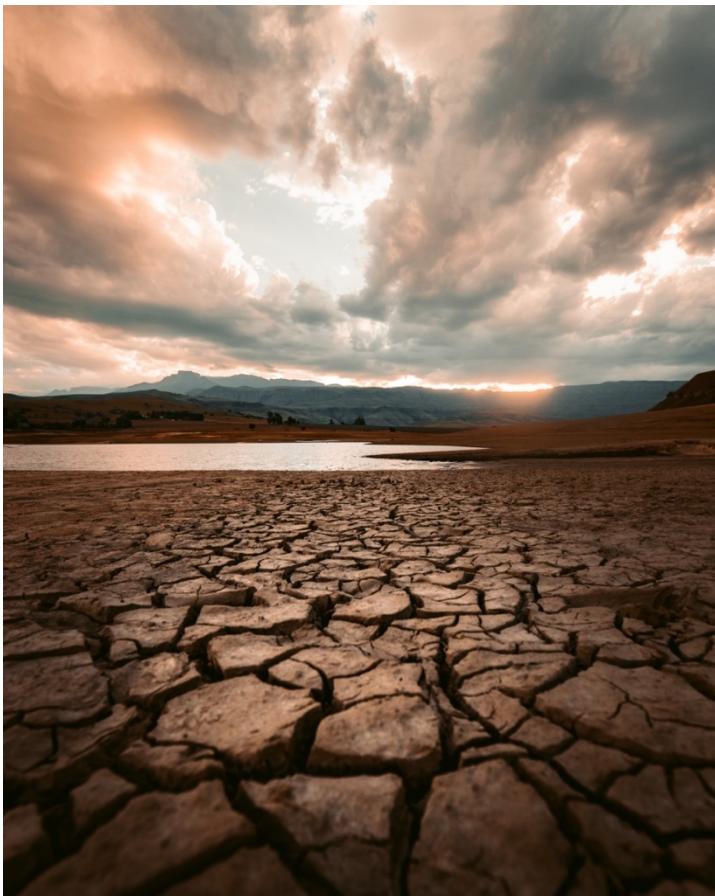


INTEGRATED DROUGHT MANAGEMENT IN ARMENIA

PROJECT FINAL REPORT



Project implemented by Country Water Partnership Armenia and Global Water Partnership Central and Eastern Europe

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1. INTRODUCTION

Republic of Armenia (RA) is a mountainous country with arid climate conditions. Its entire territory and vulnerable ecosystems is considered sensitive to climate change. A significant increase in frequency and intensity of extreme weather events (droughts, heat waves, frost, hail, strong winds and precipitation) and natural disasters (floods, inundations, forest fires etc.) along with the increase in air temperature and decrease in precipitation have been observed in the recent years. The negative impacts on ecosystems, economy, human welfare and health occurred (Armenia's Fourth National Communication on Climate Change, 2020).

Studies have shown that droughts are observed in the lower regions of Armenia almost every year, and in the foothill regions recurrence of droughts is about 50%. According to drought indices, the number of strong and very strong droughts during the period of 2000-2017 increased by 33 days relative to the baseline average (87) for 1961-1990. Drought assessment results according to the zoning show that in recent years the upper boundary of the drought zone has expanded to include mountainous areas, and the droughts onset earlier in the year. Due to the decrease in atmospheric precipitation and poor management of water resources, access to freshwater resources in the Republic of Armenia (RA) is becoming more limited. Droughts and water scarcity is becoming more frequent in the country since recent years, which poses challenges to management of water bodies, and a number of economy sectors, particularly agriculture.

Acknowledging the importance of drought and water scarcity in Armenia and responding to the challenges arisen, the Interdepartmental Committee was set up in 2021 by the order of the RA Prime Minister. The committee will coordinate measures to prevent possible drought or water scarcity, eliminate or mitigate the results of drought or water scarcity, identify potential problems, and respond promptly, as well as develop strategy to increase the efficiency of the irrigation sector. In close cooperation with the relevant state authorities of Armenia the Country Water Partnership (CWP) Armenia started the project on "Integrated Drought Management in Armenia" at the end of 2021. The CWP recognizes the special importance to the climate change impacts on water resources and aquatic ecosystems,

The goal of the project is to identify the existing legal, institutional and management gaps in drought control sector in the country, to clarify the directions of drought monitoring, early response, risk management and consequence elimination systems and to develop the content of the integrated drought management plan model jointly with the stakeholders.

This report on the project results will assist the relevant state authorities with drought management competencies (RA Ministries of Environment, Economy, Territorial Administration, and Infrastructure, etc.) to consider legal, institutional, and necessary data management gaps and to implement concrete measures and invest in filling these gaps and in developing integrated drought management plans. The activities carried out within the framework of the project will contribute to the formation of clear steps by the government in this field. This report can serve a basis for applying for the support of various international donors to improve the integrated drought management process in Armenia.

2. PROJECT GOALS AND ACTIVITIES

Taking all the above into account, the Country Water Partnership (CWP) Armenia initiated and implemented the project on "Integrated Drought Management Plan" (IDMP). The project was performed in cooperation with Global Water Partnership Central and Eastern Europe (GWPCEE), which has outstanding long-term experience with IDMP in CEE region and beyond. The project is funded by the National Oceanic and Atmospheric Administration through the Global Water Partnership Organisation. (GWPO)

The goals of the project were:

- ✓ to assess the current drought management system in Armenia based on the available information
- ✓ identify the weaknesses and gaps of the management system
- ✓ develop the content of the integrated drought management plan and clarify its legal status.

To fulfil these goals following activities were implemented:

- preparing suggestion for possible outline of IDMP for Armenia, and the check list for the survey on current status of drought management (GWPCEE)
- identifying main stakeholder and establishing of working group (CWP Armenia)
- analysing and survey on the drought management gaps (CWP Armenia, GWP CEE review)
- consulting main stakeholders in a workshop on gap analysis and drought management survey (CWP Armenia)
- preparing project deliverables and final report (CWP Armenia, GWPCEE review)

Detailed workplan is in **Appendix 1**.

3. DETAILED ACTIVITY DESCRIPTION AND MAIN RESULTS OF THE WORK IMPLEMENTED IN THE PROJECT

3.1 Identification of the main stakeholders

A desk study to identify stakeholder was conducted. Departments of state institution and non-governmental organisation responsible for the 3 pillars of drought management where identified. The three pillars are, drought monitoring and early warning, vulnerability and impact assessment, impact mitigation and response).

Bilingual survey questionnaire was developed by CWP team based on the checklist provided by GWPCEE. The questionnaires were sent by letter to all interested ministries, local self-governments in the most drought-prone areas, and representatives of the scientific and civil society.

Four chapters were identified in the questionnaire:

- Determining drought monitoring,
- National legislation addressing drought,
- National institutions and their responsibilities on drought
- Analysis of management measures/good practices

Nineteenth questions were included in the questionnaire, related to above mentioned four topics. Based on the answers to the questionnaire, the definite listing of key stakeholders was prepared. The listing of their competences in relation to drought management is to be found in Appendix 2, Chapter 2 Responsible bodies and coordination. Bilingual questionnaire and results of survey have been included in Appendix 2.

3.2 Formation of a working group and work carried out by the group

A working group was set up within the framework of the project, which included representatives of governmental institutions and departments, as well as independent experts in the field of drought. Representatives of below listed Ministries and institutions were included in the working group:

- Ministry of Environment, included “Hydrometeorology and Monitoring Center” SNC
- Ministry of Economy
- Ministry of Territorial Administration and Infrastructure, included Water Committee and Irrigation SNCO
- Statistical Committee of RA
- Ministry of Emergency Situation

A study was conducted with the involvement of all stakeholders and members of the working group to identify the legal and institutional system regulating the field of drought management, the functions of the departments, the availability of information and data on drought management in Armenia. Questionnaire was provided the Working Group members in order to identify situation among main stakeholders. A questionnaire filled in on behalf of each institution was returned, and results were incorporated in Deliverable 1 (Stakeholder mapping).

Five participatory stakeholder meeting (5) were held. The current state of drought management, gaps and weaknesses in the management system, as well as the proposed measures were discussed with stakeholders, the implementation of which will ensure a proper level of drought management in the country. During the meetings ongoing work of working group and independent experts has been discussed, also discussion between the member has been conducted.

The report "Analysis of the Drought Management System in Armenia, Identification of Weaknesses and Gaps" was prepared. The main goals were to identify existing situation in Armenia related to drought management, monitoring and early warning system, reveal gaps and weaknesses in existing system, provide recommendations for improving and establishing drought management institutional structure. Report is the main and very important step towards establishing the platform for further work. The full report was developed only in Armenian language and is attached as sperate pdf document. An extract of report, particularly weaknesses and recommendations for improvement have been translated to English is in Appendix 2 Document consists of 44 pages and included seven chapters. Information for the report has been collected with support of members of the working group. Two independent experts have been worked with the group of experts and provided information on international responsibilities of Armenia according to international Treaties and Conventions, as well as methodology, which used for drought identification.

With the support of the Project Working Group, the draft of an Integrated Drought Management Plan outline was also developed. This outline contains the main important areas., which the IDMP plan in Armenia should contain. The ideas of how to cover some of those areas in the future work are given. The IDMP structure has not been / has been discussed on national / regional level?

3.3 Stakeholder consultancy

Stakeholder consultancy had different phases. Firstly, during the stakeholder mapping, the stakeholders were consulted the nomination of the working group. Two independent experts have been joined to the group. Furthermore, brief survey for identification of institutional and legal capacity of main stakeholders' institutions has been implemented. Based on those the CWO and cooperating working group and the independent experts have prepared the documents for stakeholder consultancy.

At the workshop held in Aghveran, Armenia (May 4-5, 2022) following documents developed within the framework were discussed with the stakeholders:

- "Analysis of the Drought Management System in Armenia, Identification of Weaknesses and Gaps" project second deliverable
- "Content of the Drought Management Plan"- project third deliverable

All members of working group included independent experts have been participated in workshop. Agenda and list of participants are in Appendix 5, Photos of working meetings and final workshop in Appendix 4.

The workshop was attended by the Deputy Minister of Environment, Mrs. Gayane Gabrielyan. She expressed her willingness to assist in the implementation of legal reforms for the development of the drought management system in Armenia. The necessity to give legal status to the "Drought Management Plan" was clearly mentioned. In the absence of systematic drought

management in Armenia for various reasons, it has become impossible to ensure integrated management of this phenomenon and the basic actions are taken only to compensate for the damage already caused by the drought. It was mentioned that IDMP, with support of GWP was a first, but very important step towards of starting the collection of information and identify the further steps for improving the system. Drought management country strategy and program of measures will be necessary and it can be the next step in case of possible financing.

To present the results of the project, as well and to clarify the actions and further steps to be taken for the establishment and development of a drought management system, on the initiative of Deputy Minister of Environment decided to organize a working meeting, where will participate the members of the Interdepartmental Committee on drought management established in 2021. Taken into consideration overloaded schedule of Ministry of Environment and business travels, it was decided to organize this meeting in middle of June 2022. It is expected that UNDP DRR Programme Coordinator also will be invited to the meeting.

DMP content draft document has been developed and according to opinion of main stakeholder Ministries it needs to have a legal status. Drought management strategy development, as well as follow up with provided recommendations are the next steps, which have been framed by CWP Armenia for the upcoming period. In case of possible funding CWP Armenia will continue the work on the way to implementation of recommendations for improvement of drought management institutional and regulation systems.

APPENDIX 1. PROJECT WORK PLAN

Activities performed	Results	Implementation period	Dec 2021	January 2022		February 2022		March 2022		April 2022		May 2022
Drought Management Stakeholders Mapping/Analyses/ SAR development Sending official letters to State Authorities for establishment of the working group	SA Report Working Group established	December 2021			D							
Implementation survey with identified stakeholders, using the topics provided by CEE	Summaries survey results, Development of Report	January-February 2022						D				
Discussion of Stakeholders report and Survey results with the working group	Feedback on working group	February 12, 2022										
Draft Drought management gap analyses report Draft Content of Drought management plan	DMP draft version	February-March 2022							D	D		
Country survey among the main stakeholders, development of report based on survey results										D		
Main stakeholders workshop/ Discussion of Gap Analyses report, Content of DMP and Survey results / Aghveran	Final gap analyses report, included stakeholders survey results	May 4-5, 2022									D	
Finalize projects deliverables Drought management plan legal status discussion meeting with Deputy Minister of Environment		May 2022										FD

DD - Draft-deliverable

FD - Final-deliverable

D - Project-deliverables

Red - actually delivered



**REPORT ON
STAKEHOLDERS MAPPING**



**INTEGRATED DROUGHT
MANAGEMENT PROJECT**

Country Water Partnership Armenia

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ABBREVIATIONS

BMO	Basin Management Organization
CJSC	Closed Joint Stock Company
CEE	Central and Eastern Europe
DMP	Drought Management Plan
EU	European Union
GWP	Global Water Partnership
GWP CACENA	Global Water Partnership - Central Asia and Caucasus
IDMP	Integrated Drought Management Programme
IFAD	International Fund for Agricultural Development
LLC	Limited Liability Company
NAP	National Adaptation Plan
NAS RA	National Academy of Sciences of the Republic of Armenia
NGO	Non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
RA	Republic of Armenia
REC	The Regional Environmental Centre
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UN FAO	United Nations Food and Agriculture Organization
USAID	Mission of the United States Agency for International Development
WMO	World Meteorological Organization
WUA	Water Users Association

1. INTRODUCTION

Drought is a natural, recurring phenomena that occurs everywhere at various points in time and is occurring somewhere on Earth at any given point of time. Drought is a complex topic with ecosystem impacts that vary with its intensity and duration and socioeconomic impacts that often magnify problems for the most vulnerable members of society.

In the context of climate change, droughts are considered a major problem in Armenia. Over the past 30 years, Armenia has seen an increase in mean temperature and hot winds (especially in Ararat Valley, Vayk and Syunik), which dry the surface. Additionally a decrease in precipitation and humidity is observed. In the Ararat Valley, hot winds blow for 120–160 days per year. About 15 percent of arable land in the Ararat Valley is prone to drought under current climate conditions. These combined climatic changes have resulted in longer droughts, especially in the Ararat lowland and foothill zones.

According to the Natural Hazards Assessment Network, 98 percent of the land in Armenia is at risk of drought. Drought risk in Armenia is increasing and occurrence of drought is destabilizing food production and significantly affect the economy.¹

Desertification processes and secondary salinization² are aggravated. Approximately 80 percent of the country is threatened by desertification in various degrees. More than half of country area is threatened by severe desertification³.

Advice and advance warning for droughts is vital for reducing the risks. However, currently prediction of meteorological and agricultural drought is often possible with a very short lead time (couple of week in advance), and early warning products are only sporadically available. Drought conditions are regularly monitored and assessed, although a full-scale drought monitoring and forecasting system in the country is not yet established.

A more comprehensive agriculture and climate advisory services, including drought monitoring program needs to be developed. This includes coordination of information and knowledge between meteorology and hydrology and Comprehensive system would establish the drought magnitude and impact information required by most users in Armenia. Developing a Comprehensive Nationwide Drought Monitoring Program should include all the major user sectors in the country, such as agriculture and water resource management. Their requirements are essential in defining drought forecasts and information linked with decision-making.

Integrated Drought Management mitigates drought risk and builds drought resilience by addressing multiple components of drought management, including disaster risk reduction, climate adaptation strategies and national water policies.

Integrated Drought Management accounts for the needs of all stakeholders affected by drought. In 2013, the World Meteorological Organization (WMO) and the Global Water

¹<https://documents1.worldbank.org/curated/en/684751548347371395/pdf/134019-WP-P167315-Hydrometeorological-Report-Armenia-September2018-Final.pdf> page 17)

² Secondary salinization is the process of salt accumulation in soils as a result of disturbance of the natural moisture and leaching regime, usually as a result of over-irrigation

³ http://www.nature-ic.am/Content/announcements/7154/Armenia_CRM_TASP_Report_eng-for_web.pdf) page 28

Partnership (GWP) launched the Integrated Drought Management Programme (IDMP) to address drought issues more effectively.

IDMP's objective is to support stakeholders at all levels by providing policy and management guidance and by sharing scientific information, knowledge and best practices.

The Republic of Armenia has not developed or adopted any Governmental decision related to national plan on Integrated Drought Management. Number of Governmental decisions and National programs with regard to the desertification, and related to the drought issues have been addressed in several different papers.

The United Nations Convention to Combat Desertification (UNCCD) was established in 1994 to protect and restore our land and ensure a safer, just, and more sustainable future. The UNCCD is the only legally binding framework set up to address desertification and the effects of drought. The Republic of Armenia ratifying the UNCCD on 07 February 1997⁴. The Republic of Armenia is currently a member of many conventions, including "Climate Change" and "Biodiversity" directly relating to the prevention of desertification processes or mitigation of their impacts.

On December 2, 2015 by the decision of the RA Minister of Nature Protection (N 361-U) Commission on the implementation of United Nations Convention to Combat Desertification was set up.

The Strategy and the National Action Programme to Combat Desertification for the period of 2015-2020 was approved by RA Government in May 27, 2015.⁵

The aim of NAP to combat desertification in Armenia is to ensure the implementation of realistic activities contributing to the achievement of strategic objectives and setting rational deadlines based on the 10-year strategic program adopted during the 8th UN CCD Conference of Parties.

The main NAP priorities are the following:

- Improving of desertification-related legislation
- Enhancing of land management efficiency
- Public awareness rising on desertification issues and their solutions
- Implementing of joint activities within Rio conventions and establishment of international cooperation.

On May 6, 2021 the Government of Armenia approved a program to neutralize land degradation in Armenia (N 725-L). It will contribute to conservation, use, and management of land resources. This will lead to the increase of the effectiveness of land management and the level of public awareness on desertification problems and their solution, as well as expand international cooperation.

On July 2, 2021 by the decision of Prime Minister of Armenia (N 712-U)⁶ an inter-agency Commission was set up to prevent possible drought and water scarcity, eliminate or mitigate

⁴ <https://www.unccd.int/our-work-impact/country-profiles/armenia>

⁵ file:///C:/Users/Asus/Desktop/drought_CWP/convention/2014-National-Strategy-and-Action-Program-To-Combat-Desertification_eng.pdf

⁶ <https://www.arlis.am/DocumentView.aspx?docid=154172>

the consequences of drought or water scarcity, coordinate actions for detection of and prompt responses to possible issues and to coordinate the activities for development of a strategy on increase of the effectiveness of irrigation.

The president of the Commission is the Minister of Territorial Administration and Infrastructure, the other members are Minister of Economy, Minister of Environment, Chairman of Water Committee, Director of "Jrar" CJSC.

2. ACTIVITIES PLANNED BY THE PROJECT

National Oceanic and Atmospheric Administration (NOAA) provided financial support to GWP CACENA for support workshops for analysis of current status, gaps and challenges for the three pillars of the IDMP (Monitoring and Early Warning System, Vulnerability and Impact Assessment, Mitigation, Preparedness and Response) related to drought policy.

In the frames of the project the following activities were planned:

Review of existing resources (to check what already exists in terms of review of current status of the drought management in the region

Stakeholders mapping (to identify who we need to involve and/or distribute the survey to, invite to the workshop, etc.)

Preparation of the survey (it should be based on the Inception report we prepared for IDMP CEE and questionnaires which were prepared by CEE) (The results of the questionnaires are in Appendix 1)

Survey distribution and analysis (survey will be distributed to all identified stakeholders, results will be collected, short summary report will be prepared and analyzed)

After finalization of above mentioned task 2.5 days ‘workshop was expected to organize in Armenia and Uzbekistan, which were selected as a pilot areas of the project. The project will end at the end of May 2022.

3. REPORT ON STAKEHOLDER MAPPING

The analysis of the identified and mapped stakeholders of the project is presented in the Report. Stakeholder engagement is important because a sound scientific solution not necessarily results in solving a real-world problem. The engagement of stakeholders is essential during all phases of the project: The purpose of the stakeholder mapping activity is to identify possible and relevant stakeholders.

Stakeholder mapping is a dynamic process usually defined using the following steps:

1. Defining stakeholders;
2. Analyzing stakeholders by interest and influence;
3. Planning activities of productive communication with stakeholders;

The above mentioned is in this document ensured through the survey of stakeholders, the interest and influence of government bodies, NGOs and educational institutions, businesses and other types of organizations/institutions.

3.1 Stakeholder mapping

It is extremely important to create cooperation between stakeholders to ensure flow of information, exchange of experiences, especially in the case of examples of good practices. Cooperation is of importance to development planning because it is crucial for stakeholders to adopt a development vision and perform actions for its implementation.

Stakeholder mapping involves identifying, categorizing and prioritizing the stakeholders and organizations stressing the relation of stakeholders with drought and participation in drought management. The stakeholder mapping will help to manage and communicate with the stakeholders effectively as well as to formulate appropriate forms of engagement with these groups. The relevant stakeholders were mapped and divided by their role in drought management (Table 1).

The need of detecting the influence of stakeholders is a high priority, therefore it is important to avoid under (or over) estimating of their impacts and relevance. Stakeholders with high levels of influence on project, and as well by project need to be identified and given high priority at the outset. All stakeholders are not considered equal regarding the project impacts. Some have the potential to generate a much greater impact on the project than others. We have applied modified matrix to map stakeholders according to their influence and interests (Figure 1), which allowed us to create a picture of stakeholders' level of involvement and the type of engagement beneficial for the project implementation. This builds the understanding of what motivates stakeholders and how to win them around.

Table 1: Stakeholder identification and participation in drought management in Armenia

Stakeholders		Main role in drought management	Needs/ Expectations	Impact and influence
National Authorities/Ministries:	RA Ministry of Territorial Administration and Infrastructure RA Ministry of Emergency Situations RA Ministry of Economy RA Ministry of Finance RA National Assembly (Standing Committee on Territorial Administration, Local Self-Government, Agriculture and Environment Protection)	Development of country strategy and policy in drought management Implementation of drought mitigation/ adaptation policies Annual revision of mitigation plans Participation in drought committees Participation at the assessment of damage and possible economic losses	To improve drought management policy practices and to benefit in terms of recommendations and documentation as basis for revising policies. Coordination and capacity to revise legislation	These stakeholders have a high impact on the change process and they are highly impacted and interested
	RA Ministry of Environment	Development of country strategy and policy in drought management Implementation of drought mitigation/ adaptation policies Annual revision of mitigation plans Participation in drought committees As the authorized state body in the field of hydro-hydrological activity (on the basis of monitoring results) submits recommendation to RA Government regarding the declaration of water scarcity or drought in the RA Coordination of on United Nations Convention to Combat Desertification, Climate Change, etc	To improve drought management policy practices and to benefit in terms of recommendations and documentation as basis for revising policies. Coordination and capacity to revise legislation	
Professional Institutions:	Hydrometeorology and Monitoring Center SNCO of ME of RA	Participate in drought committees Conducting meteorological, hydrological and agrometeorological observations Implementation of Drought Monitoring and Assessment	Modernization of hydrometeorological observation network Development of advanced and state-of-the-art technologies for drought monitoring and prediction	These stakeholders have a high impact on the change process and they are highly impacted and interested

		<p>Early warning systems</p> <p>Maintaining the national hydro meteorological and climate database</p> <p>Management of the State Fund for Hydro meteorological Information</p> <p>Providing recommendation on improved drought management and policy</p>	<p>To evaluate and select the most effective and reliable indices and indicators for drought assessment</p> <p>Using the Remote sensing techniques for drought monitoring</p> <p>Establishing of EWS for drought monitoring and warning; development of data and information delivery system to end users and stakeholders</p>		
	Water committee of RA MTAI	<p>Participation in drought committees</p> <p>Participation on the drought management plans development</p> <p>Development of water policies based on risk analysis</p>	<p>Develops and implements the policy related to management and use of State-owned water management systems</p>	These stakeholders have a high impact on the change process and they are highly impacted and interested	
Local Authorities	BMO (Ministry of Environment) Regional and Local Authorities (Department of Agriculture and Environment) others		<p>To improve drought management policy practices</p>	These stakeholders are highly impacted by the change process and have high interest, but have a low impact on it themselves	
Irrigation Companies	"Jrar" CJSC- State Company, responsible for bulk irrigation water production "Melioracia" CJSC - Responsible for operation of collective drainage networks, groundwater levels determination Ararat WUA	<p>Participation in process of development of water policies based on regional risk analysis</p>	<p>Improve adaptation practices (before or during the droughts)</p> <p>Increasing experience in water efficiency technologies</p>	These stakeholders are highly impacted by the change process and have high interest, but have a low impact on it themselves	
Farmers	Young Farmers Association of Armenia Farmers' National Union Farmers collective associations		<p>Provide information, which will improve practices and suggested tools for adaptation (before or during drought)</p>	<p>Improve adaptation practices (before or during drought) in livestock and crops to minimize or avoid drought effects</p> <p>Improve adaptation practices (before or during drought)</p> <p>Avoid lack of water that limits sector development</p>	These stakeholders are highly impacted by the change process and have high interest, but have a low impact on it themselves
Fisheries	Big fish farming organizations, as a one of main water users				
Industry	Big and medium organizations worked in the region/ as main water users				
Agricultural Insurance companies	Rosgosstrakh-Armenia Ingo-Armenia Sil Insurance	Develop agricultural insurance packages and suggested respective products (included tax benefits) for adaptation	Develop adequate insurance products		

Research, Training and Development Institutions/ Universities	The Institute for Ecological Research Center NAS RA National Agrarian University of Armenia	Development of academic knowledge on risk analysis, adaptation and technology Development of modules related to drought monitoring and assessment	Provide the best international practice and academic knowledge on risk analysis, adaptation and technology used	These stakeholders are highly impacted by the change process and have high interest, but have a low impact on it themselves
International Cooperation Organizations	UN FAO UNDP Climate Change Program UNDP Global Environmental Fund EU4Climate Asian Development Bank KFW Development Bank IFAD Infrastructure and Rural Finance Support Programme Inclusive and Sustainable Economic Growth Armenia - USAID	Transfer of technology and knowledge	Additional financing of drought management mitigation activities together with state financing. Provide loans for respective groups in agricultural sector, based on risk analyze.	These stakeholders have a high impact on the change process and they are highly impacted and interested
Civil Society Organizations /NGOs	Agricultural Insurance National Agency NGO National Platform for Disaster Risk Reduction Fund The Center for Agribusiness & Rural Development (CARD) Shen NGO Khazer NGO REC Caucasus, Armenian branch Armenian Tree Project Armenian Women for Health and Healthily Environment NGO (AWHHE) "EcoLur" press club Armash Village Community Support and Development Center NGO Masis NGO Other CSO	Information dissemination, trainings and capacity building of impacted communities and households	Environmental and social improvements	These stakeholders are highly impacted by the change process and have high interest, but have a low impact on it themselves

Figure 1: Stakeholders' classification according to their influence and interest

High Power/ Influence	Group C.	Group B. National Authorities Local Authorities International Cooperation Organizations
Low Power/ Influence	Low Interest Group D. Fisheries Industry	High Interest Group A. Irrigation Companies Farmers Agricultural Insurance companies Research, Development Institutions Civil Society Organizations

Target group participation methods

It is important stakeholders become allies of the project and built the ownership of integrated drought management. Those aims are supported in a variety of ways, from keeping the stakeholders involved in every step of the process as a partner to simply ensuring that they are kept informed and given the opportunity to comment. The levels of participation range from a minimum of simply informing stakeholders through the empowerment in which the stakeholders or some of them are given final decision making authority.

Considering the stakeholders interest and influence in Figure 1, those groups will be targeted as follows:

Group A: High interest – low influence: - require special initiatives to protect their interests because of their low influence. It is important to keep them informed and to collect their feedback.

We will reach out to them, via following communication methods:

Invite to the main Workshop

FB page of CWP Armenia

Regular updates of the process by e-mail

Group B: High interest – high influence: Group B- important that there are constructive working relationships with this group, to ‘ensure an effective coalition of support for the project’. The constructive working relations should be set up within this project, keep them informed and to collect their feedback.

Suggested communication methods:

Invite to the main Workshop

Website and social media newsletters

Regular updates of the process by e-mail

Invite to kick-off meeting at the beginning of the process and ask for ideas, opinions, risk and opportunities

Organize regular meetings to give an update on the process and ask for opinions and suggestions

Group C: Low interest – high influence: is - source of significant risk to the project because of their high influence but little overlap of interests with the project. They may not want to participate in the process and could jeopardise the effectiveness of the outcome. To overcome this, we suggest building stepwise relationship and information channel with those stakeholders. Additionally, snowball mapping of stakeholders surrounding them, their motivations and needs in relation to the project themes can be done in order to find “door-openers” and supporters of the initiative. This process is a long-term step-wise work and cannot be finalized within the project.

Group D: Low interest – low influence: Group D- low priority because of low influence and low importance - unlikely to be involved in project activities. It is important to keep them informed.

Suggested communication methods:

Website and social media newsletters

Relating to DMP change management process, stakeholder groups 1-4 will be targeted as follows.

Group 1 - Their primary need is to understand the drought change process. Therefore, it is important to keep them **informed** of the process of DMP.

Group 2_Therefore, it is important to keep them **informed** and to **consult** them and ask for their opinion and advice as much as possible.

Group 3 - Therefore, we will **consult** and **involve** these people as much as possible.

Group 4 - Therefore, we **involve** them as much as possible.

Conclusion and next steps

Based on the provided stakeholder mapping which helped to identified the relevant stakeholders, following steps and stakeholders will be involved within the project

All listed in the table stakeholders are involved in the project activity. Official letters were submitted to the state authorities as well as to stakeholders, who are involved in DMP. Working group has been established and independent experts also joint to the group.

Useful links

<https://www.droughtmanagement.info/find/guidelines-tools/guidelines/>

https://www.droughtmanagement.info/literature/idmp-cee_compendium_en.pdf

https://climateknowledgeportal.worldbank.org/sites/default/files/2021-06/15765-WB_Armenia%20Country%20Profile-WEB_0.pdf

Add reference list for national documents

Add reference list for physical geography and information on drought

Annex 1. The results of “Current Status of Drought Management in Armenia” survey

A survey questionnaire “Current Status of Drought Management in Armenia” was one the informative tools used during the stakeholder engagement. It was sent by letter to all interested ministries, local self-governments in the most drought-prone areas, and representatives of the scientific and civil society.

The questionnaire has 4 sections:

- Determining Drought (Drought Monitoring)
- National Legislation Addressing Drought
- National Institutions and their Responsibilities on Drought
- Analysis of Management Measures/Good Practices

Each section consists of several questions.

The questionnaire was completed by 6 stakeholder bodies/organizations.

Section 1. Drought Monitoring

The results for the questions 1.1-1.4 is presented in 1:

- 1.1 Have water scarcity issues been identified as relevant in RBMP or WRMP?*
- 1.2 Have drought issues been identified as relevant in the RBMP or WRMP?*
- 1.3 Are the data on water demand included (or are available) in the RBMP or WRMP?*
- 1.4 Are the data on water availability included (or are available) in the RBMP?*

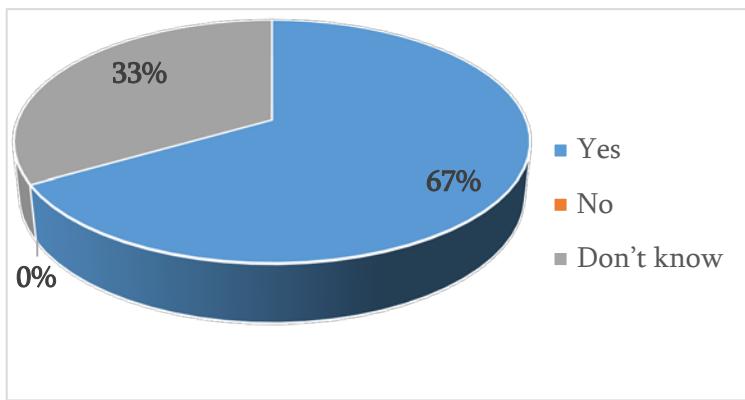


Chart 1.

Additional comments for the questions 1.1-1.4.

Water basin management plans clearly define the emergencies and their measures observed in the basin. Depending on the characteristics of each basin management area, water scarcity and droughts are addressed.

Water supply and water demand of every water basin area for the 6 years period are clearly defined in water basin management plans.

Taking into account the climate change, the amount of stored water, possible flooding scenarios, Water Users Associations and “Jrar” CJSC prepare water demand and supply applications.

Question 1.5 - Which parameters indicating the meteorological, hydrological and agricultural drought are monitored regularly?

The parameter/indicators mentioned by the stakeholders are presented in Chart 2.



Chart 2

Question 1.6 - Which parameters characterising the drought impact are regularly monitored and evaluated?

The parameters mentioned by the stakeholders are presented below:

Impact:

- ✓ Impact on society (water supply)

Environmental impacts:

- ✓ Mortality of fish species
- ✓ Impact on wetlands
- ✓ Deterioration of water body status

Impacts on socio-economic uses:

- ✓ Agricultural - loss of yield / quality of crops
- ✓ Industrial uses
- ✓ Power production
- ✓ Tourism
- ✓ Transport
- ✓ Drinking water supply of inhabitants

Question 1.7- Which EU indicators have been calculated?

Stakeholders mentioned that Standardized Precipitation Index (SPI), Fraction of Absorbed Photosynthetically Active Solar Radiation (FAPAR), Water Exploitation Index Plus (WEI+) have not calculated yet.

Question 1.8- Has an early warning indicator system been developed?

All stakeholders answered YES to this question.

Additional comments: All beneficiaries are provided with daily information on the flooding of 5 reservoirs monitored by “Hydrometeorology and Monitoring Center”. Every year in March, a forecast is given for the maximum filling of reservoirs. Based on information received from 45 operational hydrological observatories, warnings are issued about dangerous water flows.

Question 1.9 Have other plans independent of DMP been developed?

The stakeholders mentioned that the plans independent of DMP had not been developed and only one stakeholder mentioned about the Decision of the Government of the Republic of Armenia No 23 “On Approval of the Strategy and the National Action Plan to Combat Desertification”.

Question 1.10 Have the drought risk maps been developed?

All stakeholders mentioned that the drought risk maps have not developed in Armenia.

Section 2. National Legislation Addressing Drought

Question 2.1 Which strategies, policies and national plans, programs, reports and legal acts are exist in Armenia?

The results for this question are presented below:

- The United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD)
- The UNCCD 2018–2030 Strategic Framework – ICCD/COP(13)/L.18
- Decision of the Government of the Republic of Armenia No 23 “On Approval of the Strategy and the National Action Plan to Combat Desertification”
- Decision of the Government of the Republic of Armenia No 431, April 11, 2019 “On Approval of the Procedure for Classification of Land Area Coverage of the Republic of Armenia”
- Decision of the Government of the Republic of Armenia No 725-L, May 6, 2021 ““On Approval of the Land Degradation Neutralization Program in the Republic of Armenia”
- 7th National Report on Implementation of UN Convention to Combat Desertification in Armenia, 2018

Question 2.2 Umbrella documents addressing drought

The results for this question are presented below:

- Law on population protection in emergency situations, December 2, 1998

- Decision of the Government of the Republic of Armenia No 597-Ն, April 23, 2020
“On announcing water scarcity in the Northern basin and Sevan basin management areas”

Question 2.3 Other documents addressing other drought/environmental topics

The stakeholders didn't mention anything related to this question

Section 3. National Institutions and their Responsibilities on Drought

The questions of this section refer to the role of institutions involved into drought monitoring, the drought management organisational structures and working groups. Stakeholders mentioned that by the RA Prime Minister's decision 712-A of July 2, 2021, an Interdepartmental Commission was established to prevent possible drought or water shortage in the Republic of Armenia, eliminate or mitigate the effects of drought or water scarcity, identify possible problems, coordinate operative response measures, and develop an effective irrigation strategy.

Section 4. Analysis of Management Measures/Good Practices

Question 4.1 Which measures to deal with WS&D have been implemented or are planned?

The stakeholders mentioned that “Subsidizing the implementation of modern irrigation systems” program was developed by the RA Ministry of Economy and has been operating since 2018. The main goal of the project is to increase grape, fruit, berry production and export volumes, reduce the risk of climatic factors, promote the efficient use of water resources, to promote climate change mitigation and adaptation, promote incomes for farmers.

Questionnaire “Current Status of Drought Management in Armenia”

CURRENT STATUS OF DROUGHT MANAGEMENT IN ARMENIA

Question	Possible answer	Comments on provided answer
1. DETERMINING DROUGHT (DROUGHT MONITORING) 1. ԵՐԱԾՈՒՅԻ ՈՐՈՇՈՒՄ (ԵՐԱԾՈՒՅԻ ԱՆՎԱՆՈՒՄ)		
1.1 Have water scarcity issues been identified as relevant in RBMP or WRMP?		
1.2 Have drought issues been identified as relevant in the RBMP or WRMP?		
1.3 Are the data on water demand included (or are available) in the RBMP or WRMP?		
1.4 Are the data on water availability included (or are available) in the RBMP?		
1.5 Which parameters indicating the meteorological, hydrological and agricultural drought are monitored regularly?		
1.6 Which parameters characterising the drought impact are regularly monitored and evaluated?		
1.7 Which EU indicators have been calculated?		
1.8 Has an early warning indicator system been developed?		
1.9 Have other plans independent of DMP been developed?		
1.10 Have the drought risk maps been developed?		

Questionnaire “Current Status of Drought Management in Armenia”

Question	Possible answer	Comments on provided answer
2. NATIONAL LEGISLATION ADDRESSING DROUGHT		
2.1 Which strategies, policies and national plans, programs, reports and legal acts are exist in Armenia ?		
2.2 Umbrella documents addressing drought		
2.3 Other documents addressing other drought/environmental topics		
3. NATIONAL INSTITUTIONS AND THEIR RESPONSIBILITIES ON DROUGHT		
3.1 Which role has institutions involved into drought monitoring?		
3.2 Which other institutions involved into drought management?		
3.3 Have the drought management organisational structures been established?		
3.4 Has been working groups established to identify drought impacts and develop the DMP?		
4. ANALYSIS OF MANAGEMENT MEASURES/GOOD PRACTICES		
4.1 Which measures to deal with WS&D have been implemented or are planned?		

**ANALYSIS OF THE DROUGHT MANAGEMENT
SYSTEM IN ARMENIA, IDENTIFICATION OF
WEAKNESSES AND GAPS**

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Abbreviations

SNCO	State non-commercial organization
MTAI	Ministry of Territorial Administration and Infrastructure
UN	United Nations
ME	Ministry of Environment
HMMC	Hydro-Meteorological and Monitoring Center
MES	Ministry of Emergency Situations
NPDRR	National Platform for Disaster Risk Reduction

I. INTRODUCTION

Throughout human history, drought has had a profound effect on human subsistence and food security. Perhaps, agriculture is the sector that is most affected by weather and climatic conditions, particularly by drought. Lack of short-term precipitation motivated humankind to find alternative crops. Even limited droughts have had a profound effect in the early history of mankind.

At present, drought is no longer associated only with declining agricultural production. Today, the impact of the drought on energy, transport, health, environment, tourism, recreation and other sectors has become apparent.

As a result of climate change, droughts have become more frequent, their intensity has increased, which has a more devastating impact on the economy. Nowadays, the mechanisms of adaptation to short-term drought have improved; however, long droughts pose major problems for human well-being and food safety. These arid periods, when combined with other climatic factors or unstable patterns of agriculture and development, **can lead to land degradation and, if left uncontrolled, to increasing desert areas or desertification.**

Combatting drought in many countries of the world, as well as in Armenia, is mainly of a responsive nature and in crisis situations, governments have to deal with the consequences at the highest level. However, it is better to fight not only to overcome the crisis caused by the drought, but also to implement drought forecasting and precautionary measures to avoid or at least mitigate the consequences.

II. PRINCIPLES OF NATIONAL DROUGHT STRATEGY, NATIONAL AND INTERNATIONAL DEFINITIONS OF DROUGHT TYPES

1. Principles of national drought strategy

In the absence of an agreed national drought policy, the result will be only an emergency response to the drought, and the damage will be enormous, sometimes irreversible.

Therefore, governments need to pay even more attention to drought management problems, including them in national strategies to minimize their economic, social and environmental repercussions.

The national drought management strategy should be based on three pillars:

- ✓ Establishment of drought monitoring and early warning system
- ✓ Vulnerability and impact assessment
- ✓ Drought impact mitigation and response.

1.1 Drought monitoring system

The drought monitoring system should include observations of key drought indicators such as precipitation, air temperature, soil moisture, etc., and monitoring of the impact of drought on vulnerable sectors, particularly agriculture.

1.2 Early warning system

The early warning system should address the following issues:

- What can disturb the public during a drought?
- Why is it a priority (that is, what are the main causes of potentially unfavorable consequences)?
- When can the public feel the impact (giving the affected public as much time as possible to prepare)?
- Which areas are within the greatest impact zone?
- Who is most at risk and who should be warned?

1.3 Vulnerability and Impact Assessment

When assessing vulnerability and impact, it is necessary to:

- ✓ Record the impact of drought on vulnerable sectors of the economy (including non-irrigated and irrigated agriculture, animal husbandry, environment, energy, health, tourism, etc.);
- ✓ Determine, who and what is at risk and why before the drought, during the drought and shortly after the drought. Assess the physical, social, economic and environmental pressures on communities.
- ✓ Assess conditions or situations that may increase system resistance / sensitivity to drought;

- ✓ Assess the extent or size of possible damage or loss;
- ✓ Assess the resilience of drought-affected communities.

1.4 Drought impact mitigation and response

Drought impact mitigation includes both structural / physical (cultivation of relevant crops, construction of reservoirs and engineering infrastructure) and non-structural (policy, awareness, knowledge, legal framework, public commitment, practical skills) measures to mitigate unfavorable impacts of drought.

Post-drought remediation measures are needed to mitigate the effects of drought, including:

- ✓ Assessment and accounting of damage and loss caused by drought.
- ✓ Post-drought rehabilitation needs assessment.
- ✓ Attracting and managing resources, including funding for the implementation of post-drought rehabilitation measures.
- ✓ Strengthening the capacity for post- drought rehabilitation work at the national, regional or community levels.

2. Peculiarities of drought and national and international definitions of drought types

2.1 Peculiarities of drought and differences from other climatic risks

Drought differs from other natural hazards in various ways. Drought is a slow-onset natural hazard that is often referred to as a creeping phenomenon. It is a cumulative departure from normal or expected precipitation, that is, a long-term mean or average. This cumulative precipitation deficit may build up quickly over a period, or it may take months before the deficiency begins to appear in reduced stream flows, reservoir levels or increased depth to the groundwater table. Owing to the creeping nature of drought, its effects often take weeks or months to appear (Figure 2). Precipitation deficits generally appear initially as a deficiency in soil water; therefore, agriculture is often the first sector to be affected. It is often difficult to know when a drought begins. Likewise, it is also difficult to determine when a drought is over and according to what criteria this determination should be made. Is an end to drought heralded by a return to normal precipitation and, if so, over what period does normal or above normal precipitation need to be sustained for the drought to be declared officially over? Since drought represents a cumulative precipitation deficit over an extended period, does the precipitation deficit need to be erased for the event to end? Do reservoirs and groundwater levels need to return to normal or average conditions? Impacts linger for a considerable period following the return of normal precipitation. Therefore, is the end of drought signaled by meteorological or climatological factors, or by the diminishing negative impact on human activities and the environment?

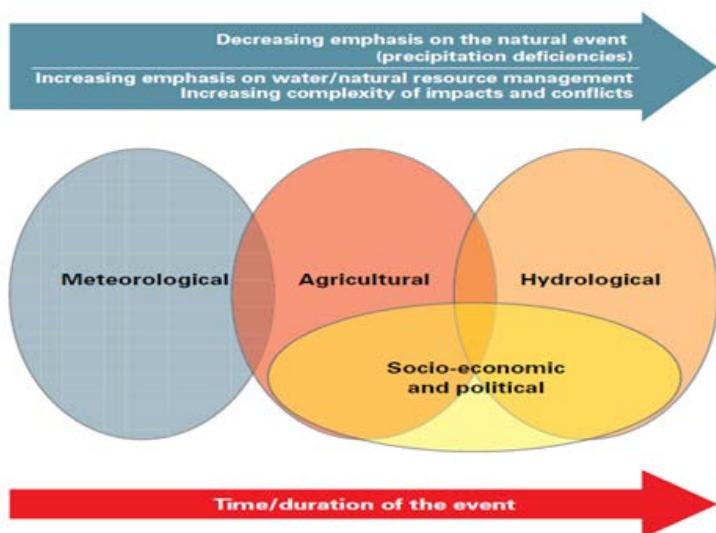
Another factor that distinguishes drought from other natural hazards is the absence of a precise and universally accepted definition. There are hundreds of definitions, adding to the confusion about the existence of drought and its degree of severity. Definitions of drought should be

region and application specific or impact specific (WMO_drought_monitoring_early_warning_2006.pdf).

2.2 International definitions of drought types

According to the WMO's "Drought Monitoring and Early Warning" manual, drought is classified into the following types: **meteorological, agricultural, hydrological, and socio-economic**.

Meteorological drought. During a certain period of time (days, weeks, months and a year), precipitation is absent or observed in such a small amount that its useful amount or significance is very small. It is accompanied by a decrease in surface flow and groundwater, as well as by other phenomena - high temperatures, low relative humidity, a decrease in cloudiness, an increase in the flow of solar radiation, which leads to an increase in evaporation.



Agricultural drought. This is defined more commonly by the availability of soil water to support crop and forage growth than by the departure of normal precipitation over some specified period. There is no direct relationship between precipitation and infiltration of precipitation into the soil. Infiltration rates vary, depending on the intensity of the precipitation event, soil type, antecedent moisture conditions, slope, and other factors.

Hydrological drought. Hydrological drought is characterized by a decrease in water flow in rivers, a reduction in groundwater resources, which leads to difficulties in meeting water demand.

Socio-economic drought: a drought that has socio-economic consequences. This type can include droughts, the intensity and magnitude of which cause significant damage to the country's economy, lead to significant social consequences, and sometimes are of a nature of humanitarian disaster.

2.3 Definitions enshrined in the normative legal acts of the Republic of Armenia on the types of drought

According to the RA Government decision №349-N of 18 March 2004 on "Establishing the List of Extremely Urgent and General Information on Hydro meteorological Phenomena and Processes" (<https://www.arlis.am/documentview.aspx?docid=96789>), the concepts of atmospheric and soil droughts were established in Armenia.

Atmospheric drought is the absence of effective precipitation (more than 5 mm per day) during the vegetation period of plants, for a continuous period of not less than 30 days, at temperatures above 30°C.

Soil drought, when during the vegetation period of plants, in a continuous period of 30 days, the effective moisture reserves in 0-20 cm layer of soil are not more than 10 mm.

According to the WMO, "**Hydrological drought** is a relatively prolonged period of dry weather, which causes water scarcity due to below-normal river discharge and / or decrease in soil moisture and groundwater level."

Drawing parallels between the national definitions and those of the WMO, it can be concluded that "atmospheric" drought corresponds to "meteorological" drought, "soil" drought" to "agrometeorological" drought, and there are not national definitions for "hydrological" and "socio-economic" drought.

Drought characterization indicators and indices are different. Different methods with common logic (generally taking into account the same factors) have been developed in different countries.

There are some differences between the definition of drought types in Armenia and the international definitions (also the name: soil-agricultural), which may lead to certain inaccuracies and misunderstandings.

III. DESCRIPTION OF THE CURRENT STATE OF DROUGHT MANAGEMENT IN ARMENIA

To carry out a complete management of drought, the following is needed:

- To assess the legal framework related to drought;
- To identify key stakeholders;
- To assess the current state of drought monitoring and forecasting;
- To assess the availability of professional potential;
- To identify the need for training;
- To assess the possibility of creating an early warning system;
- To study the international experience related to the problem;
- To study the process and opportunities of gathering information across the country;
- To explore the possibility of creating an information platform;
- To assess the relevant research potential.

1. The legal framework governing the field of drought management

Below is the framework of the legal acts of the Republic of Armenia, where there are regulations in force related to drought and water scarcity.

1.1 RA Water Code⁷

- Article 1 establishes the concepts of “Water Scarcity” and “Drought”,
- Article 30.2 sets out the grounds for the suspension of a water use permit, according to which, in the event of a drought or water scarcity, the distribution of water resources must be taken into account in ensuring the priority of water use;
- In accordance with Article 91, as a matter of priority, in order to minimize the damage caused by disasters in a timely manner, the Government shall establish a Disaster Management Information System, with the aim of preparing forecasts on the possibility of catastrophic situations in the water sector. The activities of the information system on floods, mudslides, landslides and droughts include up-to-date information and forecasts of droughts occurring or expected.
- Article 92 clarifies the powers of the authorized bodies related to declaring a year of water scarcity. According to it, based on the official information on water scarcity or drought received as a result of meteorological analysis by governmental body authorized for hydro meteorological activity, on the proposal of the Water Resources Management and Protection Body the Government announces about water scarcity and drought for the whole territory of the Republic of Armenia or for a part of it

According to this article, the decision on water scarcity or drought envisages:

- 1) Limitation of activities connected with water resources,
- 2) Reasonable or limited use of water resources in the area of water scarcity and drought,

⁷<https://www.arlis.am/DocumentView.aspx?DocID=158048>

3) Requirements to the water system management body for providing water users with water from new or alternative water sources for water supply.

Pursuant to this Article, the Government shall establish commissions and procedures for their activity, aimed at development of measures towards calculation and eradication of harms caused by disasters generated from harmful impact of water.

1.2 RA Law HO -96-N of 3 May 2005 “On the fundamental provisions of National Water Policy”⁸

Pursuant to the RA Law “On the fundamental provisions of National Water Policy”, the restriction of the use of water resources in emergency situations related to the availability of water resources is carried out by changing the priorities of water resources use and protection defined by items 4-9 of part 1, Article 13 of this law in reverse order.

1.3 RA Law HO-161 of 20 March 2001 “On Elimination of Drought Consequences”⁹

The RA Law “On Elimination of Drought Consequences”¹⁰ regulates the relations related to the state policy for elimination of drought consequences and establishes the principles of drought consequence elimination program implementation. The law states that the activities for elimination of drought consequences shall be implemented in the order and terms set out in the drought consequence elimination program.

1.4 The RA Government decision №349-N of 18 March 2004 “On Defining the List of Extremely Urgent and General Information on Hydro meteorological Phenomena and Processes”¹¹

The decision defines the concepts of atmospheric and soil drought.

1.5 RA Government Decision N248-N of 13 March 2008 "On approving the procedure for organizing emergency assistance to the population during drought and other natural disasters and man-made accidents"¹²

The decision defines the order of organizing emergency assistance to the population during drought and other natural disasters and man-made accidents.

1.6 RA Government Decision N 1111-N of 18 September 2014 "On Declaring Water Scarcity and Drought in Araratyan, Hrazdan and Akhuryan Basin Management Areas"¹³

According to the decision, water scarcity and drought were declared in Araratyan, Hrazdan and Akhuryan basin management areas. As a result of the decision, in the water, use permits of the existing water users, restrictions and limitations of water use quantities and/or regimes were made in accordance with the priorities of use and protection of resources established in the RA Water Code, the RA National Water Program and the Law on Fundamental Provisions of National Water Policy. Steps were taken to introduce pilot projects of semi-closed water supply system of fish farms in the Ararat Valley.

⁸<https://www.arlis.am/DocumentView.aspx?DocID=1784>

⁹<https://www.arlis.am/DocumentView.aspx?DocID=853>

¹⁰<https://www.arlis.am/DocumentView.aspx?DocID=853>

¹¹<https://www.arlis.am/DocumentView.aspx?DocID=138565>

¹²<https://www.arlis.am/DocumentView.aspx?DocID=42966>

¹³<https://www.arlis.am/DocumentView.aspx?DocID=93304>

1.7 RA Government decision N 597-N of 23 April 2020 “On Declaring Water Scarcity and Drought in Northern and Sevan Water Basin Management Areas”¹⁴

The goal of the decision is to prevent conflicts of interest of water users and to mitigate the expected negative impact on water resources in a situation caused by water scarcity or drought, especially when meeting the water demand, as well as to find appropriate solutions to make more efficient use of limited water resources in order to prevent possible additional water withdrawal from Lake Sevan.

1.8 The RA Prime Minister’s Decision N712-A of 2 July 2021 "On the establishment of an interdepartmental commission"¹⁵

According to the decision, an interdepartmental commission was set up to coordinate measures of prevention of possible drought or water scarcity in the Republic of Armenia, elimination or mitigation of the effects of drought or water scarcity, identification of and responding to possible problems, as well as the activities for development of strategy to increase irrigation sector efficiency.

1.9 RA Government Decision N1695-L of 14 October 2021 "On approving the program of reimbursement of irrigation water fees to water users in case of introduction of drip and sprinkling irrigation systems in up to 3 hectares of land"¹⁶

The goal of the decision is to promote the use of effective irrigation methods on agricultural lands by rendering state support to farmers investing in drip and sprinkling irrigation systems on their lands, to promote the economical and efficient use of irrigation water.

2. Drought management system of the Republic of Armenia

There is no drought management system in Armenia as such. However, certain infrastructures operate in separate units, which should be considered as management units.

2.1 Institutional Drought Management System

- ✓ *Ministry of Environment and "Hydro-meteorological and Monitoring Center"*
SNCO

The functions of the Ministry of Environment¹⁷ in the field of drought management in Armenia are directly related to forecasting, declaration of drought and resulting suspension of water use permits in the whole territory of Armenia or in a part of it.

Pursuant to Article 92 of the RA Water Code, the Authorized Body for Water Resources Management and Protection, in the person of the Ministry of Environment, has the authority to make a proposal to the RA Government to make a decision on declaring a drought. The proposal for the decision of the RA Government on the declaration of drought is submitted on the basis of the official information on drought presented by the state body authorized in the field of hydro meteorological activity as a result of meteorological analysis. The authorized state body

¹⁴<https://www.arlis.am/DocumentView.aspx?DocID=148601>

¹⁵<https://www.arlis.am/DocumentView.aspx?DocID=155596>

¹⁶<https://www.arlis.am/DocumentView.aspx?DocID=156802>

¹⁷ www.env.am

in the field of meteorological activity is the "Hydro-meteorological and Monitoring Center" SNCO of the Ministry of Environment¹⁸.

The authority to suspend water use permits is defined by Article 30.2 of the RA Water Code, which follows the adoption and entry into force of the above-mentioned decision of the RA Government. The process of suspending water use permits is carried out taking into account the priorities of water use.

According to the RA Government Decision N 1111-N of 18 September 2012 "On water scarcity and drought in the basin management areas of Araratyan, Hrazdan and Akhuryan", water scarcity and drought was declared in the three basin management areas of the Ararat valley. As a result of the decision of 2014, in the water use permits of the Ararat Valley water users restrictions and limitations of water use quantities and/or regimes were applied in accordance with the water resource use and protection priorities established in the RA Water Code, the RA National Water Program and the RA Law on Fundamental Provision of National Water Policy. The water scarcity and drought declared by the decision have not been eliminated yet and it is prohibited to issue water use permits by drilling new boreholes in the Ararat Valley.

"Hydro-meteorological and Monitoring Center" (MCC) SNCO monitors drought-related hydraulic characteristics (drought assessment is carried out according to the current methodology), i.e. development and introducing of early warning and risk forecast system for droughts, short-term, mid-term and long-term drought forecast, provision of information to the decision-makers and stakeholder organizations in accordance with the procedure.

At present, by the order of the director of HMMC SNCO, a working group is set up to develop a drought assessment methodology for pilot project for the introduction of an insurance system in the agricultural sector, in particular for drought insurance. In fulfillment of item 4 of the protocol N V / 53 of the meeting held with the acting Prime Minister on 29 June 2021, in connection with the issue of the possibility of introducing a drought forecasting system, a program of measures for introducing a drought forecasting system was presented. The latter was approved by the RA Prime-Minister and by the letter of 02 / 12.6 / 28328-2021, it was instructed to include appropriate measures for the implementation of the drought forecasting system in the programs planned for 2022.

✓ ***Water Committee/"Jrar" CJSC of the Ministry of Territorial Administration and Infrastructure (MTAI)***¹⁹

The Ministry of Territorial Administration and Infrastructure does not have clearly defined functions related to the drought control, however, starting from 2016, a number of activities aimed at addressing urgent measures have been taken to address the risks of water scarcity.

- ✓ 20 portable pumps were purchased. The purchase of portable pumps allowed making more efficient use of temporarily formed surface watercourses outside the basins / sub-basins that feed existing irrigation systems.
- ✓ 8 new deep wells were drilled existing 8 wells were rehabilitated.

¹⁸ www.armmonitoring.am

¹⁹ www.mtad.am

- ✓ In case if the capacity of natural springs and reservoirs are lower than forecasted, the water supply by "Jrar" CJSC and 15 WUAs is carried out by applying water circulation among irrigation systems and communities with the consent of the working group established by the order of the RA Prime Minister.
- ✓ In case of urgent need, additional water withdrawal is carried out from Lake Sevan.
- ✓ Irrigation systems and water metering system are being continuously modernized.
- ✓ A working group was established by the RA Prime Minister's decision of 14.01.2022 for the effective implementation of the work of the small and medium sized reservoir construction project. Taking into account the strictly professional nature of the reservoir construction works and the need for technical, engineering and hydraulic expertise and capacity, additional professional services were involved in the Water Committee by the relevant decision of the RA Government to support the main and supporting divisions of the Water Committee and to provide the organization and implementation of works.

✓ *Ministry of Economy*²⁰

Among the sectors of the economy agriculture has the greatest dependence on climate risks, and consequently on drought. It is impossible to imagine smart agriculture without direct or indirect accounting of climatic conditions. The cultivation of agricultural crops in the given area is first of all conditioned by the climate; it is a question of course how competently the agro-climatic knowledge is used in the management of agriculture.

The sector is the first to feel the impact of drought and the client ordering the establishment of a drought control system should be the implementing link, starting from water use to crop selection, species change, etc. Here the first alarms about the already observed drought are received.

However, the Ministry does not have any function to manage droughts. Nevertheless, the functions of the Ministry's Department of agricultural project management, resource use and cooperation development are indirectly related to drought management functions. These functions are:

- ✓ Comprehensive study and analysis of the actual situation in the field of agriculture, elaboration of proposals and measures aimed at improving the activity of the sector and increasing its efficiency;
- ✓ Development of strategic programs, project measures, concept papers, etc. in the field of agriculture.
- ✓ Determination of the priority directions of the sector development, etc.

All the drought-related functions of the unit are connected with the mitigation of its consequences. Information about the already occurred drought is provided to the Ministry by the local authorities, which represent the area of the affected territory. However, there is not a guidance document/format to provide the information.

²⁰ www.mineconomy.am

To mitigate the effects of drought, activities have been carried out in recent years for introducing climate risk insurance, including drought insurance system. Work is currently underway with an international consulting firm to assess possible agricultural insurance to reduce drought risk to economic entities in agriculture. Spring and autumn barley, wheat, as well as spring oats insurance against the risk of drought (water scarcity) has started in non-irrigated lands.

The 2022-2023 state support program for the development of intensive horticulture in the Republic of Armenia, the introduction of modern technologies and the promotion of non-traditional high-value crop production is being implemented under the coordination of the RA Ministry of Economy. The main goal of the program is to promote the establishment of modern, high-yield orchards through the state support to the vineyards, intensive orchards, berry orchards cultivated through modern technologies, cultivation of non-traditional high-value crops, as well as introduction of modern irrigation systems and hail protection nets, and thereby to promote the development and efficiency of fruit growing and viticulture, increase production and export volumes of competitive grape, fruit and berry, stimulate the production of non-traditional high value crops, reduce the risks related to hails and other climatic factors, contribute to the rational and efficient use of water resources, mitigate the climate change impacts and promote the increase of adaptation level, contribute to incomes of economic entities in agriculture.

Taking into account the role of drip and sprinkling irrigation systems in adapting to climate change and saving resources, the RA strategy pays special attention to their introduction. By the RA Government Decision N 104-L of 27 January 2022, the Ministry has improved the current program, stipulating that 50% of the actual expenses will be reimbursed to each beneficiary for the implementation of 0.5-10 ha modern irrigation systems. If the economic entity wants to use the credit component, a loan with a 2% interest rate is provided with a 4-year repayment period. Within the framework of the program, the construction and expansion of irrigation basins are subsidized. Moreover, the beneficiary of the program can also be the community.

At present, drip and sprinkling irrigation systems are designed and implemented in the Republic of Armenia in the absence of their irrigation regimes, which causes problems in the planning and implementation of irrigation water supply, causing dissatisfaction among water users. To solve the problem, within the framework of the policy monitoring and assessment capacity development program in the field of agriculture the RA Ministry of Economy plans to develop irrigation regimes using modern irrigation technologies, which will be the basis for determining crop water demand, designing irrigation systems and planning irrigation water demand.

➤ *Ministry of Emergency Situations (MEI)*²¹

The Ministry of Emergency Situations does not have a direct drought management function. According to the RA Government action plan for 2021-2026 approved by the decision N 1902-L of 18 November, items 6.1 and 6.2 of the section of measures related to the MES envisage

²¹ www.mes.am

seismic vulnerability assessment of dams of the reservoirs of special state importance of the Republic of Armenia. The main goal of the measure is prevention of secondary seismic risk, as well as effective management of water resources, which can play a preventive role in reducing drought risk.

The MES Department for Development of Disaster Risk Management Policy has developed a draft decision of the RA Government "On approving the National Disaster Management Strategy and its action plan" (hereinafter referred to as the Draft) and submitted it for discussion to interested government bodies, international organizations (UNDP, UNDRR, UNICEF, ARNAP Foundation (DRRNP), Armenian Red Cross Society) and the Public Council under the Minister of Emergency Situations, as well as posted it on www.e-draft.am.

After summarizing the suggestions and comments of all stakeholders, the Draft was submitted to the Prime Minister's Office for discussion on 18 March 2022. The Draft addresses a number of natural phenomena, including earthquakes, rock falls, landslides, collapses, mudslides, floods, freshets, hail, frost, strong winds, thunderstorms, rainstorms, blizzards, ice-slick, forest fires, as well as droughts.

IV. DROUGHT MONITORING

The drought monitoring system should include actual monitoring and drought assessment, with a pre-designed, tested, adopted, and approved methodology. Actual monitoring is the information received from the sites and can be / is carried out by local governments.

1. Atmospheric drought assessment

The concept of atmospheric drought is clearly defined by the RA Government decision.

The RA ME HMMC carries out monitoring of hydro meteorological phenomena and processes and maintenance of a database in the whole territory of the Republic. Assessment of drought conditions is carried out using climatic elements recorded in meteorological stations. The assessment is made on a ten-day basis, estimating the heat and humidity ratio in the current ten days.

Selyaninov's hydrothermal coefficient (HTC) and Shashko's humidity index is used to assess drought taking into account the air temperature, humidity and precipitation. The method used to assess atmospheric drought in Russia is introduced.

Soil (agricultural) drought assessment is not carried out. With all the advantages (availability of data, simplicity of calculations), the method of estimating drought intensity has a significant drawback, as drought intensity levels are determined by the standard approach for wheat-producing regions, not taking into account wetting zones. These indicators are not a complete description of the formation of arid conditions, since the same amount of precipitation, the same air temperature, humidity and other indicators depending on soil type and mechanical composition, terrain, slope positions, vegetation types and other factors may have different effects on soil moisture content.

2. Hydrological drought assessment

Indicators of hydrological drought are provision of streamflow during the vegetation period (April-September) and the amount of water reserves in snow cover in the mountains in February and late March. The latter indicator is used in the forecast of hydrological drought, when the water forecast for the vegetation period is made in late March.

Hydrological drought is primarily determined by natural processes during flow formation, i.e. formation of precipitation accumulation, seasonal snow cover formation and glacier formation and melting processes. Anthropogenic activity must be taken into account during the flow distribution or use, in addition to observations of natural hydro meteorological processes. Hydrological drought is especially acute in low water years, in the lower reaches of rivers.

There is not a developed methodology for assessing hydrological drought in Armenia, which can cause problems in terms of the availability of a legal basis (availability of a clear definition / accepted standard in force) for the information provided (for example, to insurance companies).

V. ARMENIA'S COMMITMENTS FOR DROUGHT MANAGEMENT IN THE FRAMEWORK OF INTERNATIONAL TREATIES, AGREEMENTS AND INFORMATION PRESENTED IN NATIONAL REPORTS

1. UN Convention to Combat Desertification

Armenia is a Party to the United Nations Convention to Combat Desertification (United Nations Convention to Combat Desertification in countries exposed to severe drought and / or desertification, especially in Africa) since 1997.

Under the Convention, Armenia has assumed a number of obligations, where the development of a long-term agreed strategy has a special role (Articles 9, 10). The following is mentioned there in connection with the drought.

- Establishment and / or strengthening of early warning systems;
- Strengthening drought preparedness and drought reversal potential;
- Establishment and / or strengthening of food safety systems;
- Ensuring revenue generation in drought-affected areas;
- Development of sustainable irrigation programs for both agriculture and livestock needs, depending on circumstances, including local and national resources, as well as joint systems operating at sub-regional and regional levels.

1.1 National Communications on the Implementation of the UN Convention to Combat Desertification in Armenia

In accordance with the decision 7 / COP13 of the UN Convention to Combat Desertification, Armenia submitted to the Secretariat of the Convention its 7th National Report on the Implementation of the UN Convention to Combat Desertification in Armenia.

For the first time, the national report also proposed to provide relevant information on "overcoming the effects of drought by providing mitigation and adaptation based on quality monitoring information to increase the sustainability of vulnerable groups of population and ecosystems".

In particular, the following information (related to drought) is presented:

- **Increase in average air temperature.** Average temperature was 0.4 ° C higher than the norm during 1929-1996, and 1.23 ° C (HMMC) higher during 1929-2016.
- **Decrease in precipitation.** In terms of precipitation, the average indicator was lower than the norm by 35 mm (592 mm) in 1935-1996, and by 50 mm in 1935-2016 (HMMC).
- **Annual increase in the number of extreme weather events.** The annual number of extreme weather events (hail with a diameter of more than 20 mm, winds of 25 m / s and more velocity, frost in the vegetation period and 30 mm and more precipitation per hour) in Armenia increased by about 40 events per year or 23.5% on average during 1975-2016 as compared to the average indicator (168 cases per year) (HMMC).

- **Drought intensification and quantitative increase.** Since 2000, the HMMC SNCO has been monitoring drought during April-September according to 9 meteorological stations, covering different climatic zones. According to the monitoring data, the number of intensive and very intensive drought days during 2000-2017 increased by 33 days as compared to the average (87) of 1961-1990 (HMMC).

Additional information on the Strategic Objective 3 of the Convention was also provided, with a report on drought analysis and drought effect mitigation measures in Armenia.

1.2 National action plans

- ✓ **RA Government Protocol Decision N13 of 28 March 2002 "On the National Action Plan for Combating Desertification in Armenia".**

In particular, Chapter 1 item 1.4 states that the joint projects envisaged within the framework of the environmental conventions should be aimed at improving legislation, capacity assessment and use, monitoring, environmental impact assessment, raising public awareness, specialist training, early warning system development.

- ✓ **RA Government Protocol Decision N23 of 27 May 2015 "On Approval of the Strategy and National Action Plan of Combating Desertification in the Republic of Armenia".**

In particular, Chapter IV of the Annex, approved by the Protocol Decision, represents: improvement of the necessary legislation for mitigation of drought effects to create a favorable situation (item 23), introduction of a new drought assessment and forecasting system as a priority area for scientific research (item 38), operational drought monitoring and forecasting using the application of remote sensing data (item 38), through strengthening of synergic link among 3 conventions adopted in Rio and other conventions (item 41).

- ✓ **Within the framework of the National Action Plan for Combating Desertification in Armenia for 2015-2020** (related to drought), by the order N392-A of 6 November 2012 of the RA Minister of Nature Protection the project on "Raising public awareness on the issues of desertification, land degradation and droughts in the Republic of Armenia" was approved. The aim of the project is to promote the involvement of different groups of the society in the process of prevention of desertification and drought mitigation by raising public awareness on the issues of desertification, land degradation and droughts.

2. United Nations Framework Convention on Climate Change

The Convention entered into force for the Republic of Armenia in 1994.

Armenia has undertaken a number of obligations under the Convention (Article 4), which states the following in connection with droughts:

- ✓ All Parties shall elaborate and develop appropriate integrated programs for the protection and rehabilitation of drought-affected areas;
- ✓ Study and provision of required resources (including financial resources and technology transfer) to the countries with regions prone to drought and

desertification to take actions for mitigation and/or responding to adverse climate change effects.

2.1 Fourth National Communication on Climate Change under the UN Framework Convention on Climate Change

The fourth National Communication on Climate Change was submitted by the RA Ministry of Environment in 2020.

Related to droughts, the Communication sets out:

- ✓ In recent years, along with the increase in air temperature and decrease in precipitation, also a significant increase in frequency and intensity of extreme weather events (droughts, heat waves, frost, hail, strong winds and precipitation) and natural disasters (floods, inundations, forest fires etc.) has been observed, which have a negative impact on ecosystems, economy, human welfare and health.
- ✓ According to drought indices, the number of strong and very strong droughts during the period of 2000-2017 increased by 33 days relative to the baseline average (87) for 1961-1990. In recent years, the upper boundary of the drought zone has expanded to include mountainous areas, and the droughts start earlier.
- ✓ Studies have shown that droughts are observed in the lower regions of Armenia almost every year, and in the foothill regions recurrence of droughts is about 50%.
- ✓ The results of the analysis show that over the period of 1935-2016, the aforementioned indices (climatic, heat) demonstrate upward trends throughout the entire territory of the country. These indices are highly characteristic for the increased drought recurrence, which, in turn, is caused by heat depression.
- ✓ Among the climate change induced hydro meteorological hazards, hailstorms, frosts, heat waves and droughts have the biggest impact on the loss of agricultural crop yields.
- ✓ According to forecasts, during the upcoming 100 years, the agricultural sector is likely to undergo significant changes due to climate change. In particular: more frequently observed droughts and low soil moisture will be combined with a lack of irrigation water, the water deficit of lands will increase by 25-30%; the decline in river flows by 25% will result in decrease of productivity of irrigated land plots by approximately 24%.

In order to have a correct understanding of the drought management system, it is necessary to clearly describe the possible areas of drought impact in the country, its consequences in each area, and the possible ways / means of eliminating the consequences.

VI. GAPS IN DROUGHT MANAGEMENT

- *Contradiction between the RA Water Code and the Law on the Fundamental Provisions of the National Water Policy of the Republic of Armenia*

In case of a Government decision on declaring water scarcity or drought in the whole territory of the Republic of Armenia or in a part of it, the use of water resources in the given territories is restricted or limited, taking into account the priority of water use defined by the RA Law on

Fundamental Provisions of National Water Policy. While carrying out this process, a contradiction arises between the RA Water Code and the RA Law on Fundamental Provisions of National Water Policy.

➤ ***There are no current legislative regulations for drought management***

Although there are existing legal regulations on the definition of drought types, drought declaration and elimination of consequences in various legal acts, the existing laws and by-laws do not have a systematic approach to drought management. The actions to be taken in case of drought, which can contribute to the mitigation of the effects of the drought, the implementation of measures, the actions of the authorized bodies in case of declaration of drought are not specified.

➤ ***There are no drought management mechanisms***

There is a low level of modern irrigation systems, underdeveloped agricultural consulting system, low level of water resources storage, lack of drought management mechanisms. Insufficient information / knowledge among beneficiaries (farmers, etc.) on climate change, adaptation, mitigation.

➤ ***There is no information on the work of the interdepartmental commission***

According to the RA Prime Minister's Decision N712-A of 2 July 2021, an interdepartmental commission was established to prevent possible drought or water scarcity in the Republic of Armenia, to eliminate or mitigate the effects of drought or water scarcity, to identify possible problems, to coordinate operative response measures, as well as to coordinate the works for the development of a strategy to increase the efficiency of the irrigation sector. However, there is no information on the works of the Commission.

➤ ***There is not a developed and approved methodology for drought assessment in Armenia.***

The methodology for assessing water scarcity has been developed in the form of a legal act; however, it is not enshrined in any legal act.

➤ ***There is a discrepancy between international definitions, indices and indicators and those used in Armenia***

The Hydro-meteorological Monitoring Center SNCO conducts drought assessment (ten-day) applying climatic elements recorded at atmospheric meteorological stations, as mentioned above, using the Selyaninov's Hydrothermal Coefficient (CHC). This index does not take into account the wetting conditions of the area and the classification has been made by analyzing the statistical data of wheat yield for Russia.

As mentioned above, HMMC SNCO's method of monitoring drought has shortcomings, and giving a general idea of drought, it does not describe drought with great accuracy.

➤ ***Gaps in the introduction of the agricultural insurance system***

From the point of view of agricultural insurance, the data gaps will be conditioned by when the insurance companies will start their activity in the country and what information they will require from HMMC SNCO.

Based on the results of the remote discussion, the following were singled out as gaps:

- ✓ Gap in evaporation data;
- ✓ Lack of drought assessment methodology;
- ✓ Format of certificates on drought, issuing deadlines.

➤ ***Gaps in the information system***

Each department collects, analyzes and keeps in its database the information within its activity field. The exchange of information between departments is based on written or verbal inquiries. In case of drought this model cannot work. The information will be received too late.

➤ ***Gaps in the monitoring and forecast system***

Only a part of the HMMC SNCO's hydro-meteorological stations has been modernized. This causes problems in obtaining more reliable meteorological, hydrological information, which in turn can affect the correct assessment of droughts.

Satellite data, i.e. drought indices, are also not sufficiently used; their introduction will further increase the accuracy of drought assessments, especially in determining the spatial distribution of drought.

➤ ***An early drought warning system does not exist in the country as such.***

VII. RECOMMENDATIONS AND ACTIONS TO ADDRESS GAPS IN DROUGHT MANAGEMENT

Analyzing the gaps identified in the field of drought management, the following recommendations and actions were provided to overcome them.

- **To bring the requirements defined by the RA Water Code in line with the requirements set by the RA National Water Policy**, avoiding different legal regulations related to actions of the same content in different legal acts.
- **Make necessary changes to the RA Government Decision № 349-N of 18 March 2004**, adapting the definitions and related characteristics of drought types as far as possible.
- To ensure the implementation of item 1.1 of the list of measures approved in Chapter 9 of the Annex to Decision No. 749-L of 13 May 2021 on “Approving the National Climate Change Adaptation Plan and the list of actions for 2021-2025”, a draft decision of the Government “On approving the Climate Change Adaptation Plan in the field of water resources” has been developed in cooperation with the UNDP National Climate Change Adaptation Plan, which according to Article 6, Part 2 of the Constitution of the Republic of Armenia can be circulated if there is a legal basis. In order to provide a legal basis for the development of the above-mentioned draft, a draft law "On Making Amendments to the Water Code of the Republic of Armenia" has been developed and circulated, after the adoption of which the already developed draft will be circulated in accordance with the order established by law, and will be presented to the Prime Minister's Office.
- **Within the framework of these changes and additions, develop a "Procedure for priority use of irrigation water in the conditions of water scarcity and drought"** is to be developed, which will include:
 - ✓ Methodology for calculating irrigation norms in conditions of water scarcity;
 - ✓ Methodology for calculating irrigation norms by modern irrigation methods,
 - ✓ Defining irrigation water priorities in conditions of water scarcity and drought, etc.
- **Pre-identify, inventory new or alternative sources of water supply to water users** for each water basin management area, compile clear lists, regulate the operation of the pumps to be used, regulate the use of irrigation water in case of drought or water scarcity, in order to respond quickly in case of water scarcity or drought in the whole territory of the Republic or in a part of it and to implement effective management.
- In the risky conditions of agriculture in Armenia, as well as for CC adaptation it is a priority to regulate the selection of **drought-resistant and frost-resistant crop species** in communities with excessive water demand, **the widespread use of modern water-saving technologies, and the reduction of leakage in the water sector**.

- **Implement agro-climatic zoning**, clarifying the efficiency of crop cultivation in the respective zone, paying attention to both traditional crops and new possible crops imported / to be imported.
- With the involvement of relevant experts, **select the most suitable areas for growing crops according to the crop** (where and what is expedient to grow) and **map** those areas, using meteorological elements, soil type and crop growth and development indicators.
- Study, apply / test more than one approach to drought assessment; **introduce the most applicable method(s) with the inclusion / application of meteorological and satellite indicators, index system**. Ratify the studied, applied / tested methodology by a relevant legal act.
- Make a transition **to systems of agriculture, economy management, and use of water resources, with the help of which it will be possible to always be prepared for drought and to overcome drought periods**.
- **Establish a common information platform for data collection and exchange**

As a result of the introduction of the information platform, it will be possible to exchange information in a comprehensive way in real or close to real time. Availability of an information system is an important tool for collecting and exchanging information. Develop and introduce standardized data collection and processing protocols.

In case of introduction of information platform:

- ✓ An electronic information exchange platform will be set up (in case of drought occurrence, information will be provided by farmers, village mayors, regional administrations, and the HMCC SNCO will present drought assessments and forecasts);
- ✓ The identification of potential consumers (farmer, water management system, decision maker, government) will be improved.

In case of proper development of the system mechanism, it will facilitate the rapid exchange of information among all stakeholders, timely decision-making to raise public awareness, and access to information for government agencies to cooperate on the basis of available information.

➤ **Develop and establish clear communication mechanisms between governmental, local self-governmental bodies, scientific institutions**, defining the actions to be taken by each party. Mechanisms can be approved by a government decision, plan or another normative legal act. Communication mechanisms during a drought should include:

- The framework of stakeholders and responsible parties;
- The action to be performed by each body;
- Information exchange mechanisms;
- Drought awareness actions.

➤ **Map the areas / zones most vulnerable to drought**, including information on drought duration and intensity, using historical information and relevant climate and satellite data.

➤ **Develop and introduce a drought risk forecasting system**

Drought is a natural disaster with different manifestations of space, time and intensity, so in order to manage it, it is first necessary to develop a drought risk forecasting and early warning system.

Drought assessment in our country is carried out by HMCC SNCO, whose capacity is not sufficient to make forecasts. Both drought assessment and forecasting systems need to be improved, which, along with other tools, will form the basis of the early warning system.

To improve drought monitoring and full assessment, it is necessary to establish:

- ✓ A drought assessment monitoring system using / introducing modern, widely used universal indices of risk assessment (meteorological and satellite).
- ✓ To organize staff training on modern drought meteorological indices, use of satellite information, in particular the calculation of drought indices.

➤ **Introduce a drought forecasting system**

- It is necessary to introduce a drought forecasting system using digital weather forecasting models, later probable forecasts based on monthly and seasonal forecasts.

To ensure the implementation of the drought forecasting system, it is necessary to strengthen the capacity of HMMC SNCO:

- ✓ Complete modernization of the monitoring observation network, including water metering propellers, forecasting models and new equipment, which will increase the reliability of information received from hydrological observation posts and meteorological stations;
- ✓ Installation of automatic water level recording stations in hydrological observation posts, automatic humidity meters and vapor detectors in meteorological stations,
- ✓ Localization and introducing of modern meteorological, climatic and hydrological models, as a result of which it will be possible to estimate the drought with meteorological, climatic and hydrological data in order to improve the short-term and long-term forecasting system.
- ✓ Establishment of radar monitoring, satellite data reception and processing systems for short-term, long-term forecast improvement, early warning of dangerous hydro meteorological phenomena;
- ✓ Acquisition and installation of radar stations for long-term forecasts of dangerous phenomena (3 pieces, which will cover the whole territory of Armenia);
- ✓ Creation of a mobile application to spread the warning of the expected dangerous hydro meteorological phenomena;

- ✓ Organizing training courses for specialists with the involvement of international experts on operating the new equipment, assessing the drought, localizing and applying the forecasting methodology.

➤ Create opportunities for agricultural drought assessment

To assess agricultural drought, it is necessary to:

- ✓ Equip the automatic meteorological stations with soil moisture meters, vapor and other relative sensors,
- ✓ Upgrade HMMC's monitoring network (at least at key points) with vapor sensors, and introduce / improve evaporation calculation methodology.

➤ Improve the accuracy of short-term and long-term forecasts by introducing a digital weather forecast model

It is necessary to introduce / localize modern meteorological, climatic and hydrological models, to train specialists using the models with the involvement of relevant international experts.

➤ Establish mechanisms for early warning of droughts

To introduce an early warning system, the following is needed:

- ✓ To develop an action plan in case of drought for warning, comprehensive information exchange, clear cooperation, decision-making and targeted implementation;
- ✓ To provide the legal framework for the operation of the early warning system;
- ✓ To develop classification schemes (maps) according to which the early warning and relevant consultation will be carried out:
- ✓ To define ways of early warning;
- ✓ To develop standard schemes for data and information exchange;
- ✓ To introduce a monitoring model;
- ✓ To develop an order for early warning (what information, through whom, by what means and to whom it should be communicated);
- ✓ To develop and introduce an information exchange scheme;
- ✓ To develop a control model;
- ✓ To develop / set a reporting format;
- ✓ To develop a data analysis model;
- ✓ To create a server, etc.

➤ Expand international cooperation for joint research and improvement of the relevant level of expertise.

➤ Increase beneficiaries' knowledge of both drought characteristics and understanding and correct application of information on the drought.

Annexes

Annex N1

Selyaninov's method for atmospheric drought assessment

$$\text{HTI } (\Gamma\text{TK}) - [\text{mm}/^{\circ}\text{C}] \quad \Gamma\text{TK} = \frac{\sum R(i+(i-1)+(i-2))}{0.1 \sum T \geq 10^{\circ}\text{C}(i+(i-1)+(i-2))}$$

$$Md - \text{is Shashko's moisture index } [\text{mm}/\text{mb}] \quad Md = \frac{\sum R(i+(i-1)+(i-2))}{\sum d(i+(i-1)+(i-2))}$$

Where

i - is the sequential number of the assessed ten days

(i-1)-is the number of the ten days preceding the assessed ten days

(i-2)-is the number of the 2 ten- day period preceding the assessed ten days

$\sum R$ -is the sum of precipitation

$\sum T \geq 10^{\circ}\text{C}$ - is the sum of temperatures $\geq 10^{\circ}\text{C}$

$\sum d$ - is the sum of moisture deficit

Nt ($t > 30^{\circ}\text{C}$) – is the number of days with maximum air temperature

N0 (<30%) – is the number of days with minimum air moisture

Indicators	Minim um	Maxim um	Drought intensity				
			Very strong (class 1)	Strong (class 2)	Average (class 3)	Weak (class 4)	Absence of drought (class 5)
HTI	0	5	0-0.19	0.2-0.39	0.4-0.6	0.61-0.75	0.76-5.0
Md	0	3	0-0.09	0.1-0.19	0.2-0.3	0.31-0.4	0.41-3
N0	0	11	8-11	6-7	3.0-5	1-2	0
Nt	0	11	8-11		3-4	1-2	0

Proposing methodologies for the application of new criteria based on international experience

Application of Standardized Precipitation Index (SPI), Vegetation Health Index (VHI) and soil moisture data for determination of droughts.

WMO developed a Handbook of Drought Indicators and Indices in 2016, where the drought management indices and the level of accessibility of their application are mentioned. Simple calculations, with a code or program to run the index readily and freely available, not requiring daily data are marked in green, with appropriate coloring distinguishing the indices calculated with slight difficulties or those requiring more complex calculations
https://library.wmo.int/doc_num.php?explnum_id=3192.

Standardized Precipitation Index (SPI) is among these indices that is recommended by the WMO for drought monitoring as a universal index for all and allows identifying the types of different droughts according to their consequences.

Standardized Precipitation Index (SPI)

The basis of the index is that it builds upon the relationships of drought to frequency, duration and timescales. In 2009, WMO recommended SPI as the main meteorological drought index that countries should use to monitor and follow drought conditions (Hayes, 2011). By identifying SPI as an index for broad use, WMO provided direction for countries trying to establish a level of drought early warning.

Characteristics: Uses historical precipitation records for any location to develop a probability of precipitation that can be computed at any number of timescales, from 1 month to 48 months or longer. As with other climatic indicators, the time series of data used to calculate SPI does not need to be of a specific length. Guttman (1998, 1999) noted that if additional data are present in a long time series, the results of the probability distribution will be more robust because more samples of extreme wet and extreme dry events are included.

SPI has an intensity scale in which both positive and negative values are calculated, which correlate directly to wet and dry events. For drought, there is great interest in the ‘tails’ of the precipitation distribution, and especially in the extreme dry events, which are the events considered to be rare based upon the climate of the region being investigated.

Owing to the utility and flexibility of SPI, it can be calculated with data missing from the period of record for a location. Ideally, the time series should be as complete as possible, but SPI calculations will provide a ‘null’ value if there are insufficient data to calculate a value, and SPI will begin calculating output again as data become available. SPI is typically calculated for timescales of up to 24 months, and the flexibility of the index allows for multiple applications addressing events that affect agriculture, water resources and other sectors.

Applications: The ability of SPI to be calculated at various timescales allows for multiple applications. Depending on the drought impact in question, SPI values for 3 months or less

might be useful for basic drought monitoring, values for 6 months or less for monitoring agricultural impacts and values for 12 months or longer for hydrological impacts.

SPI can also be calculated on gridded precipitation datasets, which allows for a wider scope of users than those just working with station-based data.

Strengths: Using precipitation data only is the greatest strength of SPI, as it makes it very easy to use and calculate. SPI is applicable in all climate regimes, and SPI values for very different climates can be compared. The ability of SPI to be computed for short periods of record that contain missing data is also valuable for those regions that may be data poor or lacking long-term, cohesive datasets.

Weaknesses: With precipitation as the only input, SPI is deficient when accounting for the temperature component, which is important to the overall water balance and water use of a region. This drawback can make it more difficult to compare events of similar SPI values but different temperature scenarios. <http://drought.unl.edu/MonitoringTools/DownloadableSIPProgram.aspx>

Palmer Drought Severity Index (PDSI)

Origins: Developed in the 1960s as one of the first attempts to identify droughts using more than just precipitation data. Palmer was tasked with developing a method to incorporate temperature and precipitation data with water balance information to identify droughts in crop-producing regions of the United States. For many years, PDSI was the only operational drought index, and it is still very popular around the world.

Characteristics: Calculated using monthly temperature and precipitation data along with information on the water-holding capacity of soils.

It takes into account moisture received (precipitation) as well as moisture stored in the soil, accounting for the potential loss of moisture due to temperature influences.

Strengths: Used around the world, and the code and output are widely available. Scientific literature contains numerous papers related to PDSI.

Weaknesses: The need for serially complete data may cause problems. PDSI has a timescale of approximately nine months, which leads to a lag in identifying drought conditions based upon simplification of the soil moisture component within the calculations. This lag may be up to several months, which is a drawback when trying to identify a rapidly emerging drought situation. Seasonal issues also exist, as PDSI does not handle frozen precipitation or frozen soils well. <http://hydrology.princeton.edu/data.pdsi.php>

The application of these three indices as a result of relevant research can be introduced as meteorological indices for drought risk assessment.

Satellite indices for drought assessment

Given the spatial and temporal variability and multilayered effects of drought, the provision of information on drought needs to be improved using a variety of tools and data available, as well as the monitoring of the phenomena at all scales, allowing in time provision of geographical

information (in the form of maps and data) on the areas where drought has impact on vegetation, using the internet as a primary delivery factor.

High-resolution data provide close-synoptic real-time measurements of surface conditions. As a result of studies, strong links have been established between climate variables and satellite-derived vegetation indicators.

The satellite indices (EVI, ESI NDVI, VCI, TCI, FAPAR, etc.) are marked in green in the WMO's "Handbook of Drought Indicators and Indices"; they are freely available and can be used to adjust drought assessments in Armenia.

Integrating satellite information on drought-affected vegetation with climate drought indicators will improve drought-monitoring results by providing spatial information on drought pattern and distribution.

Eventually, this information, combined with a map of key drought indicators, will be available to end users to make timely decisions.

Additional sources for the use of satellite information

Data Cube for Drought and Vegetation Monitoring

EUMETSAT (European Meteorological Satellite) organization has created the Drought & Vegetation Data Cube (D&V Data Cube) portal, which provides data for drought and vegetation monitoring and analysis from EUMETSAT's relevant SAFs and other storages. All data records are provided on a regular latitude / longitude network and in CF compliant netCDF.

FAO has developed the Agriculture Stress Index System (ASIS), based on satellite monitoring and analysis of vegetation condition.

FAO's Global Information and Early Warning System (GIEWS) and Climate and Energy Department have developed a system for identifying water stress - drought zones of high probability, at the global, regional and country level. Vegetation indices are monitored during the vegetation period of plants. ASIS can detect hotspots around the world where crops can be affected by drought.

<https://www.fao.org/resilience/actualites-evenements/histoire-detail/fr/c/296089/>

The software can be used at national level free; however, it is required to write to the organization.

Drought impact decision matrix

Impact	Cost	Equally distributed?	Growing?	Public priority?	Equitable recovery?	Impact rank

(FAO and NDMC, 2008)

An example of impact on rural economy

Income Loss Due to Crop Failure								
Why did you have income losses from crop failure?								
Crop failure				Lack of crop insurance		Inadequacy of relief assistance		
Why the crop failure?				Why the lack of crop insurance?		Why inadequacy of relief assistance?		
Lack of water WHY?	No irrigation	Poor crop selection WHY?	Farmer preference	Government incentives	High Cost WHY?	Inefficient 'blanket coverage' WHY?	Conflicting relief programmes WHY?	Too slow WHY?
Climat e	Other seeds are expensive	Farmer preference	Government incentives	No drought warning	Lack of research and relief programme coordination			

(FAO and NDMC, 2008)

An example of impact on tourism

Loss of Tourism Revenue					
Why was there lost revenue?					
Reduction of golf course revenue		Reduction of reservoir-based tourism			
Why did they lose revenue?		Why the reduction of reservoir revenue?			
Fewer daily golfers WHY?	Cancellation of tournaments WHY?	Low attendance WHY?			
Poor course conditions WHY?		Reduced water quality	Low reservoir levels WHY?		Loss of aesthetic value
Lack of water WHY?		X	Reduced precipitation	Too much release	Too much demand
Non-essential use restriction	High water use course design	X	X	X	X

(NDMC)

References

- ✓ <https://land.copernicus.eu/global/products/fapar>
- ✓ <https://www.nature.com/articles/sdata20141>
- ✓ <https://articlekz.com/article/29166>
- ✓ <https://collectedpapers.com.ua/ru/agroclimatology/posuhi>
- ✓ [https://www.academia.edu/24356458/Climate Change Impact on Agricultural Economy in Armenia?email_work_card=view-paper](https://www.academia.edu/24356458/Climate_Change_Impact_on_Agricultural_Economy_in_Armenia?email_work_card=view-paper)
- ✓ http://www.dmcsee.org/uploads/file/70_drought_indices_a_ceglar.pdf
- ✓ <https://agrimetsoft.com/Default>

APPENDIX 4. INTEGRATED DROUGHT MANAGEMENT PLAN OUTLINE DRAFT

Introduction

The Integrated Drought Management Plan IDMP enables coordination of communication among stakeholders, different groups, and the public. The plan is envisaged to facilitate coordinated activity for planning, monitoring and preparedness, making the most of time and resources. Moreover, the plan is intended as a guide to establish effective operational procedures for drought forecasting, monitoring, mitigation of drought risks and impacts. It provides a framework by which key organizations will prepare for drought, and when, and how they will implement mitigation processes and procedures. Thus, the main goals of the plan are:

- To define the roles and responsibilities of key individuals, organizations,
- To define drought standards and intensity, to set up early warning mechanisms for all stakeholders, and to develop mitigation measures.
- To propose an institutional framework and organizational system that provides training for different government and civil society groups.
- To identify mitigation measures that can be taken to reduce drought risks and impacts.
- Establish a set of procedures to continually evaluate and exercise the plan and periodically revise the plan so it will remain responsive to local needs and reinforce national drought policy (experience from governance says, if the impact of the plans and strategies are not evaluated, they tend to remain plan and the application is not ensured).

The implementation of these goals will provide the following results:

- Drought control measures are properly defined in the riskiest areas.
- Risks are assessed and all stakeholders communicate effectively with a responsibility for timely and coordinated action,
- Standard procedures are developed for intensity assessment and for implementation of drought mitigation measures.
- Full stakeholder engagement and capacity building is implemented at all levels.

Scope and Applicability

The draft plan presents a systematic and scientific approach to analysing and assessing drought impact, coordinating actions. Hydro-meteorological and socio-ecological conditions causing droughts were assessed at the national level and the droughts' intensity was assessed in individual regions or river basins. Coordination and drought mitigation actions outlined in the plan are applicable for public authorities, local governments, all types of water users, planning agencies, other stakeholders, and the general public in Armenia.

The plan specifies the methodology used by the government to estimate levels of drought intensity. It defines the responsibilities of governance institutions from national to local level. The government agencies responsible for dealing with drought are particularly addressed in this aspect. Means of communication which are appropriate to be used are defined. The sequential actions that should be taken at the local, regional, and state levels, depending on the severity of the drought and the ability to respond to it are described. The plan provides guidance for preparation actions at the local and national level during critical drought.

This project does not limit the powers of local self-government bodies and is in line with the provisions of local emergency bylaws or regulations to protect public welfare, safety, and health when necessary.

OUTLINE (with comments, where applicable)

Background

Climate change: past, present, future

The effects of drought - past, present, future.

Definition of drought

- Atmospheric drought: definition and assessment methodology
- Hydrological drought: definition and assessment methodology
- Ecological drought definition and assessment methodology
- Agricultural drought: definition and assessment methodology
- Socio-economic drought: definition and assessment methodology

Responsible bodies and coordination

The interdepartmental Working group on Drought has been established. Provide details how. Its members – who. Roles and responsibilities of public administration and local self-government bodies, starting from disaster management to response to them. Organizations with clear or indirect powers to manage problems caused by drought should be listed

Functions assigned

Ministries, departments, regional administrations, SNCOs

(What functions are assigned to and if there are not any, what functions should perform in the drought management process?)

Supporting national and international agencies

List the international organizations and funds that provide support for the drought control.

Existing approaches, projects and national policy

1. Assessment and monitoring

1.1 Drought intensity level

According to this plan, the intensity of drought is assessed by 5 levels, normal condition, when there is no drought and 4 levels of drought.

Level 0: No drought

Level 1: Mild drought

Level 2: Significant drought

Level 3: Critical drought

Level 4: Emergency drought.

These levels of drought are based on accepted drought-related indicators and forecasts. The indicators were set to all drought types and included as attachment of this report. The frequency

and coupling of drought events (more events in consecutive years) are considered. The compound effect of different drought types is also considered. The spatial aspect of drought occurrence in (part) of the basin and nested catchments is also considered and allow to monitor the spread the drought spreading and regionality. The indicators are reviewed for their performance with monitoring data and the current drought occurrence and severity trends and climate change trends on regular basis.

1.2 Drought-prone areas

Are mapped based on existing data, possible projection on drought occurrence, considering spatial-temporal patterns, and surface and ground water use under compounds effects of different type of droughts. Could be water use in those areas mapped and monitored linked to water unavailability.

1.3 Hydro meteorological data, data gaps

Existing monitoring system, problems, gaps. The information on the data can be presented in the form of a table below.

Indicator	Monitoring period	Data source	Meteorological station, hydrological post
Precipitation			
River flow			
Volume of reservoirs / lakes			
Underground water			

1.4 National Drought Assessment Indicators and Indices

National drought assessment indicators should be developed, and indices should be adopted to assess and predict drought according to the types of droughts mentioned in point 1.3. It can be presented in the form of a table below.

Type of drought	Indicator and/or Index	Source and/or example
Atmospheric		
Hydrological		
Agricultural		
Socio-economic		

1.4 Methodology for calculating indicators

1.4.1 Methodology for review of indicators performance against the trends of climate, socio-ecological changes, and the structure for adoption of new indicators

1.4.2 Additional information

1.5 Drought status determination process

This section describes the process by which the government agencies determine the level of drought. Who officially informs about the drought level and to whom? Who announces drought levels for each region / basin? Who announces end of drought, and drought compound event²²?

5.1.1 Data collection and proposal on drought

5.1.2 Drought declaration

5.1.3 Drought end declaration.

2 Drought communication

This section sets out the scope of the general drought management notice and communication.

2.1 Communication platforms

Primary communication between government agencies; describe the means of communication: messages, calls, meetings, website, etc.

2.2 Communication between public administration and local self-government bodies

During a drought, the Intergovernmental Commission on Drought Management will liaise with local and government agencies, presenting hydrological conditions, drought intensity levels, potential impacts, and appropriate response, i.e. actions and measures.

This can be presented in the form of a table.

Recipient of the message	Agency sending the message	Deadlines for sending the message
Water supply company		
Community water suppliers		
Local health organizations		
Forestry		
Farmers		
Other water users		
Firefighting services		
Territorial planning organizations, NGOs, etc.		

²² By compound events, I mean when for example meteo and hydro drought occur together, and agri drought is still not there. If measures would be taken, maybe the agri will not occur. But if socio-economic measures (e.g. preferring energy sector against irrigation) will remain, agri drought can occur. Then the compound is again meteo-hydro-agri. Lets say, it start to rain, but soil moisture is not increasing because of stormy runoff events when most of water (on sealed soils) flow out of the watershed. The meteo drought si not there, but the agri remains. Who would say, which one is ended? And who would det up the measures for tackling one type in a way, that the others are not appearing?

2.3 Public communication

It is very important that accurate, timely information about the current state of the drought and its consequences be communicated to the public. Describe the means and forms of communication.

2.4 Media communication

It is important for the media to receive guided and targeted communication (who should do it and how)

2.5 Emergency and notification

What tools should be used by the government in the event of an emergency to alert in case of danger to life, property or safety, and how to use them?

2.6 Drought end notification

3 Summary of responsibilities of public administration bodies

3.1 ME

3.2 MES

3.3 MTAI

3.4 MEc.

3.5 MH

3.6 MF

4 Drought preparedness of and response actions by government agencies

This section describes the roles and responsibilities of government agencies in:

- Conceptualizing, executing, monitoring and updating effectiveness of preparedness measures and management system components (e.g., institutional arrangements, cross-sectoral cooperation, public participation related to different types of drought, and their coupled effects, and compound events)
- Conceptualizing, executing, monitoring and updating effectiveness of response action, measures and management system components (e.g., institutional arrangements, cross-sectoral cooperation, public participation) to drought conditions at different levels of intensity and frequency.
- Both sections, include the roles and responsibilities in post-drought evaluation and audit, and consequent adaptive changes of management approaches.

4.1 Table: Government preparedness actions

Action category	Actions	Responsible
Data collection, analysis and reporting		
Coordination		
Water resources protection		
Communication and public awareness		
Technical assistance		
Financial support		

Policy and regulations
Monitoring of processes, evaluation and update

4.2 Government agency drought response actions

- 4.2.1 Drought response actions by government agency in case of 1st level drought
- 4.2.2 Drought response actions by government agency in case of 2nd level drought
- 4.2.3 Drought response actions by government agency in case of 3rd level drought
- 4.2.4 Drought response actions by government agency in case of 4th level drought
- 4.2.5 Drought response action by government agency in case of coupled drought event, and compound events

Link of government responsibilities

5 Drought preparedness and response actions – guideline for communities (as an Annex)

5.1 Drought preparedness actions at the community level

This section sets out actions to be taken at local level before the drought (preparatory) and during the drought (response). The main implementers of the actions are the municipalities and/or the managers of the public water systems. Auxiliary partners can be environmental groups, interested citizens, local councils, commissions, etc. The document outline how the capacities of the local level are built up, in both mandate, institutional infrastructure, manpower and funding.

One of the key actions to prepare for a drought is to develop a drought management plan for the community that will guide the actions before, during and after the drought.

5.1.1 Development of water saving plan:

- Development and implementation of open pipe water supply plan,
- Irrigation system efficiency increasing plan
- Land use planning including water retention systems and nature based solutions
- Closed pipe water supply management plan,
- Water loss control plan,
- Efficient water use promotion plans by changing the water tariff, etc.
- Monitoring and obligatory reporting schemes on water use

5.1.2 Development of drought management plan

- Establishment, coordination and control of a drought responsible team,
- Forecasted supply vs demand,
- Supply and demand regulation during (response) and outside (prevention) drought situation
- Development of phase by phase drought response and preparedness plan
- Adoption of the plan
- Implementation of the plan.

5.2 Community Drought Response Actions

Local authorities that may be involved in drought management include city authorities, water suppliers, local and regional health authorities, local planning councils and other regional agencies responsible for water. The general roles and responsibilities of local authorities during the drought should be mentioned here.

5.3 Post-drought actions

After the drought, the emphasis should be on protection of the affected resources, and it should be described here what actions should be taken to maintain long-term water sustainability.

Short-term measures should have an immediate impact, while long-term measures are aimed at adapting to climate change and changing drought patterns (severity, frequency). They are linked to other pressing issues. They are building resilience in natural systems (environmental flow), in managed landscapes in rural and urban areas (nature based solutions, revitalisation, soil water retention measures) and socio-economic resilience by including whole society, community.

Among such measures are:

- Storage of water resources, protection of water sources, exploitation of new springs
- Various measures of soil moisture protection: tree planting / agroforestry, forest belt, soil cover management, and intercropping, cropping systems, ecological agriculture and permaculture
- Management of landscape hydrological connectivity
- Protection of rivers and wetlands, revitalisation of floodplains and rivers
- Setting up social adaptive learning processes on community responses and action planning. Continuous participation and engagement during the non-drought period. Process ownership strengthening.
- etc.

6. Capacity building

The main goal is to have a systematic functional national system for drought control with appropriate resources, such as professional, technical, and financial. This is achieved by continuous capacity building and human resource development schemes in the respective institutions, linked to the educational institutions who prepare the new experts. Awareness rising and capacity building of end water users

6 Conclusions and recommendations

6.1 Conclusions

6.2 Recommendations

6.3 Plan revision, update

APPENDIX 5. MEETINGS AND RETREAT WORKSHOP OF THE WORKING GROUP





APPENDIX 6. STAKEHOLDER ENGAGEMENT WORKSHOP

AGENDA

Day 1 04 May	
Hour	Event
09:00-09:45	Departure of the participants from Yerevan
10:00-11:00 Arrival and Breakfast	
11:00-11:10	Welcome Speech Deputy Minister of Environment: <i>Gayane Gabrielyan</i> Chairperson of the CWP Armenia NGO: <i>Arevik Hovsepyan</i>
11:10-11:20	Presentation of the participants
11:20-13:00	<p>Part 1:</p> <p>Description of the current situation of drought management in Armenia. Moderator: A . Hovsepyan</p> <p>Legal framework regulating drought management sector</p> <p>Members of the ME working group: <i>Nazik Chzmachyan, Liana Alikhanyan</i></p> <p>Commitments assumed by Armenia under international treaties and agreements on drought management, information presented in national reports Project Expert: <i>A. Vardevanyan</i></p> <p>Institutional drought management system HMC SNCO Working Group Member: <i>Edgar Misakyan</i></p> <p>Questions, discussion</p>
13:00-14:00 - Lunch	
14:00-15:00	<p>Part 2:</p> <p>Drought management system gaps Moderator: <i>A . Savadyan</i></p> <p>HMC SNCO Working Group Member: <i>Edgar Misakyan</i></p> <p>Gaps in Legal framework regulating drought management sector Members of the ME working group: <i>Nazik Chzmachyan, Liana Alikhanyan</i> Questions, discussion</p>
15:00-15:30 Coffee break	
15:30-16:30	<p>Part 3:</p> <p>Recommendations for overcoming the gaps in the drought management system Project Expert: <i>A. Hovsepyan</i> Questions, discussion</p>

16:30- 17:30	Gaps in the drought management system and recommended measures -General discussion of the document, additions
19:00-20:00 Dinner	
Day 2 05 May	
09:00-10:00 Breakfast	
10:00- 10:30	Presentation of the content of the Integrated Drought Management Plan Project Expert: <i>A. Hovsepyan</i>
10:30-11:00	Discussion of Sections 1 – 4 of the IDMP
11:00-12:00 - Coffee break, checking out	
12:00-12:30	Discussion of Sections 5– 8 of the IDMP
12:30-13:00	Discussion of Sections 8 – 12 of the IDMP
13:00-14:00 – Lunch	
14:00-15:00	Free time
15:00	Departure from Aghveran

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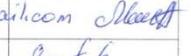
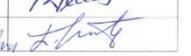
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Երաշտների համապարփակ կառավարում
Աշխատանքային խմբի հանդիպում

Մայիսի 4-5, 2022

«Արթուր Աղվերան Ռեզորչ»

ՀՀ	Կազմակերպություն	Անուն ազգանուն	Հեռախոս	Էլ.փոստ	Մտորագրություն
1.	ՀՀ շրջակա միջավայրի նախարարի տեղակալ	Գայանե Գարբիկյան	095109109	g.gabrielyan@env.am	
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5.	ՇՄՆ, հողերի և ընդերքի քաղաքականության վարչություն	Անի Խաչատրյան	011818525	ani.khachatryan@env.am	
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7.	«Հնդրության բարանության և մոնիթորինգի կենտրոն» ՊՈԱԿ Ժիրուողիայի ճառադրյան պետ	Էնգար Միսակյան	093975077	e.misakyan@mail.ru	
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19.	Վիճակագրական կոմիտե, քննադատականության վիճակագրության բաժին	Նաիրա Սահնդայան	055003293	nairam67@gmail.com	
20.	Վիճակագրական կոմիտե, քննադատականության վիճակագրության բաժնի պետ	Աննա Հակոբյան	077946667	eco@armstat.am	
21.	ՀՀ ԱԲՆ ճգնաժամային կառավարման պետական ակտանման Գիտական հետազոտությունների կենտրոնի պետ	Սարգսիկ Բակունց	098 202310	satenbakunc@yahoo.com	
22.	Փորձագետ	Աշոտ Վարդենիսյան	091340461	ashot_v@mail.ru	
23.	«Ազգային ջրային համագործակցություն» ԳԵ ՀԿ	Արեիկ Հովսեփյան	091539202	Cwp.armenia@gmail.com	
24.	«Ազգային ջրային համագործակցություն» ԳԵ ՀԿ	Ալիսա Սավադյան	091204215	asavadyan@gmail.com	
25.	«Ազգային ջրային համագործակցություն» ԳԵ ՀԿ	Լիանա Հովսեփյան	055880898	Lianahovsepyan.cwp@gmail.com	
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