditions to collect particular types of field data.

Finally, there is a lack of consideration of long-term climate trends in water management, including in the allocation of water use permits and irrigation norms for various crops, the construction and operation of water reservoirs, and health-related impacts. Isolated local communities and water user associations do not have easy access to long-term time series for water-related climate data.

## DISASTER RISK REDUCTION

Armenia is prone to extreme weather and weather-related phenomena – severe hailstorms[21] with hail size exceeding 2 centimetres; heavy rains of 30 millimetres or more per hour; snowfall of over 20 millimetres over 12 hours; winds at speeds of over 25 metres per second; persistent fogs with horizontal visibility of less than 50 metres; heatwaves and cold spells with temperatures over +40°C in summer and -25°C in winter; frosts in early fall and late spring; droughts; wildfires; floods; and mudflows. The experience of the past ten years shows that many of these events are affected by climate change.

The Rescue Service of the Ministry of Emergency Situations and its National Crisis Management Centre are responsible for disaster prevention and response with respect to both acute risks and slow onset hazards such as droughts. The Ministry thus needs and receives real-time information for early warning on severe weather events, as well as historical information for longer-term planning and budgeting purposes.

Cooperation between the HMC and the Rescue Service is well established. The HMC data are of paramount importance for managing disaster risks, and while emergency responders value the HMC early warning services, they note that improvements need to be made to the HMC hazard monitoring and modelling infrastructure, including the introduction of very short-term forecasts and further improvements in the early warning system.

Other areas for improvement include flood risk forecasting, especially at sites without gauges, and modern flood-hazard mapping for return periods of flood events. Ensuring dam safety requires adequate monitoring of water reservoirs, particularly in light of the impacts of climate change.

The capacity of users – including the staff of Ministry of Emergency Situations – to access and use disaster-relevant information needs to be developed, and the potential level of damage to communities suggests that the lack of public access to historical information is a problem. In addition, improved web communications of hazard information and a mobile application for sharing hazard-related data and information would be welcome.

### Box 3.2
### User-identified gaps and opportunities in climate services for disaster risk reduction

**OBSERVATIONS AND DATA**

- partially out of date monitoring infrastructure
- lack of adequate monitoring of water reservoirs

**RESEARCH, MODELLING, FORECASTING**

- insufficient capacities for hazard modelling
- need for very short-term hazard forecasts
- lack of flood risk forecasting especially at sites without gauges
- lack of flood-hazard mapping for return periods

**USER INTERFACE AND COMMUNICATION**

- need for public access to historical records of damage, especially at the community level
- need to further improve the early warning system
- need to improve web communication of hazard information online and through mobile applications
- lack of users' capacity to use hazard-related data

21 A recent example is the hour-long hailstorm that hit Armenia's second-largest city Gyumri in July 2020.

## AGRICULTURE AND FOOD SECURITY

Agriculture is an important economic sector in Armenian, employing about 40 per cent of the country's workforce and contributing about 20 per cent to GDP. Irrigated land accounts for more than 80 per cent of crop production. The support of a modernised hydrometeorological service for agriculture is essential for food security, which is a growing concern considering climate change impacts, water shortages, the newest global challenge of COVID19 and population growth.

A 2014 study by the World Bank[22] noted that "farmers currently use [hydrometeorological] forecasts made available through the television, but these are aimed at too broad a geographic area and do not provide information specific for agriculture (for example, information that would allow them to know when to apply pesticides, when to irrigate, or when to plant). Today, [following historical habits] many farmers still plant when the snow is at a certain level on Mount Ararat… Farmers noted the need for better local capabilities for hydrometeorological data, particularly for short-term temperature and precipitation forecasts. Those capabilities are acutely needed in the short term to support better farm-level decision-making."

Similarly, a 2018 study[23] established that "The Ministry of Agriculture needs more localised and finer resolution information. Lead times longer than the current five days would permit better response to high-impact weather and more reliable seasonal forecasts." Furthermore, "it is unclear how well the information packages are distributed to the farmers and how well the farmers understand the information's value. The HMC sends the information packages to the regions where they are personally distributed to farmers in remote areas. This dissemination methodology is outdated; weather information during the blossoming season in early spring and for late autumn frosts is critical. A more modern means, such as SMS messaging, is needed as is education outreach and training for farmers."

The Ministry of Economy's Department of Agricultural Programs Elaboration, Resource Use and Cooperation Development receives weekly and monthly HMC data, and while the accuracy of short-term weather forecasts is satisfactory, they are still not available for specific areas. Multi-year averaged monthly data are hard to obtain. Soil temperature – an important indicator in agricultural programming – is not available and the Ministry is unaware of where to find it. The establishment of intensive orchards requires climate information for specific areas under consideration. Similarly, producers need systematic and localised information about the intensity of solar radiation to help assess the efficiency of greenhouses.

Due to climate change, hailstorms that previously occurred only in May, June and July now also occur in August and September, damaging crops near harvest time. Therefore, seasonal climate information is increasingly required to cover different stages of crop growth. The Ministry broadcasts frost and hail information on television, websites,[24] and through Vivacell MTS mobile service. The www.minagro.am site, however, has not been updated since July 2019, after its former owner the Ministry of Agriculture was dissolved and its departments were merged into the Ministry of Economy. The Strategy of the Main Directions Ensuring Economic Development in Agricultural Sector of the Republic of Armenia for 2020-2030[25] defines the main priorities of the country's agricultural policy including risk management measures such as hail protection systems and access to high quality agricultural insurance. The strategy increases the focus on climate change awareness, and on adaptation and mitigation strategies such as improved monitoring of climate change relevant to the agriculture sector and climate smart agricultural practices.

The Central Bank of Armenia established the Agricultural Insurance National Agency in 2019 to administer an agricultural insurance programme, currently on a pilot basis. Prior to that, a needs assessment was conducted with UNDP support in 2014, and a EUR 5.3 million grant agreement, with AMD 885 million co-financing from the 2018 state budget, was signed between Armenia and KfW bank in 2017

22 Ahouissoussi et al., 2014

23 World Bank Group, 2018

24 www.minagro.am and www.mineconomy.am

25 https://mineconomy.am/media/10030/Razmavarutyun.pdf (English summary at https://mineconomy.am/media/10033/Razmavarutyun_Hamarotagir_Angleren.pdf)

to support agricultural insurance. The pilot introduction of agricultural insurance started in the fall of 2019 covering apricots, grapes, peaches, apples, wheat and barley in selected marzes. Deadlines for purchasing insurance for spring frosts and hail and fire have been set, and KfW and the Government are each paying 50 per cent.

The insurance will not cover the loss of crops, but only the costs of initial investment by the farmers. So far, a lack of awareness has led to a relatively small number of insurance policy purchases. The Agency has a website[27] with a basic user interface. Only three out of six private insurance companies agreed to participate in the programme, but are not interested in advertising and selling policies because the data are insufficient to calculate the risks. The project requested HMC information going back to 1965 in order to identify risk areas for frost and hailstorms.

The Armenian Agricultural Alliance has 17 member organisations and two associated members. The Alliance uses HMC information about air temperature and precipitation provided through mass media. Multi-year time series are available only on a paid basis, thus making long-term studies very expensive. Data provided by the HMC are not sufficient for agricultural insurance, as there is no statistical history on damages. The organisation believes that on the local level (in marzes) the trends of climate change are still poorly understood. Considering that agriculture is highly vulnerable to climate change and 80 per cent of the land in Armenia is arid, there is a need to assess climate change impacts on arid lands.

The organisation witnessed the operation of private hydrometeorological stations, two of which have been installed by the Millennium Challenge Corporation Armenia at two water user associations, but the stations stopped operating after the completion of the project when payment for maintenance stopped. Other limitations for turning hydrometeorological services into businesses are the low level of education of farmers, the seasonality of service demand (2 months), and the fact that for small farmers agriculture is considered more a means for living than a business. As large industrialised farms start emerging, they might need improved hydrometeorological information for planning and optimising production.

Grape and wine producers are concerned about climate change impacts on vineyards, which continuously forces their production upwards towards higher-mountain areas. Localised information is required to plan activities in this climate-sensitive industry, and meteorological stations are needed especially at altitudes above 2,000 metres. In addition, relatively high installation and operation costs may require long-term public-private partnership solutions.[28]

The Center for Agribusiness and Rural Development (CARD) is an Armenian foundation, the successor to USDA's Farm Extension Project (1993–1996) and the Marketing Assistance Project (1996–2005). CARD is currently operating on a broad financial basis as a one-stop shop for various agricultural services, with franchise-based farm service centres all over the country. Since 2015, CARD has operated three German-made weather stations, with data processed in Germany and fed back to agronomists who issue advice based on the analysis. CARD is currently implementing a five-year USAID-funded project "Armenia Rural Economic Development – New Economic Opportunities" to promote inclusive, sustainable economic security and growth by supporting at least 100 businesses in at least 60 communities. One of the objectives is to further develop local weather station services for farmers through the Armenian National Agrarian University, where a soil and irrigation centre is to be established. Plans include exploring visualisation and presentation tools for agrometeorological data and forecasts. CARD is also part of the UNDP National Adaptation Plan project.

27 www.aina.am

28 As a result of NFCS online cluster consultation on 30 June 2020, the HMC has suggested that one of the new automated stations provided to Armenia be located at a high-elevation vineyard and operated by vineyard staff. The data will be shared with the HMC.

## Box 3.3
## User-identified gaps and opportunities in climate services for agriculture

**OBSERVATIONS AND DATA**

- out-of-date monitoring infrastructure, lack of proper calibration of equipment
- sparse observation network above 2,000 metres altitude (vineyards)
- resource constraints for expanding automated monitoring (may need public-private partnership solutions)

**RESEARCH, MODELLING, FORECASTING**

- no localised long-term and seasonal forecasts
- absence of full-scale drought monitoring and forecasting system
- no short-term hazard forecasts

**USER INTERFACE AND COMMUNICATION**

- lack of easy access to real-time data, historical trends, seasonal averages at specific locations, per crop type, per agricultural practice
- lack of historical data on damage to crops (for insurance purposes)
- lack of user knowledge about, and limited capacity to use, available data
- room for intensified dialogue between the HMC and agriculturalists
- lack of awareness about actual and future climate impacts on agriculture

Needs for improved forecasting of hazardous agrometeorological phenomena, including short-term forecasts, and an enhanced early warning system for improved agrometeorological services were also noted.

Finally, agricultural users call for the modernisation of the entire cycle of agrometeorological monitoring, data processing and transmission, and expect that localised and area-, crop- and practice-specific data (both current and long-term statistics) and forecasts become increasingly available and easily accessible through such user-friendly channels as a renovated HMC website, messengers and mobile phone applications. Increased interaction and dialogue between agricultural producers and the HMC are to be encouraged.[29]

29 During the 30 June 2020 consultation, the HMC suggested setting up a dedicated task force for this purpose.

## ENERGY

Among many areas, the energy sector is under the responsibility of the Ministry of Territorial Administration and Infrastructure. Climate data help determine the placement of new facilities, and weather forecasts help power station managers predict demand for electricity, assess options when the grid is overloaded and determine appropriate times for maintenance. Detailed forecasts of temperature, precipitation, wind and rime ice are important for the proper management of electric transmission lines. Longer-term weather forecasts help plan the start and end of the heating season and the amount of fuel needed, while forecasts of air temperature are important for the proper distribution of pressure in natural gas pipelines. The development of new hydropower facilities is based on multi-year hydrological monitoring data, and operators and managers need current water consumption data as well as weekly to seasonal forecasts of available water resources.

Organisations active in the energy sector have long-standing relationships with the HMC.[30] As an example, the natural gas utility company, Gazprom Armenia, has a contract with HMC for the provision of three daily readings (morning, afternoon and night) of barometric pressure and air temperature, and for monthly averages of the three daily values. These data are needed for calculating gas leakage and for the development of gas-heating projects. Winter forecasts may be requested, but are often inaccurate. The HMC time series for specified locations sometimes include data of insufficient accuracy and some locations have outdated equipment. In some areas of high importance, the absence of stations hinders calculation of gas leakage. The company would be interested in buying improved services (more accurate and cheaper) from licensed providers.

Alternative energy attracts a growing number of research, business and civil society organisations. Information from hydrometeorological services is important for the development of solar and wind power, as wind speed and solar radiation help determine the potential for power generation.

In 1989–1990, the scientific association ECOTECH developed the first Wind Power Atlas of Armenia[31] by analysing synoptic data from 37 hydrometeorological stations. According to the results, theoretical wind-power potential in two zones of Armenia was estimated at 2,426–4,418 MW. Today, research organisations receive data from HMC as well as from international organisations and online platforms.[32] The data are being processed for various research purposes and to derive new datasets. Scientific institutions belonging to the National Academy of Science, such as the Institute of Geology and the Centre for Ecological-Noosphere Studies, are also sources of relevant information.

From 2002 through 2003, the United States Department of Energy (DOE) sponsored a project to help accelerate the use of wind energy in Armenia through the development of a wind energy resource atlas.[33] The DOE National Renewable Energy Laboratory led the project in collaboration with SolarEn, an international corporation, and its Armenian subsidiary SolarEn LLC. The goals of the project were to develop detailed wind resource maps for all regions of Armenia; to produce a comprehensive wind resource atlas documenting the results; and to establish a wind-monitoring programme to identify prospective sites for wind energy projects and help validate some of the wind resource estimates.

The Armenia Renewable Resources and Energy Efficiency Fund (R2E2) was established in 2005[34] as an autonomous non-trade, non-profit organisation to promote energy efficiency and renewable energy, foster market development and attract investments in the sector. R2E2 based its initial maps for different components of solar radiation on satellite data and historical data from seven solar-energy measuring stations belonging to the HMC. To enhance the precision, R2E2 installed four ground-based meteorological stations on the proposed

30 Some also operate their own weather and hydrological observation stations (see Table 2.2).

31 https://r2e2.am/wp-content/uploads/2017/06/Windpower_in_Armenia.pdf

32 E.g. CHRS https://chrsdata.eng.uci.edu/, Copernicus https://climate.copernicus.eu/, NOAA https://www.noaa.gov/, NASA etc.

33 https://www.nrel.gov/docs/fy03osti/33544.pdf

34 Government Decree 799-N of 28th of April 2015 https://www.arlis.am/DocumentView.aspx?docid=28817

locations of the solar power plants. The stations are equipped with the highest possible precision, second-class standard solar radiation measuring equipment with the accuracy of 1 W/m2. The stations measure solar radiation and hydrometeorological and other useful parameters such as aerosol optical depth and photovoltaic module surface temperature. From 2016 through 2017, the Fund together with the World Bank assessed Armenia's solar power potential, and produced a Solar Atlas[35] that has highly accurate maps and shows sites suitable for solar power plants.

## Box 3.4
## User-identified gaps and opportunities in climate services for energy

**OBSERVATIONS AND DATA**

- out-of-date monitoring infrastructure
- lack of observations of solar radiation
- lack of observation in specific locations (e.g. to support operation of gas pipelines)
- comparability issues with hydrological observations

**RESEARCH, MODELLING, FORECASTING**

- insufficient quality of winter forecasts

**USER INTERFACE AND COMMUNICATION**

- paid access to some data for energy research

Ecoteam, a smaller alternative energy NGO, deals with solar energy and needs HMC data in projects on installation of solar panels. The available data are, however, insufficient since the HMC has only two automated stations measuring direct and scattered radiation. In addition, the data are provided on a paid basis. Thus the organisation mainly uses data from the US Department of Energy National Renewable Energy Laboratory or maps prepared by R2E2. According to Ecoteam, some of the organisations active in this field install their own meteorological stations to get the data before implementing solar energy projects.

Another NGO, Women in Climate and Energy, conducts awareness-raising projects on climate, energy and environmental issues through social media platforms, surveys and studies on climate change and human perceptions. The organisation collects information from local and international sources and from media platforms, and collaborates with organisations dealing with hydrometeorological or climate information – the HMC, ministries, local authorities, American University, civil society and international organisations.

35 Maps from the Atlas are accessible at https://r2e2.am/en/2017/06/26/solar-maps/.

## HEALTH AND RECREATION

Armenia's historically strong health care community depends on HMC information for both epidemiological research and prevention of diseases. The National Center for Disease Control and Prevention (NCDC) under the Ministry of Health needs information on temperature, humidity and wind strength and direction for modelling the spread of diseases. The NCDC runs information campaigns on hot and cold days on TV, other media and on the Center's website[36] and Facebook page. The HMC provides information upon request free of charge and without delay. The reliability and accuracy of HMC information has improved. At the same time, according to NCDC, the HMC website can be improved in terms of content, user interface for both local and international users, and useful links, and the HMC Facebook page can be an additional, more popular and timely, means of disseminating information. Climate change increases the NCDC workload as new diseases are activated, new pathogens emerge and some dormant diseases return, while outbreaks of seasonal zoonotic and vector-borne diseases have become unpredictable.

Other users note that there may still be gaps between weather and climate information available from the HMC (e.g. heatwave warnings) and actionable information required by health authorities (e.g. the expected mortality and risk groups). Such information needs to be communicated proactively, and there is room for stronger cooperation with the health community to add value to HMC data and forecasts.

The trophic status of Lake Sevan is a particular case where climate data are relevant to public health. Eutrophication is likely to intensify with climate change, and toxic algae blooms increase risks to fish and to the sanitary safety of lake-dependent water supplies.

Armenia is widely known for its recreational resources and medicine. Jointly with the HMC, the Research Institute of Spa Treatment and Physical Medicine has developed a national Atlas of Climate and Natural Medicinal and Recreational Resources of Armenia,[37] a unique guide for regional development, opening opportunities for ecotourism and health tourism. Climate plays an important role in Armenian tourism and recreation.[38]

As in any mountainous country, the day-to-day and spatial variability of Armenian weather is high, and more short-term and localised information would be useful to tourists and hikers. Armenia has suitable landscapes for skiing, but tour operators often have difficulty obtaining a snow-cover forecast for the coming week or ten-day period (not least because some are not aware of where they can obtain such information). Locally oriented automated stations could provide data to tour operators and tourists in particular areas and could also support the promotion of sport and recreational ski tourism. Indeed some tourist operators are already installing their own weather stations, but their number is still small and the results are not available to outside users.

While short-term weather forecasts are important for tourism managers, long-term climate projections are required for planning and developing tourist and recreational infrastructure such as ski resorts, as the State Tourism Committee noted. Further strengthening the cooperation between the HMC and other entities such as the Academy of Sciences and the World Tourism Organization may address the needs of the tourism industry.

36 https://ncdc.am/

37 http://fizecomed.com/hy/page.php?id=38 and http://fizecomed.com/ru/page.php?id=38

38 For example, the city of Dilijan is considered a health resort that has natural healing resources, peat, mud, clay, mineral water, as well as a climate that has significant positive effects on people suffering from various diseases. The 13 July 2020 online cluster consultation included a suggestion that regional 'bio-passports' be created for each resort area, listing its medical resources and climate. Such Information could then be used to market opportunities for international and domestic tourism.

## Box 3.5
## User-identified gaps and opportunities in climate services for health and recreation

**OBSERVATIONS AND DATA**

- lack of short-term and highly localised information to support tourism
- insufficient number of private weather stations and lack of data exchange

**RESEARCH, MODELLING, FORECASTING**

- room for cooperation with health and tourism experts and organisations to add thematic value to HMC data and forecasts
- lack of access to short-term snow forecasts (or lack of information on how to access the forecasts)
- lack of clarity about future Sevan eutrophication and its health and water supply impacts

**USER INTERFACE AND COMMUNICATION**

- insufficiently effective and user-friendly website of the HMC
- lack of other means of disseminating health-related warnings
- room for marketing regional climate resources to promote recreational tourism
- need for long-term projections to support the planning of tourism infrastructure

## OTHER SECTORS AND PERSPECTIVES

Many users of hydrometeorological and climate information and services fall outside of the five key GFCS sectors described in the previous sections. They have had opportunities to share their perspectives both through face-to-face interviews and during the online consultation on 13 July 2020.

The HMC routinely provides monthly and annual hydrometeorological data to the Statistical Committee, which can request additional data against payment. The Committee's website has a link to the publicly accessible ArmStatBank, which has a section with UNECE environmental indicators[39] including atmospheric air pollution, climate change and water resources. The Statistical Committee does not, however, get sufficient data about renewable water resources. Similarly, there are no reliable data about evaporation and water reservoirs.[40] Water data at the levels of marzes and basin management units are needed for producing quality-of-life indicators. The Committee is willing to make information more attractive by adding new data to its system, and emphasised the need for work with journalists.

Climate information is important for urban development. Climate considerations have been integrated into the standards and regulations for construction, last updated in 2013, and updating the regulations based on more recent data and climate trends will require HMC inputs.

Climate change research is becoming popular in Armenia. The HMC implements downscaling of global climate models and develops climate projections for the country, and various organisations and projects use these data in their own studies assessing the impact of climate change, but there is room for enhancing collaboration and cooperation and for improving services in this area.[41] The HMC also performs analyses based on WMO climatic indices from the data from 47 meteorological stations. This work includes climate change assessments and forecasting, consideration of the vulnerability of agricultural crops to climate change, and satellite monitoring of crop growth and development. Drought conditions are regularly monitored and assessed, although a full-scale drought monitoring and forecasting system is not yet established.

The UNDP Climate Change Programme commissions long-term climate projections, contracted to external experts through project-based funding. These projections are used in Armenia's National Communications to the United Nations Framework Convention on Climate Change, and in strategic documents related to adaptation, in other policy documents, and for project development in specific sectors.

Yerevan State University trains hydrologists and meteorologists at the Department of Geography and Geology. The faculty and students use all kinds of hydrometeorological information, especially for masters' theses. The data are also used for the implementation of research projects, which are of scientific value to the HMC. Climate information is mainly obtained from the HMC through written requests by the university, and in some cases from the Internet. Data are received with delays, and are often incomplete and prone to technical errors. The information quality could be improved by increasing the requirements, professional quality, and salaries of the HMC.

Considering the strategic and socioeconomic importance of Lake Sevan for Armenia, there is a need to develop up-to-date models for the lake ecosystem for proper management and restoration of its ecological balance under climate change. The NFCS should target improvements in the hydrometeorological information base for modelling and assessment of the lake's ecosystem, including more straightforward access to data. The Institute of Hydroecology and Ichthyology of the National Academy of Sciences, which conducts research on Lake Sevan and other aquatic ecosystems, notes that having open online access data would be

39 UNECE has developed a set of environmental indicators (https://www.unece.org/env/indicators.html) through its Working Group on Environmental Monitoring and Assessment and the Joint Task Force on Environmental Statistics and Indicators.

40 This makes it difficult to calculate the water stress indicator for Armenia, which is the ratio of total withdrawal to total renewable supply.

41 As a concrete example, researchers encountered difficulties trying to obtain multi-year climate data for forestry research and planning (in order to identify suitable locations for specific tree species depending on the climate change trends of the past 50 years).

a welcome alternative to providing time-consuming written requests. For some of the required data the issue is availability rather than accessibility: real-time data collection and information on evaporation and groundwater flows in Lake Sevan area are lacking. Some of the gaps could be filled through a joint programme of hydrological and biological monitoring to support Sevan research efforts. Automated water quality monitoring of the lake, providing continuous (e.g. hourly) data would facilitate the work of the Center for Ecological-Noosphere Studies of the National Academy of Sciences, which together with German partners is studying the use of high-resolution satellite imagery to detect water quality. The Institute of Informatics and Automation of the National Academy of Sciences is working with the inter-agency Lake Sevan Commission to develop a high-accuracy predictive model for the lake.

Users also highlighted the overall importance of making climate information available to the general public: if in the past such information was primarily intended for climatologists, these days many other people need and use the data. The provision and exchange of such data thus needs to be radically expanded beyond state agencies and international organisations. Modern and user-friendly data-access tools (e.g. mobile applications) are the future.

## Box 3.6
## User-identified gaps and opportunities in climate services for other sectors

**OBSERVATIONS AND DATA**

- lack of water-related data for statistical work (surface and groundwater flow, water reservoirs, evaporation)
- lack of data at marz and water management unit levels
- lack of real-time data from automated monitoring
- some incomplete or inaccurate data

**RESEARCH, MODELLING, FORECASTING**

- need for inputs to revise construction regulations in view of climate change

**USER INTERFACE AND COMMUNICATION**

- significant delays with data provision in response to requests
- lack of access to data online (Lake Sevan research)
- lack of access to long-term time series for climate impact research
- need to expand data exchange beyond state agencies and international organisations
- room for working with mass media to expand and advertise climate services

# 4 Conclusions and the way forward

The hydrometeorological and climate information system in Armenia has developed over decades into a well-established service, collecting and providing relevant information to multiple users. Users of hydrometeorological information represent various sectors, ranging from resource management and utilities to scientific research and agricultural insurance providers. At the same time, there still are significant challenges and gaps to be addressed for a strong and reliable National Framework for Climate Services. These gaps, which are also opportunities for NFCS development, are summarised in Table 4.1.[42]

## Table 4.1
## Summary of identified gaps and opportunities

| | Water | DRR | Agro | Energy | Health | Other |
|---|---|---|---|---|---|---|
| **OBSERVATIONS AND DATA** | | | | | | |
| Out-of-date monitoring infrastructure | ● | ● | ● | ● | | |
| Lack of observations at specific locations | ● | ● | ● | ● | ● | |
| Lack of automated monitoring | | ● | ● | | ● | ● |
| Reduced scope of field expeditions | ● | | | | | |
| Insufficient use of remote sensing | ● | | ● | | | |
| Insufficient or unavailable data, including on: | ● | ● | ● | ● | ● | ● |
| Water balance (incl. flow and evaporation) | ● | | | | | ● |
| Groundwater | ● | | | | | ● |
| Water reservoirs | | ● | | | | ● |
| Snow cover | ● | | ● | | | |
| Soil temperature and moisture | | | ● | | | |
| Solar radiation | | | | ● | | |
| Issues of data comparability | ● | ● | | ● | | |
| Issues of data accuracy | | | | | | ● |
| Insufficient data exchange among networks | ● | ● | | | ● | ● |

42 The lack of identified gaps or opportunities by some sectors does not necessarily mean the lack of such gaps or opportunities per se. For instance, out-of-date infrastructure not identified as an issue by all sectors does not mean that the issue does not exist, but that participants from these sectors may have focused on products and services higher up in the value chain.

| | Water | DRR | Agro | Energy | Health | Other |
|---|---|---|---|---|---|---|
| **RESEARCH, MODELLING, FORECASTING** | | | | | | |
| Lack of capacities for, and accuracy of: | | | | | | |
| Flow modelling and forecasting | • | | | | | |
| Flood risk forecasting and mapping | | • | | | | |
| Hazard modelling and short-term forecasting | | • | • | | | |
| Long-term and seasonal forecasting | | | • | | | |
| Full-scale drought monitoring | | | • | | | |
| Winter temperature forecasting | | | | • | | |
| Short-term snow forecasting | | | | | • | |
| Need to study climate impacts on Lake Sevan | | | | | • | |
| **USER INTERFACE AND COMMUNICATION** | | | | | | |
| Users unaware of what data exist | • | | • | | | |
| Users unaware of how to access and use data | • | • | • | | | • |
| Suboptimal data-access modalities | • | | • | • | | • |
| Lack of access to: | | | | | | |
| Real-time data | | • | • | | • | |
| Location-specific data | | • | • | | • | • |
| Seasonal climate information | | • | • | | | |
| Multi-year time series | | | • | | | • |
| Hazard damage history and statistics | | • | • | | | |
| Lack of user awareness of climate impacts | • | | • | | • | |
| Need for modern communication channels | | • | • | | • | • |
| Need for improved early warning communication | | • | • | | | |
| Room for dialogue with users and co-producers | | | • | | • | • |

Most observation technologies and monitoring equipment are out of date due to the lack of systematic funding and upgrades. More automated monitoring would improve the quality and reliability of data, and networks for both meteorological and hydrological measurements need to be expanded to cover more locations to meet the needs and expectations of users. In part, such expansion and the operation of an expanded network could only be achieved in partnership with sectoral, private and international partners.

Complementary data can and should be collected through a broader use of remote sensing and by expanding the practice of regular field expeditions complementing the fixed observation network.

At the moment, users in their daily work lack data about a variety of subjects such as surface water, groundwater, snow cover, soil temperature and moisture, and solar radiation. Some of these data are truly not collected for the reasons above, or not collected at the required volume

and resolution, or are simply not easy to find and access for users outside of the narrow hydrometeorological community.

Data accuracy remains an issue as does the comparability of observations by different operators, a situation that will only increase if observation networks continue to integrate new equipment and more partners, but such an expansion also offers possibilities for enriching the data exchange among the networks.

Technical and human capacities need to be improved to enhance the availability, quality and accuracy of forecasts for users with a range of needs – data on stream flow, floods and natural hazards on very short lead times for disaster risk management; information on long-term and seasonal patterns, drought and heat forecasts for agriculture; winter temperatures for pipeline operations; and snowfall data for ski tourism.

The sustainable management of Lake Sevan includes the determination and maintenance of its optimal water level, and research is needed on the likely climate impacts on the lake ecosystem, including eutrophication, biodiversity and public health and emergencies.

The HMC regularly provides available information to organisations with data contracts, but makes only limited data available online or through social media. Thus most climate and hydrometeorological data are difficult to obtain, and are not properly marketed. Users often do not know what information is available, how it can be acquired or how much it would cost. There still is an overall lack of interaction between the providers of climate information and the users, who as a rule are not involved in shaping and developing climate products and services.

Agriculture and tourism need localised and real-time information to support their day-to-day operations, while researchers and many sectors require area-specific time series for long-term planning. Newly emerging agricultural insurance schemes depend on the availability of area-specific history of damage from natural hazards, while farmers need ways to access information relevant to their specific crops and practices.

Despite considerable efforts, a significant gap remains between climate science and sectoral practitioners at the national, marz and local levels. While modelling and the development of long-term climate projections are still linked to specific, mostly international, projects, they are yet to find their way into sectoral and business planning.

To effectively deliver climate services to users, Armenia needs modern and effective channels. Upgraded, user-oriented websites, a new approach to mass media, the active use of social media, messenger and targeted applications are all widely demanded – and can dramatically improve access to the information that may already be available but remains hidden in data repositories. Making this happen will, however, require building stronger capacities among both providers and users of information.

And there is considerable room for expanding and making systematic HMC interaction with users of climate services through the regular collection of feedback, co-designed workshops and other forms of dialogue. The community of interested users can not only help conceive and shape innovative and relevant products, but also add value to them with their thematic expertise as was suggested in the discussions on agriculture, health and emergencies.

Lack of resources remains a major constraint, as modern technologies are costly while low salaries make the state sector unattractive for qualified specialists. Thus all sources of potential funding are to play a role in upgrading the technological and human capacities to bring climate services up to the expectations of Armenian users.

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Presentations by the management and staff of the Hydrometeorology and Monitoring Center under the Ministry of the Environment of the Republic of Armenia (Valentina Grigoryan, Levon Azizyan, Gagik Surenyan, Edgar Misakyan) during the online thematic cluster consultations in June and July 2020 also informed this work.

# ANNEX A

# Questionnaire for in-depth interviews

## [Potential] producers or co-producers of climate information

1. What hydrometeorological, climate or related data are collected/processed/shared by your organization?
2. What other producers of similar or other hydrometeorological/climate information are available in the country? What kind of information do they collect, analyze and produce? How is this information utilized, shared? Does your organization collaborate with any of them?
3. What other producers of similar or other hydrometeorological/climate information are available outside of the country (international organizations, companies, online platforms etc. – e.g. IBM Weather, Copernicus etc.)? What kind of information do they collect, analyze and produce? How is this information utilized, shared in Armenia? Does your organization collaborate with any of them?
4. What kind of information do you make freely available to the general public? (How accessible is such information to users: is it open source?) Make available at request/against payment? Provide to specialized users?
5. What additional data products/information services could your organization provide? Why it is not being done currently? What are the challenges preventing your organization from doing it? Why do you think such additional information and services will be in demand?
6. Would you be able/willing to produce information and services jointly with AHS?
7. Who are your users? Who requests data/information from you? To your knowledge, who requests data from the AHS, other agencies?
8. What are the most popular types of information requested from your organization?
9. What are the regulations/legal requirements on the provision of climate information which apply to your organization? What are the payment scales, if any?
10. Do you actively work with potential users of your information? Is there a Public Relations/ Outreach Division or a responsible staff member for this function in your organization?
11. Do you have feedback mechanisms so that you can get information on the level of user satisfaction or users' opinion about the quality of your services?
12. How is the work with mass media organized? Is your organization pro-active, or do requests rather come from the media? (E.g., for holding a press-conference.) How often does such communication happen? Is there a media relations division/function at your organization?
13. Are you satisfied with the ways media outlets communicate information you provide? Do they communicate it well and in the right way or do they "mess up" things?
14. What is your opinion about the role of social media in hydrometeorological/climate information transfer and early warning? Can you give examples from the field of hydrometeorology/climate services?
15. Would you think that the draft Law on Environmental Information recently circulated by the Ministry of the Environment may help improve hydrometeorological and climate information services? Were you able to provide comments to the draft?
16. How "modern" is climate research in Armenia? Are you aware of climate modelling and forecasting activities (by whom, where, what is being researched)? Are there linkages among different research results and processes?
17. Have you used climate projections in your work? (If so, what for, where from?)

## [Potential] users of climate information

1. What kind of hydrometeorological information do you (and/or your clients, partners) need in your field of activities? What are the benefits of using such information in your field (reduced risks and losses, increased efficiency etc.)?
2. Do you (your clients, partners) ever use hydrometeorological or climate related information in your area for decision making? For other purposes (which)?
3. If you (your clients, partners) do use hydrometeorological and climate information, where do you/they get it (both local and international)? Is the information timely and complete? Are you happy with the quality of the available/provided information? How can it be improved?
4. Are you (your clients, partners) sufficiently aware of relevant information and services available directly from the AHS?
5. If you (your clients, partners) do not get hydrometeorological/climate information directly from the AHS, are there intermediaries providing such information and related analytical services? Who are they? Do they do it well?
6. Are you satisfied with the kind of information available, its formats, access modalities? Are there gaps?
7. Is there a need/demand for additional or add-on (complementing AHS) climate information and services in Armenia?
8. In your opinion, who/which entities could produce and deliver such information and services in addition to AHS? Consider e.g. other governmental entities, private sector, academic institutions etc.
9. For what kind of climate information products/services would you (your clients, partners) be willing to pay? In your opinion, what information should be provided for free (covered from the state budget)?

## Additional questions

- What sectoral climate adaptation strategies or similar documents exist in Armenia? (For example, does Agricultural Strategy for 2020-2030 include adaptation to climate change?)
- Are details available about the GCF projects under development? Can there be synergies with improving climate information services? Are there specific needs?
- Who and on what conditions has access to information from the Zvartnots Armenian Aero-Meteorological Center?
- To all sectors to be interviewed: can they reconfirm the respective findings from the World Bank's Road Map (pp. 42-45 of the report)? Have things changed/are changing since then?
- From the World Bank's Road Map: "Stakeholder consultations have shown that these forecasts are aimed at too broad a geographic area... Farmers have indicated a need for better local hydrometeorological information and services, particularly for short-term temperature and precipitation forecasts." When, with whom such consultations were done? Are results available?
- To AHS: have there been recent user surveys, user workshops, or similar? Are records available?

# ANNEX B

## Interview participants

Ministry of Economy (Ira Panosyan, Acting Head of the Department of Agricultural Programs, Resource Use and Cooperative Development; Department of Primary Agricultural Production)

National Center for Disease Control and Prevention under the Ministry of Health (Nune Bakunts, Deputy General Director; Ruben Grigoryan, Head of the Department of Environmental Hygiene; Lusine Paronyan, Head of the Department of the Epidemiology of Transmissible Parasitic Diseases)

Statistical Committee (Nelly Baghdasaryan; Asia Podpomogova, Senior Specialist, Ani Hambardzumyan, specialist of the 1st category)

Water Committee of the Ministry of Territorial Administration and Infrastructure (Sona Hayrapetyan, Senior Specialist of the Department of Irrigation and Collector Drainage Systems)

Water Resources Management Agency under the Ministry of the Environment (Edgar Pirumyan, Acting Head; Arman Shahnubaryan, Water Cadaster and Monitoring Division)

Zvartnots Aero-Meteorological Centre (Tatul Hayrapetyan, Director)

Gazprom Armenia, closed joint stock company (Ruben Vardanyan, Deputy Head of the Technical Department)

Geocom, limited liability company (Alexander Arakelyan)

JINJ, limited liability company (Eduard Mesropyan, Director)

Jrar, closed joint stock company (Edik Sargsyan, Deputy Director)

Armavir Water Users Association (Vahagn Arshakyan, Director)

Armenian Agricultural Alliance, coalition of civil society organisations (Meri Nikoghosyan, VISTAA Ltd; Gor Movsesyan, loan expert; Gagik Poghosyan)

Energy and Environmental Consulting, NGO (Artashes Sargsyan, President)

Women in Climate and Energy, NGO (Mary Harutyunyan)

Yerevan State University, Department of Geography and Geology (Trahel G. Vardanyan, Professor of the Chair of Physical Geography and Hydrometeorology)

# ANNEX C

## Schedule and generic agenda of thematic cluster consultations

| | |
|---|---|
| Hydrology and water resources | 24 June 2020 |
| Disaster risk reduction | 26 June 2020 |
| Agriculture and food security | 30 June 2020 |
| Others (health, tourism, energy, transport, urban development etc.) | 13 July 2020 |

Start at 14:00 Yerevan time, duration about 2 hours

| | | |
|---|---|---|
| | **INTRODUCTION** | |
| 5’ | Tour de table / introduction of participants | Nora Mirzoyan, World Bank |
| 10’ | Introduction to GFCS | WMO (introductory film*) |
| 20’ | NFCS Armenia project (vision, process, results)<br>Baseline study, gaps and challenges | Nickolai Denisov, Zoï Hydrometeorology and Monitoring Center |
| 20’ | Cluster-specific focus (water, agro etc.) | Lusine Taslakyan, Zoï |
| 10’ | Q&A, reflections | All |
| | **DISCUSSION** | |
| 10’ | Introduction to the discussion (general + cluster-specific) | Nickolai Denisov, Zoï |
| 40’ | Discussion round table | All |
| 10’ | Conclusion / take-away from the discussion | Nickolai Denisov, Zoï Hydrometeorology and Monitoring Center, |

* The introductory film was not shown in all the meetings, but was made available in advance at the WMO YouTube channel:

https://www.youtube.com/watch?v=geY4YbkZQEE&feature=youtu.be (English with Armenian subtitles)
https://www.youtube.com/watch?v=8UsKa2dVG_A&feature=emb_logo (Russian)

# ANNEX D

# Participants of online cluster consultations and summary feedback

## List of participants

**Hydrometeorology and Monitoring Centre under the Ministry of the Environment**

Levon Azizyan, Acting Director
Armen Dpiryan, Deputy Director
Gagik Surenyan, Deputy Director
Valentina Grigoryan, Adviser to the Director
Yeranuhi Baghdasaryan, Assistant to the Director
Sona Grigoryan, Chief Specialist of the Department of Scientific and Technical Cooperation and Capacity Building
Edgar Misakyan, Head of the Hydrology Service
Hovakim Frunzikyan, Deputy Head of Hydrology Service, Head of the Department of Hydrography, Hydromorphology and Hydrometry
Amalya Misakyan, Head of the Department of Hydrological Forecasts of the Hydrology Service
Ruzanna Grigoryan, Head of the Department of Hydrological Research and Monitoring of the Hydrology Service
Zarmandukht Petrosyan, Head of the Climate Service
Hamlet Melkonyan, Chief Climatologist of the Climate Service
Yelena Khalatyan, Deputy Head of the Climate Service, Head of the Department of Climate Research and Monitoring
Andryusha Avagyan, Deputy Head of Service, Deputy Head of the Department of Meteorological Forecasts of the Meteorological Service
Sona Hayrapetyan, Leading Specialist of the Department of Meteorological Forecasts
Larisa Grigoryan, Head of the Department of Agrometeorology
Armine Sahakyan, Leading Specialist of the Department of Agrometeorology
Lusine Vardanyan, Leading Specialist of the Department of Agrometeorology
Larisa Simonyan, Chief Specialist of the Department of Agrometeorology
Vehanush Badalyan, Chief Specialist of the Department of Agrometeorology
Anna Tsarukyan, Head of the Department of Heliogeophysics and Radiology
Narine Soghoyan, Chief Specialist of the Department of Service and Marketing

**Ministry of the Environment**

Liana Ghahramanyan, Coordinator of the Ozone Programme
Anna Torosyan, Assistant to the Director of Hayantar (ArmForest)
Ruzanna Voskanyan, Director of Environmental Project Implementation Unit
Tatul Hayrapetyan, Acting Director, “Zvartnots” Aviameteorological Centre

**Ministry of Emergency Situations**

Hovhannes Yemishyan, r/s colonel, Deputy Director of the Rescue Service

Sos Margaryan, Acting Director of the Seismic Protection Territorial Survey
Satenik Bakunts, Head of the Centre of Scientific Research of the State Crisis Management Academy
David Tadevosyan, State Crisis Management Academy
Karapet Safaryan, State Crisis Management Academy
Haykandukht Gharibyan, State Crisis Management Academy
Hasmik Harutyunyan, Senior Methodist of the Quality Assurance Center, State Crisis Management Academy

**Ministry of Economy**

Anahit Voskanyan, Tourism Product Development Expert of the Tourism Committee
Varsik Martirosyan, Deputy Head of the Department of Primary Production
Qristina Khanoyan, Chief Specialist of the Division of Agricultural Resource Use of the Department of Agricultural Programs Elaboration, Resource Use and Cooperative Development
Garnik Sevoyan, World Bank PHRD Project Manager, Ministry of Economy of Republic of Armenia

**Ministry of Health**

Tigran Vahramyan, Director of the Scientific Research Institute of Spa Treatment and Physical Medicine
Karine Maysuryan, Head of the Centre of Natural Healing Resources and Ecological Medicine of the Scientific Research Institute of Spa Treatment and Physical Medicine

**Ministry of Territorial Administration and Infrastructure**

Azatuhi Gamburyan, Chief Specialist of the Division of Renewable Energy of the Department of Energy
Nazik Margaryan, Senior Specialist of the Division of Renewable Energy of the Department of Energy
Anna Martirosyan, Chief Specialist of the Division of Energy Efficiency and Technical Norms of the Department of Energy
Anna Margaryan, Water Committee
Aleksandr Sargsyan, Head of Airport Certification and Air Traffic Management Department of the Civil Avation Committee
Gevorg Afyan, Head of Environmental Impact Management Service, Road Department

**Statistical Committee of the Republic of Armenia**

Nelly Baghdasaryan, Member of the RA State Council of Statistics, Nature Protection Sphere
Naira Mandalyan, Senior Specialist, Department of Environmental Statistics
Ani Hambardzumyan, Specialist of the Department of Environmental Statistics

**Urban Development Committee**

Nshan Martirosyan

**Armenian Territorial Development Fund**

Lusine Gevorgyan, Environmental Specialist
Asya Osipova, Environmental Specialist
Shahane Arsenyan, Environmental Specialist
Shushan Qurqchiyan, Monitoring and Assessment Specialist

**Regional administrations**

Hayk Chobanyan, Governor of Tavush Marz
Tigran Musheghyan, Acting Head of the Department of Urban Development of Tavush Regional Administration

Karen Azatyan, Expert of the Department of Urban Development of Tavush Regional Administration
Tigran Sakanyan, Assistant of Deputy Governor of Tavush Marz
Siras Ohanyan, Head of the Division of Nature Protection of the Department of Agriculture and Nature Protection of Gegharkunik Regional Administration
Mikael Almoyan, Chief Specialist of the Division of Nature Protection of the Department of Agriculture and Nature Protection of Gegharkunik Regional Administration

**Center for Ecological Noosphere Studies of the National Academy of Sciences**

Shushanik Asmaryan, Deputy Director, Head of the Department of GIS and Remote Sensing
Nairuhi Maghakyan, Scientific Secretary, Research Fellow of the Department of Environmental Geochemistry
David Papoyan, Head of the Informational-Analytical Center for Risk Assessment of Food Chain
Marine Navasardyan, Senior Research Fellow of the Department of Bioenergy and Feed Quality
Vahagn Muradyan, Senior Researcher of the Department of GIS and Remote Sensing
Garegin Tepanosyan, Research Fellow of the Department of GIS and Remote Sensing
Nona Movsisyan, Lab Researcher of the Department of Radioecology

**Institute of Informatics and Automation of the National Academy of Sciences**

Vladimir Sahakyan, Deputy Director

**Institute of Zoology and Hydroecology and Ichthyology of the National Academy of Sciences**

Lusine Hambaryan, Head of the Department of Hydroecology, Associate Professor of the Department of Ecology and Nature Protection of Yerevan State University

**Yerevan State University**

Nelly Hovhanissyan, Head of the Chair of Ecology and Nature Protection
Gor Aleksanyan, Faculty of Geography and Geology, Chairman of Tavush Tourism Development Agency

**National Polytechnic University of Armenia**

Yeremia Yengibaryan, Senior Scientist, Doctor of the Heliotechnical Laboratory, afyan

**American University of Armenia**

Alen Amirkhanyan, Director of Acopian Center for the Environment

**Armenian National Agrarian University**

Meruzhan Galstyan, Director of Ecology and Organic Agriculture Research Center
Gurgen Yeghiazaryan, Head of the chair of Water management department
Ashot Voskanyan, Director of the Agrarian Policy and Economics Research Center
Karine Mnatsakanyan, Senior Research Fellow of the Agrarian Policy and Economics Research Center
Marianna Hovhannisyan, Senior Research Fellow of the Agrarian Policy and Economics Research Center
Suzanna Abrahamyan, Junior Research Fellow of the Agrarian Policy and Economics Research Center
Margo Ghazaryan, Junior Research Fellow of the Agrarian Policy and Economics Research Center
Karine Sargsyan, Senior Research Fellow of the Ecology and Organic Agriculture Research Center
Armenuhi Paronyan, Senior Research Fellow of the Ecology and Organic Agriculture Research Center
Marine Markosyan, Research Fellow of the Ecology and Organic Agriculture Research Center

**Private companies**

Anna Karapetyan, Agrotrend CJSC
Alexander Arakelyan, GIS Specialist of Geocom LLC
Hayk Yertsyan, GIS Specialist of Geocom LLC
Liana Margaryan, Geoinfo LLC
Martin Sarungulyan, Deputy Chief Engineer, Head of Perspective Development and Technical Department of the Electric Power System Operator CJSC
Armen Julikyan, Head of the Central Regulatory Service of the Electric Power System Operator CJSC
Siranush Asatryan, Head of Energy Regime Planning Service of the Electric Power System Operator CJSC
Hamlet Zaqaryan, Head of Electrical Regime Planning Service of the Electric Power System Operator CJSC
Avag Harutyunyan, Director of Maran Winery
Vardges Davtyan, "Lukashin" Agricultural Cooperative
Taron Tunyan, "Jrar" CJSC
Eduard Mesropyan, "Jinj" CJSC

**Non-governmental organisations**

Karen Chilingaryan, Consumers' Consulting Center
Gor Movsesyan, Agricultural Alliance
Ara Arzumanyan, Armenia Renewable Resources and Energy Efficiency Fund
Nune Sarukhanyan, Green Lane
Lilit Avdalyan, ICARE Foundation

**World Bank**

Nora Mirzoyan, Consultant
Marina Sahakyan, Program Assistant

**UNDP Armenia**

Diana Harutyunyan, Climate Change Program Coordinator
Georgi Arzumanyan, Programme Policy Adviser
Armen Chilingaryan, Disaster Risk Reduction Programme Coordinator
Gohar Hovhannisyan, UNDP/GCF Programme Coordinator
Aram Ter-Zaqaryan, UNDP/GCF Programme Team Leader
Ruben Muradyan, UNDP/GCF Programme Expert
Ara Hovhannisyan, UNDP/GCF Programme Expert
Gayane Igityan, UNDP/GCF Programme Expert
Gagik Gabrielyan, Representative of the UNDP/GCF Programme subcontractor (Card Foundation)
Armineh Hovsepyan, UNDP/GCF Programme Expert
Varduhi Hayrumyan, Representative of the UNDP /GCF Programme Subcontractor (AUA)

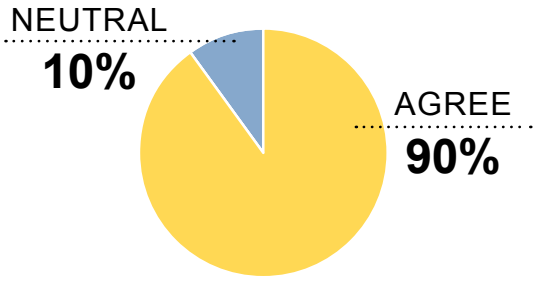
**EU Water Initiative *Plus***

Vahagn Tonoyan, EUWI+ project coordinator, UNDP expert

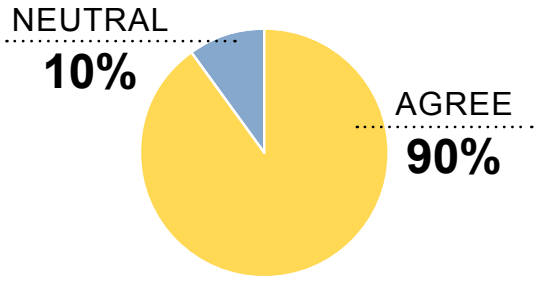
**Zoï Environment Network**

Nickolai Denisov, Deputy Director
Lusine Taslakyan, Consultant
Arevik Hovsepyan, Consultant

## Summary feedback

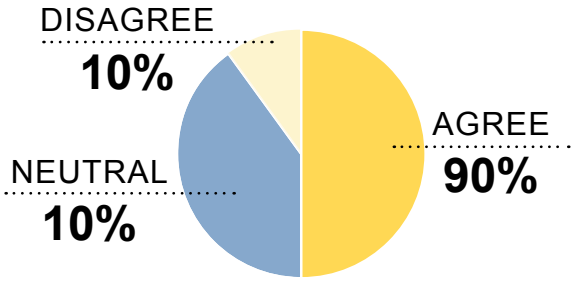



1. Was the content of the meeting well organised and easy to follow?

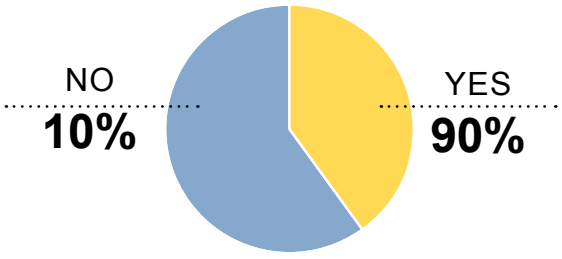



2. Was sufficient Information provided about the development of the NFCS?


3. Were the discussed themes and topics important for your organisation?




4. Was sufficient time allocated for the discussion?




5. Could the meeting have been more efficient? *

## * If so, in what way?

- Face-to-face meetings are more efficient, as many participants would have probably expressed their opinions more actively and there would have been a more effective discussion. Unfortunately, for obvious reasons, this format was not possible.

## 6. What are the most pertinent problems with respect to the provision of, or access to, hydrometeorological data, forecasts, warnings, risk information and similar products and services?

- Lack of information in the media apart from temperature / weather forecasts.
- Incomplete information on HMC website.
- Absence of required data or their provision on a pay-for basis.
- Lack of clarity about terms of access to data.
- Insufficient timeliness and accuracy of information.
- Lack of access to real-time data, including from privately-operated weather stations [e.g. for tourism].
- Lack of regular information about climate change, related hazards and trends, risk forecasts.

## 7. Other comments, suggestions

- Provide wide and extensive “open” information to experts in agriculture, ecology, water use, healthcare, and other important fields.
- Create an online database to allow faster access to data for implementing design and construction projects (e.g. for the construction of water reservoir, wastewater treatment plants) and for the proper management and design of irrigation systems.
- Launch mobile applications so that even a farmer in remote region, who doesn’t follow TV, radio and press, could register there and receive warnings about catastrophic events and changes in the area.
- Conduct pilot projects for specialized hydrometeorological services in various fields, e.g. microclimate-oriented automated stations for agriculture, weather stations for the road service etc.
- Address issues of Lake Sevan, including frequently observed in recent years blooms of toxic algae and the consequences of that for human health and food security.
- Take climate data into account in construction and urban development contexts.
- Accept my gratitude for the well organized meetings, active discussions and so many interesting views.

# ANNEX E

## Legal basis for access to hydrometeorological and climate information

As defined by the 2001 Law on Hydrometeorological Activities, one of the main functions of the Armenian Hydrometeorological Service is to provide reliable and accurate meteorological, hydrological and climate information to the public, governmental authorities, and to sectors of the economy that are highly dependent on weather and climate conditions, with special attention to dangerous and unfavourable phenomena. The law differentiates among three types of information on hydrometeorological phenomena and processes – extremely urgent, general and professional.

The law covers accessibility, openness, reliability and the effective use of information based on factual hydrometeorological data and forecast phenomena among the principles of hydrometeorological activities, and defines the roles and responsibilities of both the producers and consumers of information. A state authorised body (the AHS at the time of the adoption of the law) is also in charge of licensing commercial entities performing hydrometeorological activities, but the AHS is the only body authorised to make official announcements, warnings and forecasts, or transmit other information related to the safety of people's lives, health and property. The law defines the types of information that is provided free of charge or for payment. Charges are imposed on consumers, other than state bodies, only for services related to finding and retrieving data from repositories, and for copying, reproducing, mailing or otherwise transmitting the data.

The 2003 Law on Freedom of Information[43] was widely considered a progressive document. In practice, however, many governmental bodies and officials were reluctant to grant access to information, and additional regulations were needed to further support and improve the implementation of the law. Such regulations, adopted by the Government in 2015,[44] regulate information collection, classification and maintenance.

Being a party to UNECE Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, Armenia has taken an obligation to provide effective public access to environmental information within its broad scope held by various public authorities. The progress in implementing this and other obligations under the Convention is reflected in national implementation reports.[45]

The current legislation is yet to be adapted to include the concept of open data and to provide the respective governance and enforcement mechanisms. For the moment, Armenia does not have an open data portal, and the public information spread among various websites is usually published in a format that cannot be read by machine. As a rule, public websites do not provide metadata about reports and data they publish.[46]

43 Law on the Freedom of Information of the Republic of Armenia of 23.09.2003, https://www.arlis.am/DocumentView.aspx?docID=1372

44 Government Decree 1204-N of 15.10.2015 https://www.arlis.am/DocumentView.aspx?docid=101115

45 See https://apps.unece.org/ehlm/pp/NIR/qwery.asp?LngIDg=EN.

46 PricewaterhouseCoopers, 2019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