CLIMATE CHANGE ADAPTATION TECHNOLOGY NEEDS ASSESSMENT

in

ENERGY, AGRICULTURE, WATER, FORESTRY, TRANSPORT, HEALTH

sectors of the

REPUBLIC of MOLDOVA

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FOREWORD

The Republic of Moldova stands at a critical juncture in its development, where climate change adaptation is essential for safeguarding its economic, social, and environmental future. The country has aligned with the UNFCCC Parties in recognizing the significance of technology, following Article 10 of the Paris Agreement's Technology Framework, which emphasizes innovation, implementation, capacity building, enabling environments, collaboration, and stakeholder support.

As global weather patterns grow more erratic, Moldova adopted a strategic approach to climate adaptation, backed by technological innovation and coordinated policy efforts. Recognizing the technological needs for climate adaptation as a cornerstone of effective action, Moldova conducted a Technology Needs Assessment (TNA) in six priority sectors—Agriculture, Energy, Water, Forestry, Health, and Transport—during 2021-2023. In-depth sectoral assessments took an inclusive approach, guided by Sectoral Work Groups focused on enhancing resilience and promoting sustainable development in each area. The TNA was carried out as part of the second iteration of the National Adaptation Plan, funded by the Green Climate Fund and supported by UNDP and FAO UN Agencies.

The TNA process laid a robust foundation for integrating climate adaptation into sectoral planning, addressing existing adaptation gaps, and fostering systemic resilience in response to climate impacts. The identified and prioritised technological solutions aligned with Moldova's broader national and sectoral adaptation strategies, such as the *National Programme for Adaptation* (2023-2030), *Moldova 2030 Sustainable Development Strategy*, *Low Emission Development Programme* 2030 and *Nationally Determined Contribution 2.0 and 3.0* (under consultation*).* The outcomes of the TNA emphasised transformative adaptation, aiming to meet Moldova's adaptation needs by establishing resilient systems capable of responding to identified climate impacts, vulnerabilities, and risks in a timely manner, matching the anticipated pace of climate change.

The TNA process in Moldova followed a structured, three-stage approach to ensure a comprehensive understanding and prioritisation of adaptation technologies: Identification and *Prioritization of Adaptation Technologies; Barrier Analysis and Enabling Environment; Development of Technology Action Plans (TAPs)* followed by the identification of *Project Ideas* (Energy, Water, Forestry, Transport, Health and investment Concept Note (Agriculture). Sectoral TNA Reports offer a thorough exploration of the technological pathways that can facilitate effective climate adaptation across the prioritized sectors.

Climate adaptation TNA assessments form a vital component of Moldova's contributions to global adaptation efforts under the Paris Agreement, underscoring the country's commitment to strengthening resilience against climate-induced impacts.

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WATER RESOURCES

Integrated Report (TNA, BAEF and TAP)

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Chapter 1. Introduction

The Technology Needs Assessment project provides a great opportunity for the Republic of Moldova to perform a country-driven technology assessment to identify environmentally sound technologies that might be implemented with a substantial contribution towards addressing climate change adaptation needs of the country.

The aim of the Technology Needs Assessment project is to support developing countries and countries with economies in transition to develop their potential for adapting to Climate Change, in accordance with their obligations under the United Nations Framework Convention on Climate Change (UNFCCC). The main contribution of the Republic of Moldova in this project is the following:

- Better understand climate risks and identify causes of vulnerabilities for selected sectors.

- Prioritize technologies which can be used in environmentally safe technology packages, consistent with national development goals and priorities.

- Facilitate access to and transfer of environmentally sound technologies.

- Facilitate the implementation of paragraph 4.5 of the United Nations Framework Convention on Climate Change on know-how access.

- Identify barriers that prevent primary/preferred technology acquisition, implementation and dissemination.

- Develop a Technology Action Plan (TAP) to overcome barriers, define the scope of activities, and create a favorable environment to facilitate technology implementation and dissemination.

Technology prioritization is the first step in the Technology Needs Assessment project, implemented by applying the methodology proposed by the UNFCCC and the UNEP/DTU partnership. Technology prioritization aiming to elaborate country framework for Climate Change adaptation and mitigation includes sector technological information, sectoral vulnerability assessment, stakeholder engagement and capacity building, technology prioritization according to developed criteria, and understanding the mechanisms for technology transfer.

The applied methodology allows for flexibility and has been elaborated to consider country-specific conditions and needs. Technology prioritization for adaptation has been conducted through the following steps:

- Identifying critical sectors regarding Sustainable Development Goals (SDG) and national security.

- Assessing country-specific climate change risks.
- Creating a preliminary overview of key sectors vulnerabilities.
- Facilitating adequate for TNA assessment institutional arrangements and engagement of relevant stakeholders.
- Identifying the current stage of technological development in the prioritized sectors.
- Developing the criteria and context for technology prioritization.
- Identifying technologies suitable for country-level implementation.
- Verifying the impact of identified technologies through expert and stakeholder consultation.
- Prioritizing technologies that are to be involved in the next stage of the TNA elaboration.

According to IV National Communication of RM to UNFCCC, the sectors most vulnerable to climate change are forestry, agriculture, energy, water resources, transport and human health. There were several criteria for sector selection, such as the importance for the national economy and country development, impact to food security, and contribution to meeting the country's UNFCCC obligations. Details on the processes and reasons used in selection are provided in the first chapter of the TNA report.

During the TNA assessment, a review of existing in-country climate-related policy documents, regulations, national reports, and other relevant information was undertaken to understand how the adaptation component is addressed in the policy framework of the Republic of Moldova. Despite the crucial importance of the water sector in the economic and social development of the country, comprehensive strategic and legislative documents concerning these sectors adaptation to climate change are scarce. Thus, the TNA project of the Republic of Moldova and the present report are the first steps to help address the lack of national adaptation policy for climate change in terms of technological needs for the water sectors.

The Ministry of Environment of the Republic of Moldova is the designated national institution, which leads and coordinates the TNA process in the country. The essential elements of the institutional arrangement of the TNA process in Moldova include a TNA Coordinator, a National TNA Committee, National Capacity building expert, National Consultants and Sector working groups.

The TNA is a country-driven process. Therefore, the primary purpose of involving stakeholders is to help identify technological and institutional gaps and interests, along with identifying more immediate opportunities. This can assist in maintaining the sector's sustainable development or increasing its productivity, while minimizing the impact of climate change. Several main groups of stakeholders were identified as being most relevant and most involved in the TNA process:

- Decision makers from the government ministries and agencies with responsibilities for developing a framework of relevant national policy and beneficiaries of international agreements.

- Local and regional authorities who enact the policies.

- Academics who are the leading developers and disseminators of innovation and knowledge in the country.

- Business and private sector representatives as end consumers of technologies.

- Representatives of civil society.

The beneficiary of the TNA in the Republic of Moldova is the Ministry of Environment. The key government stakeholders participating in the TNA process are the Ministry of Agriculture and Food Industry, State Agency Apele Moldovei, Environmental Agency and Agency of Geology and Mineral Resources.

Gender issues can influence the process of technology transfer and implementation for the management of water resources, therefore, during the implementation of TNA activities and preparation of the TNA report, attention was paid to gender balance, including both women and men as a target audience and mainstreaming the gender dimension throughout the process. Furthermore, the proposed adaptation technologies are gender-neutral and offer equal benefits for both men and women.

Climate change impact may reduce water flow in the future, with significant changes in the hydrological regime of water bodies. The most dangerous manifestations of the change in the hydrological regimes are floods, flash floods and drought.

Climate change adaptation activities are already being implemented in the framework of national and state programs, along with national and regional programs and plans. To ensure the continuity of activities on adaptation to climate change, the Ministry of Environments implemented in 2020 the Strategy of Adaptation to Climate Change. However, they are not sufficient for addressing sectoral and country's vulnerabilities to current and future climate change risks.

Based on the proposed TNA methodology, national experts have prepared a long list of possible technologies and technological fact sheets for the water sector. Criteria for prioritization of technologies have been clustered under Economic, Social, Environmental, Climate Related, and other groups. Based on current national strategy documents and expert judgments, the following criteria were selected for prioritization of mitigation technologies:

Costs:

1. Investment cost

2. O&M cost

The benefits of the technology were divided into 5 separate criteria:

Economic:

1. Reducing the risk produced by technology on climate impact.

2. Favoring the increase in the volumes of water resources produced by technology.

Social:

3. Creation of new jobs as a result of the application of technology.

Environmental:

4. Improving the quality of aquatic ecosystems as a result of the application of technology.

Climate-related:

5. Reduction of losses of water resources as a result of the application of technology.

For the water sector, the list of top prioritized adaptation technologies includes:

1. **Improving the sustainable management of water resources by applying the water management balance sheet.**

2. **Improving the monitoring and forecasting of runoff, water quality and the efficient exchange of information between various institutions.**

3. **Optimization of number of reservoirs based on hydrological indicators.**

The results of the technology prioritization exercise were shared among all interested stakeholders to ensure project result dissemination and to provide the opportunity to give feedback and comments, which have been considered and incorporated into the TNA report. Stakeholder inputs and recommendations will be considered during the next steps of the TNA process, which includes assessment of barriers to implementation of prioritized technologies and preparation of technology action plans.

1.1 About the TNA project

The Technology Needs Assessment (TNA) is a country-driven set of activities directed mainly at the identification and prioritization of climate change mitigation and adaptation technologies. TNA supports national sustainable development, builds national capacity and facilitates the implementation of prioritized climate technologies.

The concept of TNA was formalized at the 7th Conference of Parties under the United Nations Framework Convention on Climate Change (UNFCCC) process in 2001, by establishing the technology transfer framework with the purpose of increasing and improving transfer and access to environmentally sound technologies and know-how. The overall approach involves cooperation among various stakeholders (private sector, governments, donor communities, bilateral and multilateral institutions, non-governmental organizations as well as academic and research institutions), including activities on TNAs, technology information, enabling environments, capacity building and mechanisms for technology transfer.

The Government sees the National Adaptation Planning (NAP) process as key to achieving the adaptation objectives outlined in its 2014 Climate Change Adaptation Strategy of the Republic of Moldova, and its 2020 Nationally Determined Contributions (NDC), as well as the continued mainstreaming of climate change considerations into its policies and budgeting processes. The proposed project supports the Government of the Republic of Moldova in advancing the second cycle of its National Adaptation Planning process (known as NAP-2). The outcomes of the NAP-2 national adaptation planning processes are:

- Outcome 1: To strengthen and operationalize the national steering mechanism for climate change adaptation (CCA).

- Outcome 2: To improve the long-term capacity on planning and implementation of adaptation actions through CCA technologies.

- Outcome 3: To improve the mainstreaming of climate change adaptation through the increased alignment of national development priorities, in the priority sectors (forestry, health, energy and transport).

The NAP-2 goals will be achieved within two parallel implementation tracks. The first track, implemented by UNDP, expands and deepens the national approach developed under the NAP-1. It strengthens synergies both vertically, at different levels of the governance, and horizontally, between the sectors affected by climate change. This is to reduce duplication of efforts, pool scarce resources for effective use, and ensure a coherent and comprehensive approach to the integration of CCA responses into development planning. The second track will focus on adaptation in the agriculture sector and will be concurrently implemented under the auspices of FAO.

The Project Sub-Outcome on up-taking Adaptation Technologies aims to expand the CCA capacity building activities with the development of a CCA Technology Framework. This Framework articulates the medium- and long-term objectives needed to acquire technological know-how to address CCA needs and achieve widespread and transformational technology transfer at sub-national and sectoral levels. Within the Technology Framework, technology assessments will provide information on technology needs. The prioritized technologies will be included in the formulation of gender responsive CCA investments proposals for further finance mobilization.

The key deliverables of the TNA are the following:

1. TNA report describing the prioritized technologies for adaptation in selected sectors including the process followed and the rationale for the latter.

2. Barrier Analysis and Enabling Framework (BA&EF) report on existing barriers for the prioritized technologies and enabling framework to facilitate the deployment and diffusion of technology priorities.

3. Technology Action Plan (TAP) report for mitigation and adaptation describing the approach for the uptake and diffusion of prioritized technologies that will contribute to the country's social, environmental and economic development.

As a result of the implementation of phase I of the TNA process, the main activities were:

- Analysis of the set of policies and normative and permissive acts developed in the field of water resources oriented towards climate change.

- Identification of innovative technologies that can be applied to adapt to climate change in the water resources sector.

- Identification of the main actors in the water resources sector from the representatives, from which a working group was formed.

The main results obtained were:

- The identified technologies were grouped by impact criteria and short TFSs were developed for each of them.

- Because of the multi-criteria analysis, together with the working group members, the climate change adaptation technologies were prioritized. After this, based on a complex exercise, the priority technologies for the country were identified.

1.2 Existing national policies related to technological innovation, adaptation to climate change and development priorities

The main normative acts in the field of water resources, which represent a result of the implementation of village policies, the list of important reports made on the given sector, as well as the important scientific monographs are presented as follows:

No	Normative act	Highlights
1.	The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014	The purpose of the Strategy is to develop the water supply and sanitation sector, to create the necessary framework for the gradual assurance until 2030 of access to safe water and adequate sanitation for all localities and the population of the Republic of Moldova, thus contributing to the improvement of health, dignity and quality of life and to the economic development of the country.
2.	Water Law no. 272 of 23.12.2011	The purpose of the law is to create a normative framework for the monitoring, evaluation, management, protection and efficient use of surface water and underground water.
3.	The law regarding the areas and sheets for the protection	The purpose of the law is to protect rivers and water basins against pollution, impurity, depletion and

	of the waters of rivers and water basins no. 440 of 27.04.95	siltation. It also governs the use of related lands, as well as regulating the creation of water protection zones and riparian water protection sheets for rivers and water basins, the regime of use and the activity of their protection.
4.	Law no. 182 of 19.12.2019 regarding the quality of drinking water	The purpose of the law is to ensure sustainable drinking water quality compliance by creating a flexible and transparent legal framework, as well as by promoting adequate risk management.
5.	Law on public water supply and sewerage service no. 303 of 13.12.2013	The purpose of the law is to create the legal framework for the establishment, organization, management, regulation and monitoring of the operation of the public drinking water supply, technological, sewage and industrial wastewater treatment service.
6.	Law on associations of water users for irrigation no. 171 of 09.07.2010	The purpose of the law is to create the legal framework for the establishment and operation of irrigation water user associations and the creation of an effective mechanism for managing the state-owned irrigation and/or drainage infrastructure.
7.	Law on fish stock, fishing and fish farming no. 149 of 08.06.2006	The law regulates the manner and conditions for the creation and protection of the fish stock, for the reproduction, growth and acquisition of hydrobionts, for the improvement of aquatic fish objectives and the development of fish farming, it establishes the principles of the activity of public authorities empowered to manage aquatic biological resources.
8.	Regulation regarding flood risk management, approved by Government Decision no. 887 of 11.11.2013	The regulation establishes the regulatory framework for flood risk management.
9.	Government Decision no. 433 of 18.06.2012 for the approval of the Regulation on flood protection dikes	The regulation establishes the requirements for the design, construction and operation of flood protection dikes; and extends to flood protection dikes located in the Republic of Moldova.
10.	Government Decision no. 977 of 16.08.2016 regarding the approval of the standard Regulation for the exploitation of reservoirs/ponds	The model regulation for the exploitation of reservoirs/ponds regulates how the regulation of reservoirs/ponds is drawn up and establishes the general criteria for the exploitation of water reservoirs, regardless of the form of ownership, built according to the requirements of the normative and legislative acts in force, to maintain their correct and

		sustainable exploitation, and applies to any natural or legal person who owns and manages reservoirs/ponds.
11.	Government Decision no. 890 of 12.11.2013 for the approval of the Regulation on environmental quality requirements for surface water	The regulation establishes the environmental quality requirements for surface water and the way to classify surface water into quality classes.
12.	Government Decision no. 932 of 20.11.2013 for the approval of the Regulation on the systematic monitoring and record of the state of surface water and underground water	The Regulation establishes the creation of a multi-annual complex system of quantitative and qualitative assessment of surface and underground waters by using the procedures and technical measures of sampling, analysis and synthesis, for the purpose of sustainable management and exploitation of aquatic resources.
13.	Government Decision no. 931 of 20.11.2013 on the approval of the Regulation on the quality requirements of underground water	The regulation provides both the quality requirements of groundwater, as well as the rules regarding the state of groundwater, their management objectives, as well as the rules regarding the use and protection of groundwater against the effects of any type of pollution.
14.	Government Decision no. 775 of 04.10.2013 regarding the boundaries of the districts of river basins and sub-basins and the special maps where they are determined	The decision approves the boundaries of the watershed districts and subbasins.
15.	Government Decision no. 867 of 01.11.2013 for the approval of the Model Regulation on the method of constitution and operation of the River Basin District Committee	The regulation establishes the way of constitution and operation, structure and attributions of the River Basin District Committee.
16.	Government Decision no. 802 of 09.10.2013 for the approval of the Regulation on the conditions for discharging wastewater into water bodies	The purpose of the regulation is to regulate the discharge conditions, for the introduction of specific substances into a body of surface water, into a body of underground water or into the lands of the water fund.
17.	Government Decision no. 835 of 29.10.2013 on the approval	The regulation establishes the method of recording and reporting the water used by water users, who

	of the Regulation on the record and reporting of water used	operate based on the environmental authorization for the special use of water, regardless of the form of ownership and the source of water used.
18.	Government Decision no. 881 of 07.11.2013 for the approval of the Methodology regarding the identification, delimitation and classification of water bodies	The methodology establishes the methods for the identification and delimitation of surface and underground water bodies and the principles of their classification.
19.	Government Decision no. 949 of 25.11.2013 for the approval of the Regulation on sanitary protection zones of water intakes	The regulation establishes rules for the delimitation, creation and operation of sanitary protection zones for water intakes from surface and underground waters.
20.	Government Decision no. 950 of 25.11.2013 for the approval of the Regulation on the requirements for the collection, purification and discharge of wastewater in the sewage system and/or water bodies for urban and rural localities	The purpose of the regulation is to establish the requirements for the operation of wastewater collection systems and for the operation of treatment plants, to establish the requirements for the treatment of wastewater in rural areas, to protect the quality of water resources, to establish the methodology for calculating additional payments for the discharge of wastewater in the public sewage system exceeding the CMA of established pollutants.
21.	Government Decision no. 894 of 12.11.2013 for the approval of the Regulation on the organization and operation of the one-stop shop in the field of environmental authorization of the special use of water.	The purpose of the regulation is to streamline and rationalize the coordination and approval procedure of the necessary documents for the environmental authorization for the special use of water.
22.	Government Decision no. 836 of 29.10.2013 for the approval of the Regulation on the prevention of water pollution from agricultural activities	The regulation establishes the method of identifying polluted waters from agricultural activities, as well as the identification and delimitation of vulnerable areas. Also, the Regulation provides for the development of an action program for the prevention of water pollution from agricultural activities and some codes of good agricultural practices.
23.	Government Decision no. 506 of 01.11.2019 regarding the approval of the framework procedure regarding the organization, development	The procedure regulates the unitary legal framework related to the organization and carrying out of the procedures for awarding the contract for delegating the management of public water supply and sewerage

	and awarding of contracts for delegating the management of the public water supply and sewerage service	services, as well as the concession of the assets that make up the water supply and sewerage systems.
24.	Government Decision no. 1466 of 30.12.2016 for the approval of the Sanitary Regulation on small drinking water supply systems	The purpose of the Regulation is to regulate the provision of safe drinking water supply to the population in small communities, the prevention and liquidation of possible pollution of small drinking water supply systems.
25	Decision No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems	This Regulation establishes public health requirements for water quality, the choice of location, arrangement and operation of water capture, accumulation and distribution facilities, as well as the related territory. The purpose of the Regulation is to regulate the provision of safe drinking water supply to the population in small communities, the prevention and liquidation of possible pollution of small drinking water supply systems. The Regulation applies to small drinking water supply systems, operational or designed, that supply less than 200 m3 on average/day or that serve communities of less than 2000 people and serve to satisfy the population's drinking and household water requirements.
26	The national development strategy "Moldova 2030"	The national development strategy "Moldova 2030" is a strategic vision document, which indicates the development direction of the country and society to be followed in the next decade, based on the principle of the human life cycle, rights and quality of life, and includes four pillars of sustainable development, with 10 corresponding long-term objectives.
27	The Sustainable Development Goals (SDGs) formulated by the 2030 Sustainable Development Agenda	The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. These 17 goals build on the successes of the Millennium Development Goals and now cover new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among other priorities. Objectives are interconnected; often, the key to success in one area will involve addressing issues more commonly associated with another area.

28	INDC-1 of the Republic of Moldova	The Republic of Moldova intends to achieve an economy-wide unconditional target of reducing its greenhouse gas emissions by 64-67 percent below its 1990 level in 2030 and to make best efforts to reduce its emissions by 67 percent. The reduction commitment expressed above could be increased up to 78 per cent below 1990 level conditional to, a global agreement addressing important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale commensurate to the challenge of global climate change. The adaptation component is present in this document.
29	INDC-2 of the Republic of Moldova	The Republic of Moldova has included, in its updated NDC, the adaptation component in line with Articles 2.1 and 7.1 of the Paris Agreement and Katowice Rulebook (COP 24), as an opportunity to communicate the country's strategic vision on climate change adaptation. The adaptation component, as a forward-looking document, incorporates country's adaptation priorities that derive from the in-force policy documents, such as the Climate Change Adaptation Strategy and the Action Plan for its implementation (2014), as well as from the Fourth National Communication to the UNFCCC (2018), and from a number of national level policy documents covering cross-sectoral socioeconomic areas and sector-specific development documents of the national priority sectors: agriculture, water resources, human health, forestry, energy and transport.
Reports		
2	World Bank: Rural Productivity in Moldova – Managing Natural Vulnerability, 2007	This study outlines the key opportunities and considerations for the mitigation of natural hazards, especially for the highly exposed and vulnerable agricultural sector. An analysis of the occurrence, impact and potential mitigation options for a range of natural hazards affecting Moldova is undertaken within this report, with a focus on reducing risk through natural hazard mitigation or by addressing vulnerability.19 Within the report, climate change is not analyzed as a separate threat but is broadly incorporated within a number of key threats.

3	Ministry of Ecology and Natural Resources and State Hydro-Meteorological Service: Climate Monitoring and Droughts, 2007	This comprehensive study covers both theoretical and practical aspects of climate and drought monitoring. It is based on the latest country-level climate data, including historical observations from local meteorological stations going back over 150 years. The study also includes detailed analysis of the impacts of projected future changes in climate on agricultural systems in the country, including the impact of extreme events.
4	Moldova's Second National Communication under the United Nations Framework Convention on Climate Change (UNFCCC)21 (SNC, 2009).	The document includes climate projections for Moldova to 2100 and undertakes a preliminary vulnerability assessment of sectors including agriculture, water resources and forestry. This assessment includes an analysis of climate change impacts using three separate GCM's and time periods, as well as broad recommendations and potential adaptation and mitigation options for each sector. To assess the economics of mitigation and adaptation actions, the report also includes cost benefit analysis; however, no evaluation or prioritization of the adaptation options was performed.
5	National Human Development Report (NHDR, 2010/2011): Socio-Economic Impact of Climate Change in Moldova and Policy Options to Adapt	This report undertakes a comprehensive assessment of climate change vulnerabilities, impacts and adaptation measures at the sectoral level for Moldova. Sectors analyzed in this work include agriculture, water resources, energy, transport, human health and natural systems. Existing policies, laws and regulatory systems are assessed in relation to their effects on climate-induced vulnerabilities for a number of sectors, including agriculture, forestry, disaster management and water.
6	The Third National Communication of Moldova under the United Nations Framework Convention on Climate Change (UNFCCC) 2013.	To evaluate Moldova's environmental performance, we have utilized the data referring to Environmental Sustainable index (ESI) and Environmental Performance index (EPI) annually produced by Yale University's and Center for International Earth Science.
7	The Fourth National Communication of the Republic of Moldova Prepared to be reported to the United Nations Framework	The Fourth National Communication of the Republic of Moldova to the United Nations Framework Convention on Climate Change was developed within the Project "Ensuring the support of the Republic of Moldova in order to prepare the first updated biennial report and the fourth national

	Convention on Climate Change	communication in accordance with its obligations towards the Convention- United Nations framework on climate change", implemented by the Ministry of Agriculture, Regional Development and Environment and the United Nations Environment Programme, with the financial support of the Global Environment Facility.
8	Vulnerability Assessment and Climate Change Impacts in the Republic of Moldova. Research, Studies, Solutions. Chisinau, 2018, "Bons Offices" - 352 p.	The Research Study Complementing Chapter 5 "Vulnerability Assessment and Climate Change Impacts" of the Fourth National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change.
	Monographs	
1	Maria Nedealcov. Regional climate changes. Inst. of Ecology and Geography - Ch.: Sn, 2020. "Impressum" – 367 p.	The paper provides a deep analysis of climate change at a regional level. Changes in climate components – temperatures, precipitation, evaporation and its derivatives – are analyzed. Droughts and heatwaves and their impact on environmental components are described in detail.
2	Bejenaru Gh., Melniciuc O., Water resources of the Republic of Moldova (formation theory and regional synthesis), Chisinau, "Protipar Service", 2020, 338 p.	The monograph is dedicated to the development of methodological principles regarding the evaluation and research of water resources in the Republic of Moldova in the context of their change under the influence of human economic activity and in relation to the possible climate changes of this century. A complex system of calculations regarding the genetic components of the formation of water resources of rivers and intermittent streams is proposed based on the genetic-statistical theory of river flow, using elements of systemic and factorial analysis.

1.3 Vulnerability assessments in the country

Assessments of the vulnerability to climate change of different sectors in the Republic of Moldova are carried out periodically and in the form of a synthesis are published in specialized communications, of which the most relevant for the water resources sector are "National Communication Three and Four of the Republic of Moldova elaborated within the Convention-United Nations framework on climate change" [7,6].

Unfortunately, the water resources sector is not elucidated on in communication IV, while in national communication III, it is described well enough with conclusions and recommendations [7]. Here, the water resources sector is analyzed in the chapter "Sectoral impacts of climate change in the Republic of Moldova" along with the agricultural, forestry, energy, transport and health sectors. Finally, a series of recommendations, formulated as measures to adapt the sector to climate change, is presented as follows:

- More efficient operation of reservoirs, dams and dikes.

- Protection of wetlands (one of the main positive functions of wetlands is to allow additional groundwater recharge and reduce peak overflows downstream).

- Measures to protect the irrigation infrastructure against floods.

- Techniques to improve soil texture, aggregation, organic matter content and soil cover to manage water use during dry periods.

- Better flood forecasting.

- Installation of warning systems about dikes breaking.

- Technical assistance through extension training in combination with the modernization of irrigation, to ensure the distribution among farmers of techniques to minimize the vulnerability of agricultural farms to climatic phenomena.

- Developing effective collaboration between the Republic of Moldova, Ukraine and Romania to monitor overflow, improve weather/flood forecasting and ensure early warning for all downstream countries.

To assess vulnerability to climate change, the Republic of Moldova developed an IVC based on the Model of Vulnerability and Resilience Indicators (VRIM) [7]. VRIM is a holistic vulnerability assessment method that incorporates many issues, allows comparative analysis of countries to identify their degree of vulnerability and adaptive capacity, and international donors use this method to target financial resources. An attempt was made to reproduce, as closely as possible, the VRIM, keeping the original set of indicators, in some cases, however, the type of indicators was adjusted to the national specifics (the original model consists of 18 indicators, after the adaptations made at the national level – out of 19).

VRIM is based on four hierarchical levels: The vulnerability index (level I) is made up of two determinants (level II) – sensitivity (the degree of negative impact of the system by the climate) and adaptive capacity (the ability of society to maintain itself, to minimize losses or increase welfare gains); in their turn, the determinants are composed of other components (categories) (level III), for sensitivity they represent living infrastructure, food security, agricultural ecosystems, water supply, human health, and for adaptive capacity – economic capacity, human resources, environmental conditions; each sector includes 2-3 indices (level IV).

In the Third National Communication of the Republic of Moldova, it is mentioned that climate change is only one of the factors that will determine the future indices of water availability and use. Non-climate factors could exacerbate or mitigate the adverse effects of climate change on water availability and quality. They, too, could have a significant influence on water demand. Increased pollution and development will play a dominant role. However, considering the underground water reserves, the moment when the water deficit will become an impediment to development will most likely occur after 2030 [7]. Non-climatic impacts could be generated by several domains, starting with policies and legislation and ending with technologies and infrastructure, land use patterns and agricultural activities (irrigation).

Although large rivers are the main source of water, access to water is not equal in the Republic of Moldova. The greatest distance between a locality and the nearest water source is about 6 km. About a quarter of the population lives in the 6 km buffer zone of the Dniester and Prut rivers; this area constitutes a fifth of the national territory and includes 23% of the total number of localities. The rest of the population is forced to rely on various water supply systems designed to transfer water from these rivers or rely on poorer quality local resources. The northern part of the country (and the central part, to some extent) is, more or less, assured of water, while the southern part suffers from a natural water deficit. At the same time, medium- or long-distance water transfer systems are virtually non-existent in the south. This region is among the most exposed to water scarcity. Also, surface water resources in the south of the country (and, less commonly, in the central part of the country) are most at risk of being depleted in drought years. Under these conditions, the geographical location of water users will play the most decisive role in the future in ensuring access to safe water resources. The water-scarce region, as it expands northward, already reaches the most populated areas, which puts maximum pressure on water resources and contributes to the most intensive use of water. The most vulnerable regions to water shortages will be the South, the Center and the municipality of Chisinau, for which the highest level of risk was discovered with high probability in relation to the anticipated impact of climate change.

For the water resources sector in the Republic of Moldova, eight of the identified risks are priority [7], which are also found in the National Strategy for Adaptation to Climate Change:

1. High risk of drought and water scarcity.
2. High requirements for irrigation.
3. Increasing the frequency and intensity of flooding.
4. Reducing the availability of water from surface water sources or groundwater.
5. Changes in water demand.
6. Water quality indices (eg, mineralization, hardness, dissolved oxygen) affected by higher water temperatures and annual average runoff layer variations.
7. Increased water pollution with pesticides and fertilizers, caused by increased soil washing.
8. Changes in the average annual runoff layer of rivers, both increasing and decreasing.

In the Green Climate Fund Commitment Country Program (2019), it is indicated that, according to climate projections, water availability will fall below the level of total demand for several decades, and the southern region of the country could face a reduction of 1/3 – 2/3 of water resources by the end of the XXI century. Particularly vulnerable to the anticipated climate changes are the more densely populated and economically important regions, which are already facing water shortages (the South, the Center and the municipality of Chisinau). Addressing deficits in these regions will be critical to sustaining sustainable economic recovery.

The major risks for the water resources sector are: (i) changes in water demand (increased by population growth, economic development and irrigation needs); (ii) changes in river flows, both increasing and decreasing; (iii) high risk of drought and water scarcity; (iv) increased irrigation needs; (v) reducing the availability of water from both surface and groundwater sources; (vi) increasing the frequency and intensity of flooding; and, (vii) increased pesticide and fertilizer pollution caused by greater soil washing.

Even in the absence of climate change, the projected increase in water demand means a considerable anticipated water deficit by the years 2040-64. The value of unmet demand is dominated by municipal and industrial consumption, valued at approximately US$95 million.

As a result of the risk and vulnerability assessments, the priority directions for adaptation to climate change were identified, which met in the Climate Change Adaptation Strategy 2014-2020 with the main objectives:

Specific objective no. 1: The creation, by 2018, of an institutional framework in the field of climate change, which ensures the effective implementation of adaptation measures at national, sectoral and local level.

Specific objective no. 2: The creation, by 2020, of a mechanism for monitoring the impact of climate change, the associated social and economic vulnerability and managing/disseminating information on climate risks and disasters.

In the field of water resources, research will involve revealing the impact of climate change on them, namely: (i) defining critical thresholds for water resources; (ii) improving capabilities to calibrate current models of soil washing due to precipitation; and, (iii) anticipating the economic and social impact of climate change on water volume, water supply and water supply, including irrigation, drinking water supply, leisure/tourism, hydropower and industry and losses in systems. Capacities will be strengthened to develop and implement hydro-economic assessment systems at river basin level to assess further development of water resources and the viability of associated development, such as hydroelectric development, waste treatment and irrigated agriculture. Current feasibility studies or planned pre-feasibility studies for irrigation (including from groundwater sources) and land use projects are required, including the requirement that they include an assessment of the physical and economic impacts caused by climate change. Assessments and analyses of the social, economic and environmental benefits and costs of future adaptations will be carried out.

Specific objective no. 3: Ensuring the development of climate resilience by reducing by at least 50% the risks of climate change by 2020 and facilitating adaptation to climate change in 6 priority sectors.

In the recently published document "ASSESSMENT OF THE IMPLEMENTATION OF THE REPUBLIC OF MOLDOVA'S CLIMATE CHANGE ADAPTATION STRATEGY AND ITS ACTION PLAN UNTIL 2020", an analysis of the implementation of the strategy was carried out. The draft document is for consultations, August 2021 [10].

Water resources in Moldova are vulnerable to climate change. Although at the current level of use, there is still no water security issue, effective management of water supply and demand and timely application of adaptation measures will be crucial for the country's development in the medium and long term.

Unlike the health, forestry, energy and transport sectors, there is neither a Sectoral Adaptation Plan nor specific recommendations that address the rather vast policy area of water resource management. For these reasons, **this sectoral assessment is based** on the results of the completed actions described in MADRM's annual monitoring reports on the implementation of SNASC 2020 and its Action Plan. In addition to the Strategy, a number of relevant policy documents in the water management sector were analyzed to gather additional information on whether and how ASC actions have been integrated into sector policy. These include: *Dniester and Danube River Basin District Management Plans (PGDBH) -Prut-Black Sea*; *The Water Supply and Sanitation Strategy (SAAS) and its Action Plan for 2014-2020*; *The National Program for the implementation of the Protocol on Water and Health in the Republic of Moldova for the years 2016-2025 (recently updated until 2030)*; *The flood risk management plan (developed by the EIB in 2015, but not officially adopted by the Government)*; *Water security diagnosis and future prospects in (BM, 2020); Water sector policy perspectives for Moldova (OECD, 2021); The National Drought Plan in the Republic of Moldova (2019, within the UN Convention to Combat Desertification/UNCCD/Drought Initiative)*.

Since **the distinction of actions to adapt to climate change was not always explicit** in these strategic documents, data on such information was also sought within the climate and inter-sectoral projects, which were implemented in Moldova in the period 2014-2020. For this purpose, the available reports and publications were also studied regarding completed and ongoing projects, which either directly address SC aspects or have a high relevance for SC adaptation (*with external funding, as well as reported completed projects and financed by the National Ecological Fund /FEN/ and the National Fund for Regional Development /FNDR/*).

As a result of a thorough analysis of the types of projects implemented, it can be concluded that the number of those **directly addressing climate change in the field of water policies is quite small** and is mainly financed by development partners (especially the EU, ADA, SDC and BM). Most of the projects implemented during the evaluated period are those in the category of water supply and sanitation, under the umbrella of the *AAS Strategy* and *the National Program for the implementation of the Protocol on Water and Health*, followed by projects dedicated to the maintenance of flood protection dikes. A historical review of allocations from the National Ecological Fund (NEF) between 2015 and 2020 reveals that **more than 80% of NEF resources** were allocated to AAS (*mainly water supply*). Moreover, **the National Fund for Regional Development (FNDR) also finances AAS projects**, without a clear synergy between these two streams. Currently, 10 out of 32 projects implemented with EU and FNDR support are in the AAS field (*especially water supply*). These were assessed as *indirectly related* to climate change adaptation of the water resource management sector.

Regarding the approached *project analysis date,* **a number of climate change adaptation measures were identified** and assigned to the monitoring indicators in the SNASC and its Action Plan. As a result, **four** of the planned activities in the water sector were assessed as *fully implemented* and **only one** as *partially implemented*. The latter refers to the slow pace of improvements in the field of wastewater collection and treatment.

The most tangible results of climate change adaptation measures in the field of water resource management can be summarized as follows:

✓ The number of studies carried out to *assess the available water resources, determine their vulnerability to climate change, water requirements and needs* for the main consumption categories.

✓ To *improve the availability of water at the source and increase the resilience of rural communities to SC* – over 200 reservoirs have been created since 2014; 10 basins for collecting and storing rainwater were built in 5 districts; over 6,114 ha of wetland habitat in the Lower Prut meadow in Moldova have been officially designated under the auspices of the Ramsar Convention on the International Importance of Wetlands.

✓ Tangible progress *has been achieved in the introduction of integrated water management based on the river basin principle* – the legal basis and integrated management planning of the Dniester and Danube-Prut-Black Sea watershed district (*however, the measure is assessed as partially implemented due to the lack of progress substantial regarding indicators regarding wastewater treatment*).

✓ To *improve adequate flood risk management in the country* – the Flood Protection Master Plan was developed in 2015 with the support of the EIB (*although this was not officially adopted by the Government*); The concept of the national flood risk management system was approved in 2018; 71 km of dikes were rebuilt in the period 2014-2020; the flood warning and forecasting system is implemented by the SHS.

✓ Measures were taken *to combat drought and water shortage* – the National Drought Plan of the Republic of Moldova was adopted in 2019; drought risk management measures have been integrated into the new cycle of the two River Basin District Management Plans 2022-2027 now developed; water storage capacities have increased (by ~ $5000m^3$ according to expert estimates).

✓ National and regional coordination bodies have been created that *address various aspects of integrated water management* at river basin level and transboundary level (committees of river basin districts, the Moldovan-Romanian Hydrotechnical Commission and the Commission for the sustainable use and protection of the Dniester River Basin / Dniester Commission).

✓ *The State Cadastre of Water Resources* was developed, containing a water resources information system (SIRA) - it could be updated with relevant ASC information.

After analyzing the measures implemented from the perspective of the provisions of HG 386/2020 regarding their *relevance, efficiency, effectiveness* and *impact,* it can be concluded that all measures have contributed to the implementation of the indicators from the Action Plan, especially **by integrating climate change considerations into the management policies water**.

The extent to which interventions have contributed to increasing the water sector's resilience to immediate climate change and natural hazards makes them **relevant** to sectoral needs. They are also judged to be **sufficiently effective,** considering their substantial contribution to *the integration* of ASC considerations into water resource management policy, both at national and river basin level.

As mentioned above, this document is being updated and will include a programmatic approach to adaptation planning in all sectors.

Over the course of about 10 years, in the Dniester Basin, jointly with the Ukrainian authorities, a series of Dniester projects were implemented within the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Here, special attention deserves the component "Climate change and security in the Dniester River Basin", which is part of the project "Climate change and security in Eastern Europe, Central Asia and the South Caucasus". This component is also part of the UNECE pilot project program on adaptation to climate change in transboundary river basins. One of the results of this project was the identification of strategic directions for adaptation to climate change in the Dniester River Basin [9]. It should be noted that this is the only publication where an attempt has been made to map the vulnerability to climate change of the water resources sector.

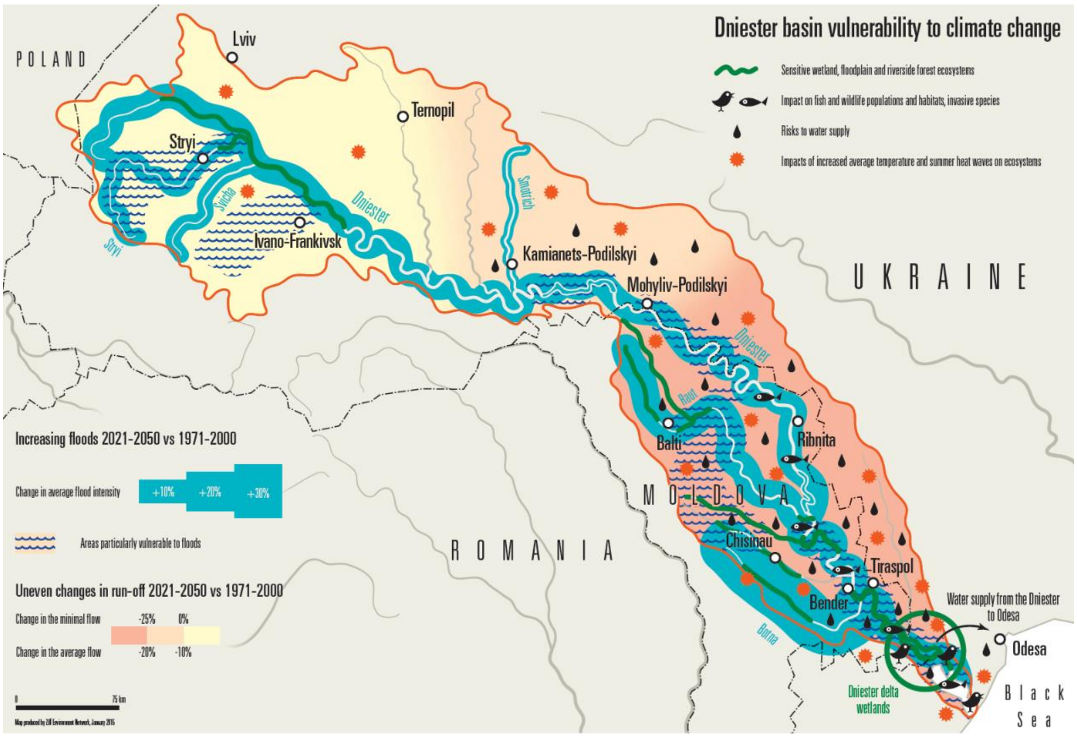


Figure 1.1. Vulnerability of the Dniester Basin to climate change

The first mapping of the adaptation potential was also carried out in this paper [9].

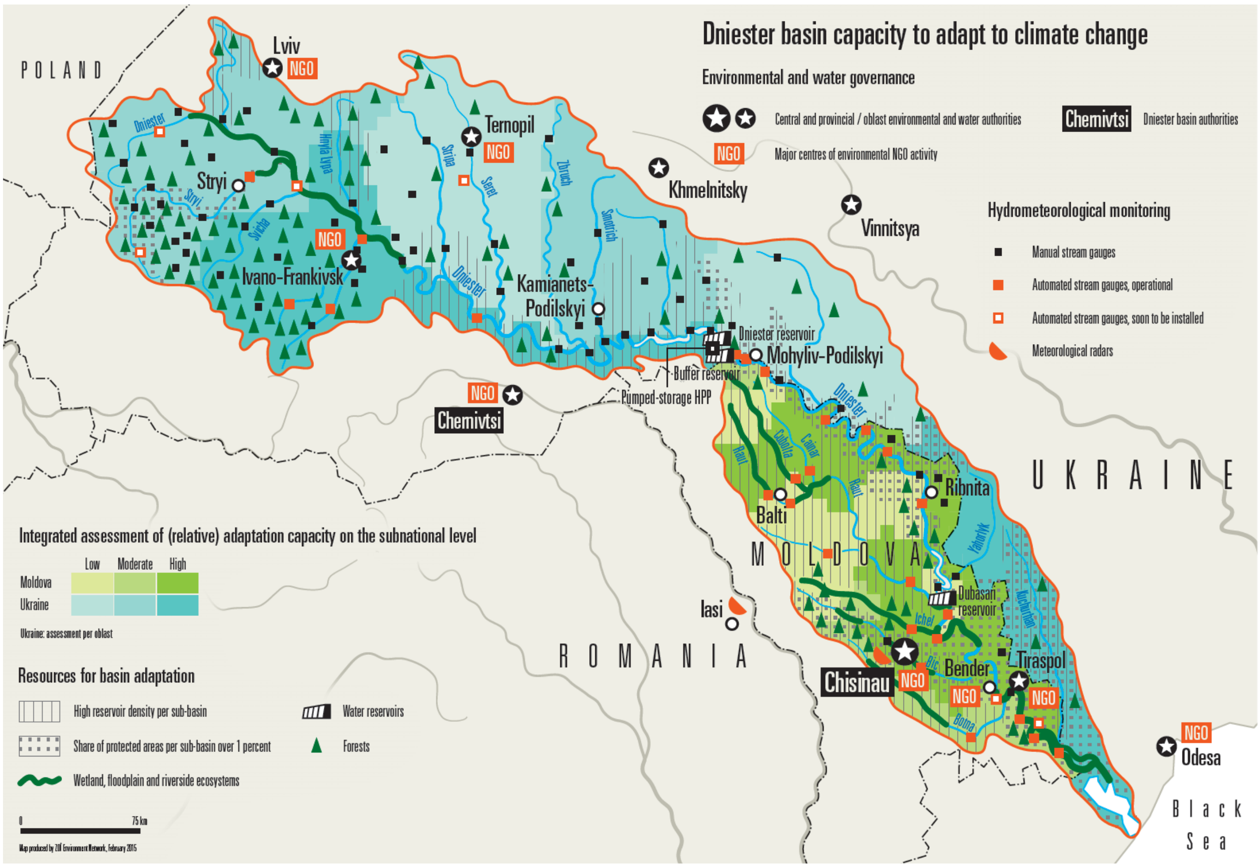


Figure 1.2. The adaptation potential of the Dniester Basin to climate change

Finally, it is very important to update deep vulnerability studies periodically, no less often than every 5 years. Previous studies are already out of date because they are based on outdated data. As a systemic approach to these studies, the results published in "Strategic directions for adapting to climate change in the Dniester River Basin" [9] can be used, which can also be applied to the Prut Basin, so practically for the entire territory of the country.

1.4 Sector Selection

1.4.1 An Overview of Expected Climate Change and its Impacts on Water Sector

Surface and underground water resources of the Republic of Moldova

Water Law N 272 of 23.12.2011 contains the notion of water resources – surface water, underground water and atmospheric precipitation falling on the territory of the Republic of Moldova [11]. In hydrology, water resources represent the totality of surface and underground waters, which are used or can be used by humans [3].

Surface water resources

Surface water resources account for about 90% of the total water resources in the country. Water resources can be divided into the following categories [4]:

Natural – water resources that are formed under natural conditions and are dictated by the factors of annual runoff.

Real –water resources formed in the river basins as a result of the modification of natural resources through human activity, emphasizing the transformation of the surface of the receiving basin, which changes evaporation and other indicators of the conditions of the formation of the runoff.

Ecological (protective) – these represent resources intended for maintaining the ecology of rivers and related lands (especially meadows). They cannot be used in water management, only in aquatic management, which is not related to water capture, for example in hydropower.

Available – water resources available for use in water management, which is the difference between real and ecological resources. They are used for water consumption (land irrigation, municipal and industrial water supply) as well as for water use (fish farming, recreation, etc.).

The last scientific publications related to the complex analysis of water resources in the Republic of Moldova were made by 2020 [4,1]. Even if the analyzed data referred to the year 2015, the information presented, as well as the calculation methodology, could be used to update the assessment of water resources.

According to agreements with the neighboring states (Romania and Ukraine), the available water resources of the Dniester River are divided equally between Ukraine and the Republic of Moldova. The resources of the Prut River are divided equally between three states. The Republic of Moldova also has available the resources of internal rivers, which are formed on the Dniester-Prut interfluve (Table 1.1).

Table 1.1. Available and ecological, total and own water resources of the Republic of Moldova for the base period 1961-1990 (mil m^3) [3,5]

Ensuring water resources	Water resources			
	Dniester	Prut	The Dniester-Prut interfluve	Total
Available*				
Media	6840/3420 00	2290/763	72.5	9200/4260
75%	4450/2230	1610/535	20.0	6080/2780
95%	2170/1080	966/322	0	3140/1410
Ecological*				
Guaranteed	3560/1780	524/174	10.8	4100/1960

** In the denominator, the total available and ecological water resources; In the numerator, own available and ecological water resources.*

When analyzing the change in water resources under the influence of global warming, the subject of quantitative assessment of available and own ecological resources is considered important.

The evaluation of the future own available resources of the Dniester and the Prut, according to the projections and horizons adopted, is possible on the condition that their change is proportional to the change of the real water resources of the Republic of Moldova (Table 1.2).

Table 1.2. The expected values of the available own resources of the rivers of the Republic of Moldova on the horizons of global warming projections [3,7], mil m^3

ensuring	Available reference leakage	The expected values of the annual own runoff norm available, according to the time horizons and projections adopted								
		2010 – 2039			2040 – 2069			2070 – 2099		
		CSIRO	HAD CM2	ECH O	CSIRO	HAD CM2	ECH O	CSIRO	HAD CM2	ECH O
	Dniester - Bender									
Mediate	3420	4668	2952	2380	4408	4408	2068	5393	5500	1340
75%	2230	3352	1949	1465	3096	3096	1222	3777	4132	610
95%	1080	2012	936	550	1772	1772	375	2170	2704	0
	Prut - mouth									
Mediate	763	1062	676	579	985	966	560	937	1237	425
75%	535	747	435	361	681	667	347	646	877	241
95%	322	450	388	165	398	389	156	375	538	82
Summary available water resources										
Mediate	4260	5730	3628	2959	5393	5374	2628	4981	6737	1765
75% 75%	2780	4099	2384	1826	3777	3763	4569	3456	5009	851
95%	1410	2462	1324	716	2170	2162	531	1938	3242	82

Note. The available water resources of the country do not include the water resources of the (small) rivers in the south of the country, which are not part of the Dniester and Prut basins, because their values are small and within the limits of the accuracy of determining the water resources of big rivers.

Underground waters of the Republic of Moldova

In the modern conception, potential (or exploitable, RE) reserves represent the maximum amount of water that can be extracted from an aquifer without changing the hydrogeodynamic balance [13]. In the Republic of Moldova, the exploitable reserves were calculated only for interstratal aquifers (without phreatic waters) that contain large amounts of water. The last official calculations of underground water exploitation reserves were made in 1981, based on data up to 1978 [18]. Although fourty years have now passed, the data of these estimates are still used to this day.

The data in Table 1.3 show the volume of potential RE (RP) and exploitable (RE) of groundwater.

Table 1.3. Determination of exploitable reserves of potable underground water in the territory of the Republic of Moldova, within its geographical borders, year 2018 [11]

Method and year	Potential underground water reserves (RP), m^3/day	Exploitable reserves (RE), m^3/day
Stasev et al. (1962)	1,199,105.00	760,320.00
Zelenin et al. (1973)	1,500,003.00	540,004.00
Saraevskii et al. (1982)	2,542,800.00	733,700.00
Moraru et al. (2001)	4,331,874.54	1,819,387.00
Moraru (2013)	3,729,888.00	1,566,553.00

Underground water in our country has been exploited centrally since the 1950s. The most intense period of water use was the period 1960-1992 (maximum approx. 900 million m^3/year). Currently, the volume of water used in the country's economy and social activity is about 120 million m^3/year or 0.12 km^3/year. From the interval of exploitation reserves, the volume of water extracted constitutes the partial interval 3.1-5.6, or 31% (minimum) and 56% (maximum) unused stock reserves.

Currently, aquifers regenerate groundwater reserves. The Republic of Moldova possesses interstratal underground water reserves in sufficient quantities to be used in other branches of the national economy and social needs. This situation can be even more optimistic, if the reserves of phreatic aquifers are also considered [13].

Water resources directly react to changes in the thermal and rain regime of the climate, in other words, to changes in air temperature and the amount of precipitation.

Air temperature

To facilitate the perception of climate change, especially the thermal regime of the planet, we will offer some conclusions presented in the report produced by the IPCC (The Intergovernmental Panel on Climate Change), Global warming by 1.5°C (selectively, highlighted for water resources) [16].

According to computational estimates, human activity is a cause of global warming of about 1°C above pre-industrial temperatures with a probability range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if the current pace is maintained.

The global average land surface temperature observed in the decade 2006-2015, reflecting the long-term warming trend since the pre-industrial period, was 0.87°C above the 1850-1900 temperature. Anthropogenic global warming, driven by past and present greenhouse gas emissions, is now increasing by 0.2°C per decade.

Warming, as a result of anthropogenic emissions from the pre-industrial period to the present, will not stop for hundreds or even thousands of years, and will continue to be a cause of long-term changes in the climate system such as rising ocean levels with the respective consequences, but it is very unlikely that these emissions alone will become the cause of global warming by 1.5°C.

Thermal extremes on land are expected to exceed global ones – extremely hot days in temperate latitudes will become about 3°C warmer with 1.5°C global warming and nearly 4°C with 1.5°C warming global by 2°C. Extremely cold nights in temperate latitudes will be 4.5°C warmer at 1.5°C global warming and almost 6°C at 2°C global warming. The dynamics of the observed temperatures are presented in (Figure 1.3).

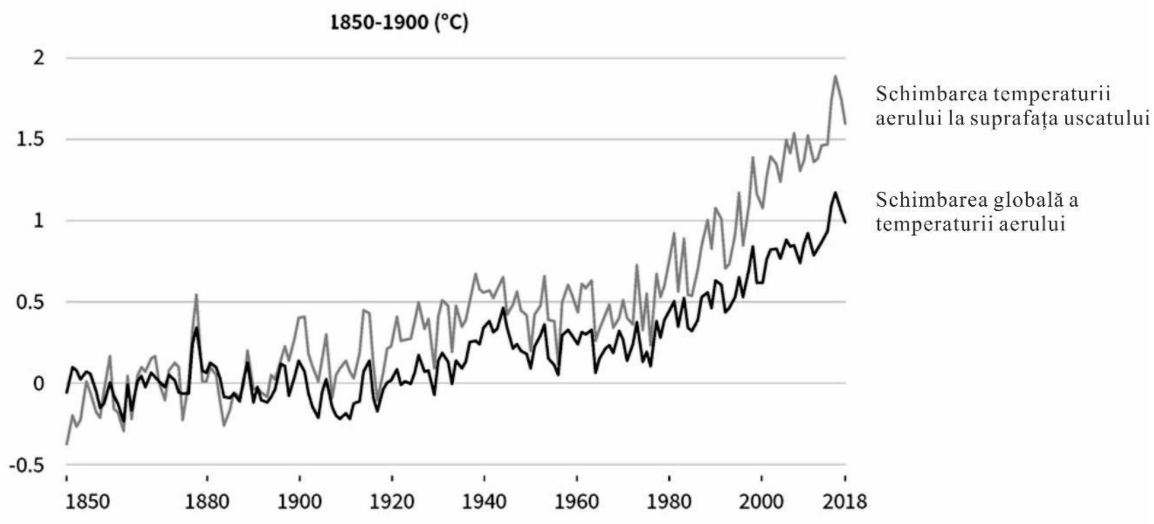


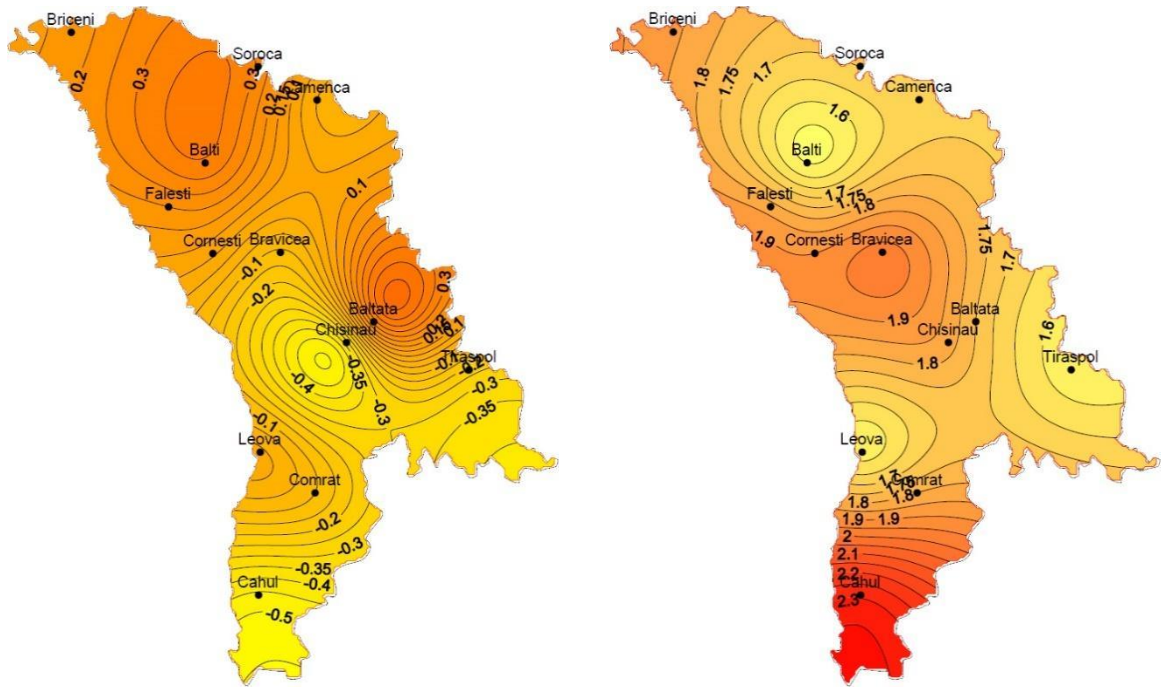
Figure 1.3. The evolution of air temperatures observed since 1850

Europe's climate has warmed by about 1°C over the last century, higher than the global average. All the years of the 21st century (2001-2013) are among the first warmest years globally since 1880, according to the 2013 National Oceanic and Atmospheric Administration (NOAA) report. 2013 ranks as the fourth in the list of the warmest years in the last 133 years, being the 37th consecutive year with an average temperature higher than that of the 20th century. The years 2010, 2005 and 1998 occupy, in order, the first three places in the list of warmest years since 1880.

The air temperature in the Republic of Moldova in the last century has increased above the global average and that recorded in Europe, according to the same reference period. Thus, in the period 1901-2000, the increase in the global average annual temperature was 0.6°C, in Romania it was below the global average level of 0.3°C, and in the Republic of Moldova, it was 0.9°C, i.e. above the global average level by 0.3°C. In the period 1901-2006, the global increase was 0.74°C, in Romania 0.5°C, and in the Republic of Moldova 1.06°C.

Climate change is characterized by a pronounced warming trend. The climate of the Republic of Moldova is influenced by the physical-geographic position on the globe (in the temperate latitudes of the northern hemisphere: The parallel of 45° lat. N), but also by the geographical position on the continent (including its meridional extent), which gives the climate a character temperate continental, with greater differences persisting between the south and the north of the country. Thus, the average annual temperature in the south of the country rises to about 10.5-11°C, while in the northern part, at comparable altitudes, the values of this parameter are lower by about 1.5-2.0°C. At the same time, during the evolution of the climate in the region, there are periods when the principle of zonality is not respected, having reverse situations, when in the northern part the positive trend can be observed, and in the southern part, on the contrary, the tendency of temperature decrease can be attested annually [14].

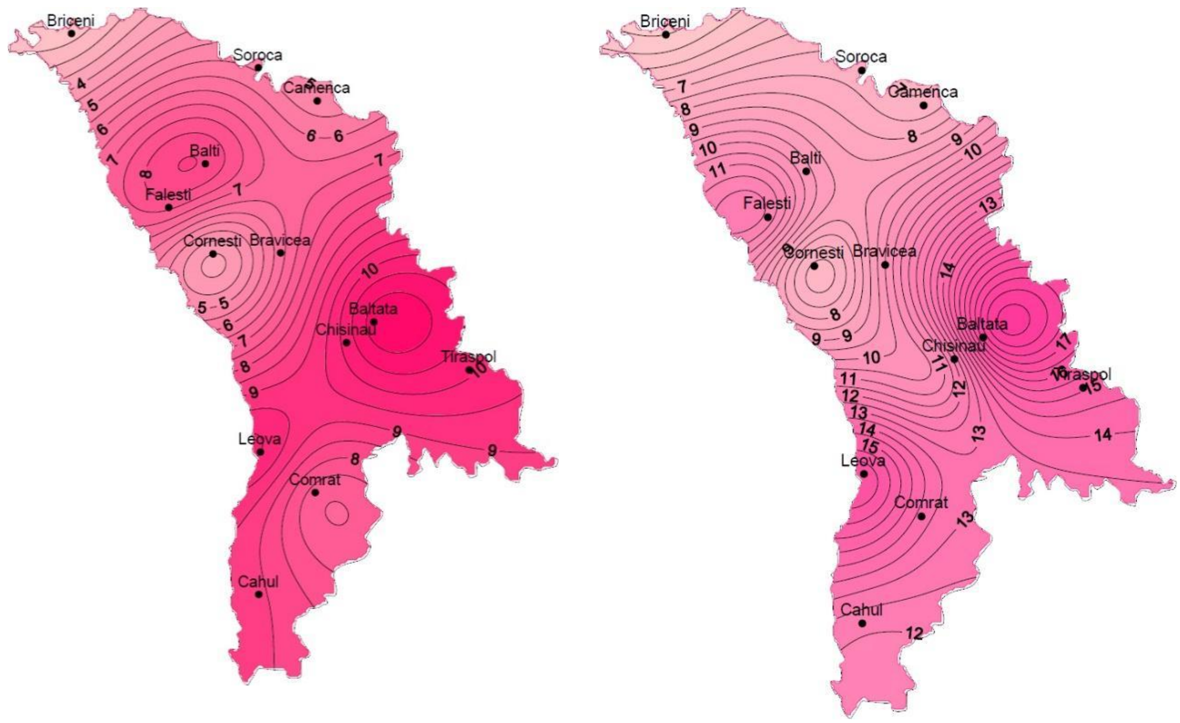
It should be noted that during the period 1961-1990 the south, southeast and central part of the country registered a negative trend, i.e. decreasing air temperature (Figure 1.4.a), and in the north and northeast, an increase of 0.3°C was recorded. During the period of 1981-2010, an increase in temperature is recorded everywhere, with its rather significant footprint in the southern part (Figure 1.4.b). So, if in the northern part the trend is 1.5-1.6°C, while in the southern extremity the temperatures increase faster by 0.7°C, reaching a value of 2.3°C.



A b

Figure 1.4. Variation of the average annual temperature for two reference periods (a – 1961-1990; b – 1981-2010) [10]

The trend of increasing temperature has also intensified the phenomenon of dryness and heat, it being evaluated for the summer season (June-August). Figure 6 shows the trends of this phenomenon at the national level, for the periods 1961-1990 and 1981-2010.



a b

Figure 1.5. The phenomenon of dryness and heat (number of days) for two reference periods: a – 1961-1990; b – 1981-2010 [12]

During the period 1961-1990, dryness and heat were manifested with a reduced intensity (3-7 days), in most of the country, which means that agricultural crops in general are not frequently affected by the thermal stress generated by the temperatures in air above the threshold of 25°C and relative air humidity below 30%. Locally, in the south of the country, the phenomenon shows an increased intensity (10 days). In the period 1981-2010, the surface affected by the phenomenon expands, with a "pole" appearing in the center, in the west of the country and in the southwest of the territory (fig. 1.5.a, fig. 1.5.b).

Thus, in certain specific years (2015), the phenomenon of dryness and drought can exceed 7-8 times the multiannual average values (Figure 1.6), having its different spatial specificity.

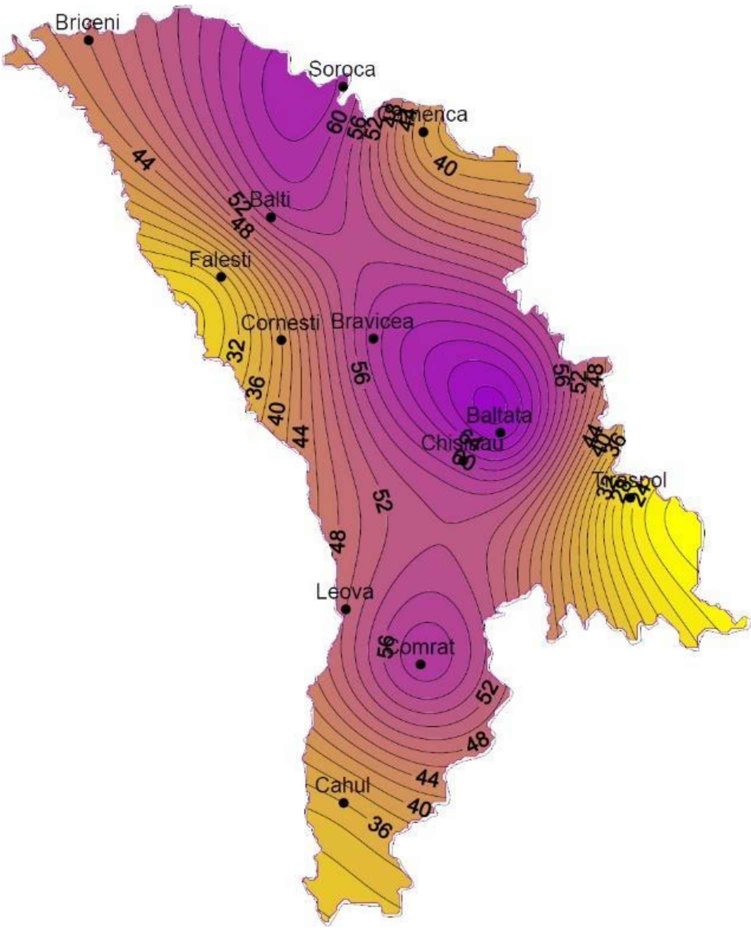


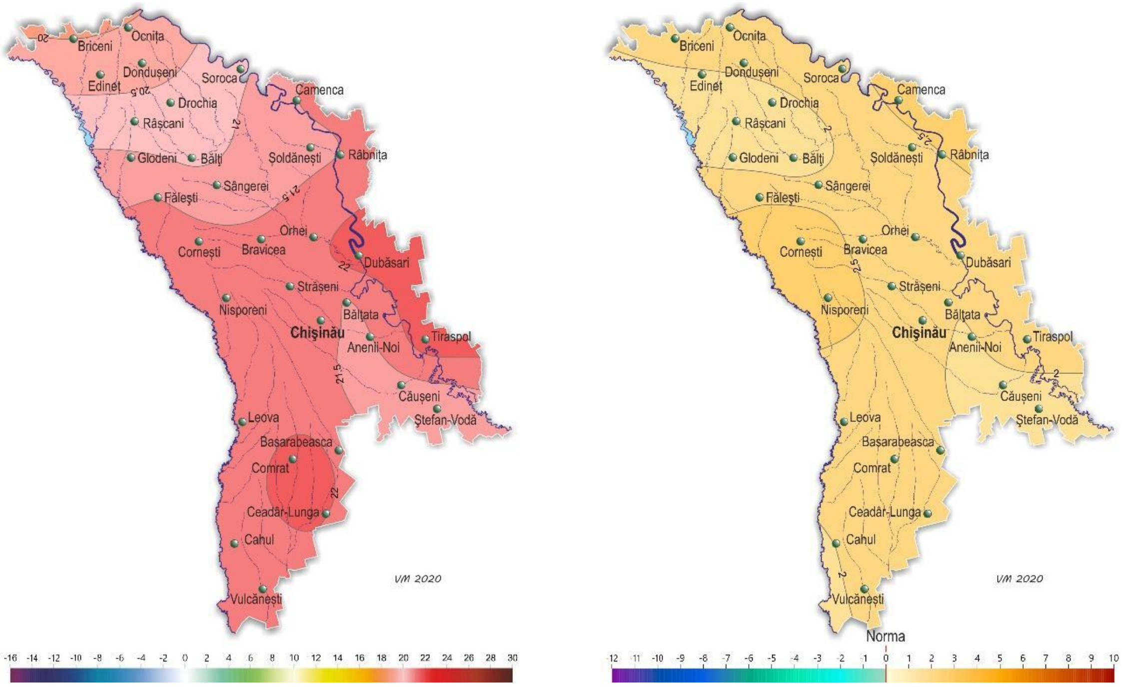
Figure 1.6. Manifestation of the phenomenon of dryness and heat in 2015 (number of days) [12]

The year 2020 was characterized by an unusual drought, comparable with the harshest droughts seen to date. The detailed analysis of this phenomenon for the year 2020 will be carried out after processing all the data measured by the State Hydrometeorological Service but a brief analysis of the thermal regime of the summer months can already be conducted.

During the month of **June 2020,** warmer weather than usual was reported on the territory of the Republic of Moldova and overall, the given year was highlighted by several thermal records [5].

The average monthly air temperature was higher than the norm by 1.5-2.5ºC and amounted to +20..+22ºC, which is reported on average once every 3-7 years (Figure 1.7).

The maximum air temperature on the territory of the country rose to +35ºC (Meteorological station Camenca, Râbnița, Dubăsari, Tiraspol, Leova, Comrat, Ceadâr-Lunga), which during this period is reported on average once every 5-8 years. The number of days with the maximum air temperature of +30ºC and more on the territory of the country was 8-15 days, the norm being 2-6 days, which in this month is reported on average once in 5-10 years. The maximum air temperature of +35ºC and more was recorded isolated on the territory of the country during one day (the norm being one day).



A b

Figure 1.7. Monthly average air temperature (a) and average air temperature deviation (b) in June 2020

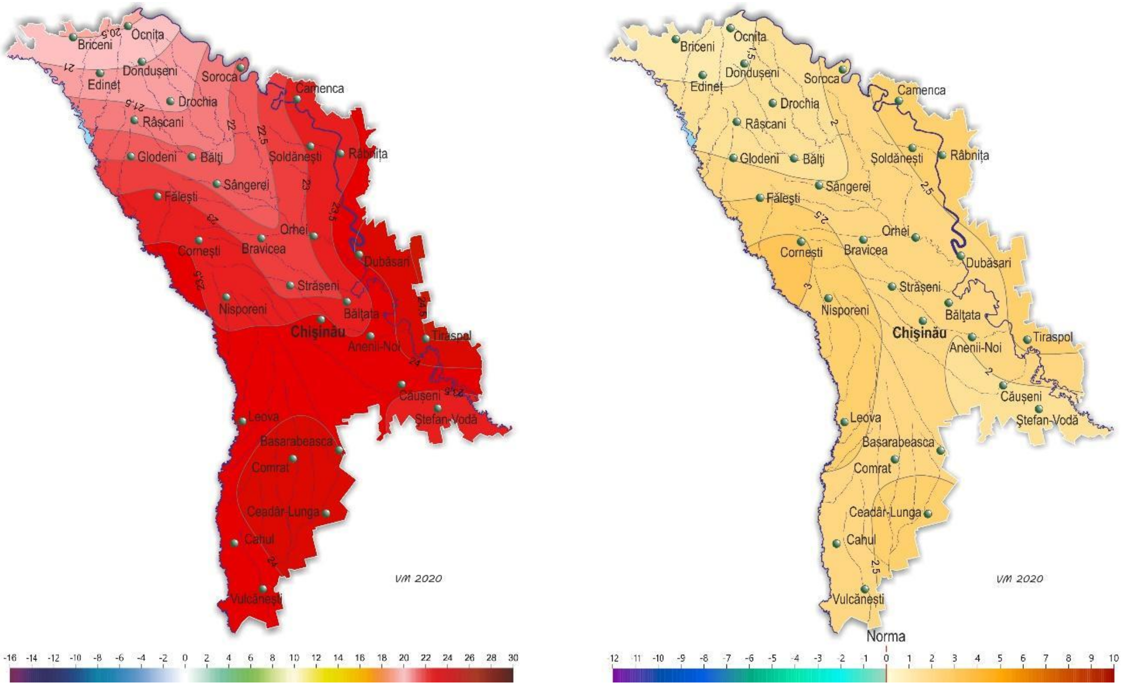
During the month of **July 2020,** inhomogeneous weather was reported throughout the country according to the thermal regime [5].

The average monthly air temperature was higher than the normal values by 1.5-3.0ºC and was +20.5..+24.5ºC, which is reported once in 10 years on average (Figure 1.7, Figure 1.8).

The maximum air temperature on the territory of the country rose up to +37ºC (Meteorological station Camenca, Fălești, Bravicea, Tiraspol, Comrat, Ceadâr-Lunga, Cahul), which is reported on the territory on average once every 5-10 years.

The number of days with maximum air temperature of +30ºC and more on the territory of the country varied from 7 days in the north of the country to 24 days in the south, the norm being 3-11 days. The maximum air temperature of +35ºC and more constituted 1-6 days (the norm being one day).

The minimum air temperature dropped to +8ºC (Balțata meteorological station).



A b

Figure 1.8. Monthly average air temperature (a) and average air temperature deviation (b) in July 2020

During **August 2020,** hot weather was reported throughout the country [5].

The average monthly air temperature was higher than the norm by 2.5-4.0ºC and was +21.5…+24.5ºC, which is reported on average once every 10-15 years (Figure 1.9).

The maximum air temperature rose to +38ºC (Tiraspol meteorological station, Ștefan-Voda), which is reported once every 7 years on average. The minimum air temperature dropped to +8ºC (Balțata meteorological station).

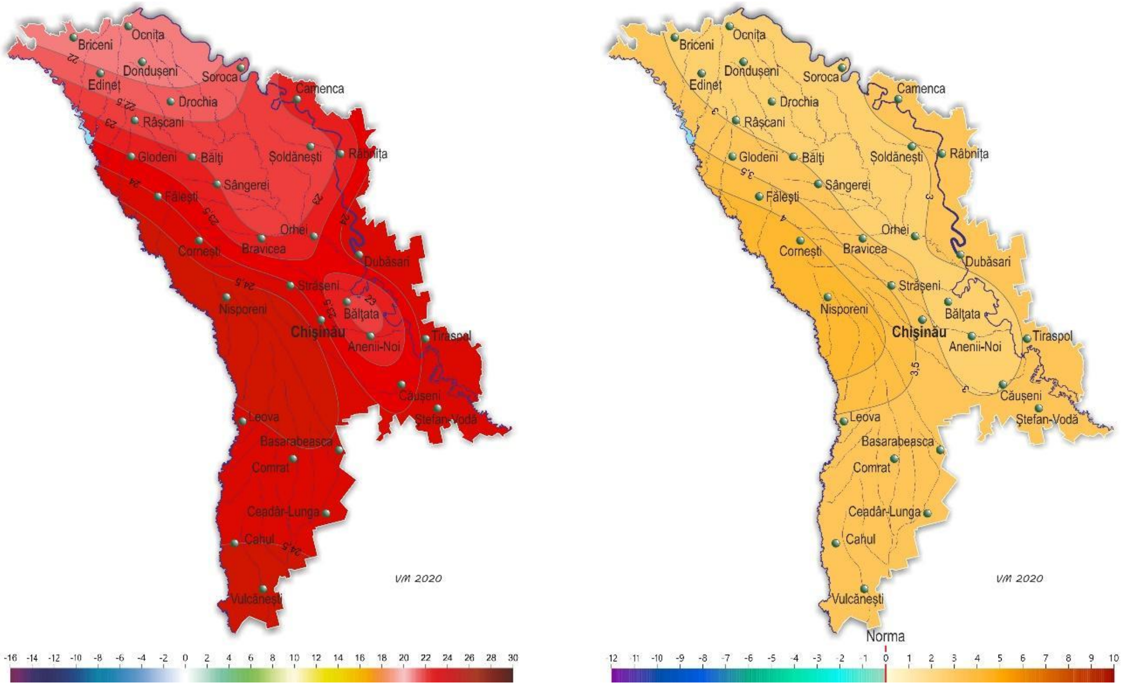
The number of days with the maximum air temperature of +30ºC and more constituted 11-23 days in the territory (the norm being 3-10 days), and the number of days with the air temperature of +35ºC and more – 1-4 days (the norm being one day).

Another important indicator in the estimation of the climate warming process is the harshness of winter, expressed by the duration of its manifestation, which records a reduction of it by 10 days in the north and by 6 days in the south in favor of the period 1981-2010.

In regional terms, the contemporary period (1961-2019), being conventionally divided into four stages of 30 years each, which in fact represent the reference periods proposed by the World Meteorological Organization (WMO) and the Intergovernmental Commission on Climate Change (IPCC), reveals that the last stage (even if it consists of 29 years: 1991-2019), is the warmest stage in the contemporary period of instrumental observations.

Thus, the lowest thermal values of the year remain unchanged, i.e. they were recorded in 1933 and 1929, when the average annual temperature was 7.2 – 7.9°C. The years 1934, 1985, 1912, 1940, 1987, 1888, 1976, 1980 were characterized by low values in the range of 8-8.3°C.

In the case of the warmest years, the year 2007 remains the warmest in the series of instrumental observations (1887-2019), followed by the years 2015, 2016, 2017, 2018, 2019, which, according to its values, "take" out of the top very warm years previous years with significant thermal values. Thus, the year 2008 represents the temporal limit of extremely warm years, when the average annual temperature was 11.3°C, compared to the multiannual average of 9.6°C. **So, in the last pentad 2015-2019 of the current decade, the average annual temperature was already 12.0°C, which once again demonstrates the fact that we are on the threshold of substantial climate changes [14]**.



A b

Figure 1.9. Monthly average air temperature (a) and average air temperature deviation (b) in August 2020

Atmospheric precipitation

The changes in the global hydrological cycle (the cycle of water in nature), which will take place at the end of the century. XXI as a reaction to global warming, will not be homogeneous. The differences in the amounts of precipitation, which fall in humid and arid regions, as well as during the rainy and dry seasons, will broadly increase, even though there may be some exceptions (Figure 1.10) [17].

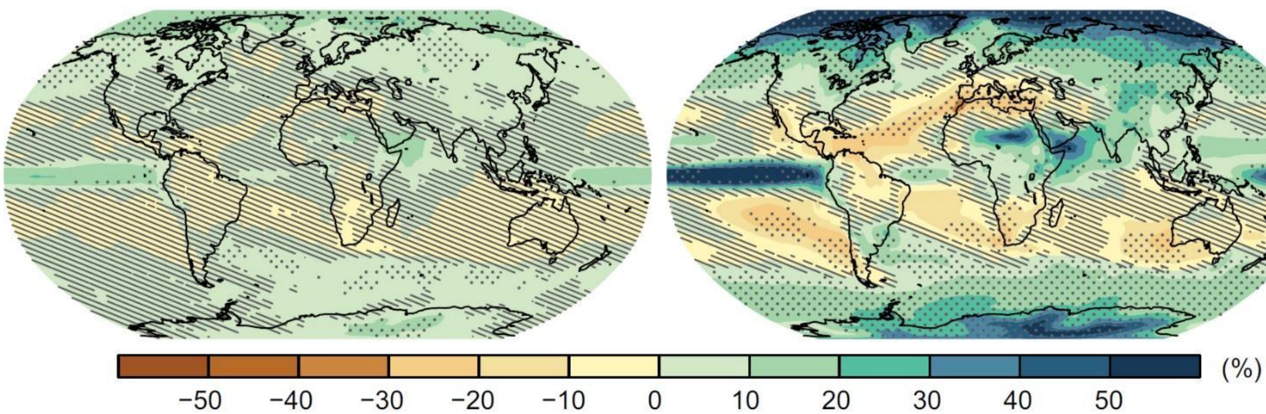


Figure 1.10. Change in annual amount of precipitation (1986-2005 – 2081-2100). Left – 32 analyzed climate models, right – 39 analyzed models. Hatching – natural changes predominate, scoring – patterned changes predominate

According to the RCP8.5 scenario (the worst scenario) towards the end of the century in dry regions of temperate latitudes the average amount of precipitation is likely to decrease, while in humid regions of the same latitudes, precipitation is likely to increase.

With the increase in global average air temperature, the intensity and frequency of extreme precipitation will likely increase on continents in temperate latitudes [17].

For the analysis of the dynamics in space and time of atmospheric precipitation, the years 1891-2019 were analyzed, in which an increase in the amount of annual precipitation by 0.5993 mm/year is attested. It should be noted that the amount of annual precipitation on the territory of the Republic of Moldova registered an increase of 0.719 mm/year during the years 1891-2010, which is 0.1197 mm less. In the last decades, there is a frequent alternation of positive and negative rainfall anomalies in both annual and seasonal periods, demonstrating the extremely variable nature of the manifestation of both years with excess rainfall and years with a rainfall deficit. In 1903, the annual amount of atmospheric precipitation was only 271.8 mm, and in 1912 the most significant values of 915 mm were recorded. With the inclusion of the last 5 years, the position of dry and rainy years remained unchanged compared to previous research obtained within this compartment. So, what has been reported attests that, although the rainfall anomalies are manifested with an increased frequency (through their antipodal alternation), their absolute intensity over time has not been exceeded [5].

The spatial distribution of average annual precipitation has an orientation from northwest to southeast and varies from below 475 mm in the southeast of the country, to over 625 in the northwest of the country (Figure 1.11) [4]. The higher forms of relief attest to an increase in precipitation against the background of the zonal distribution (Podișul Codrilor, for example).

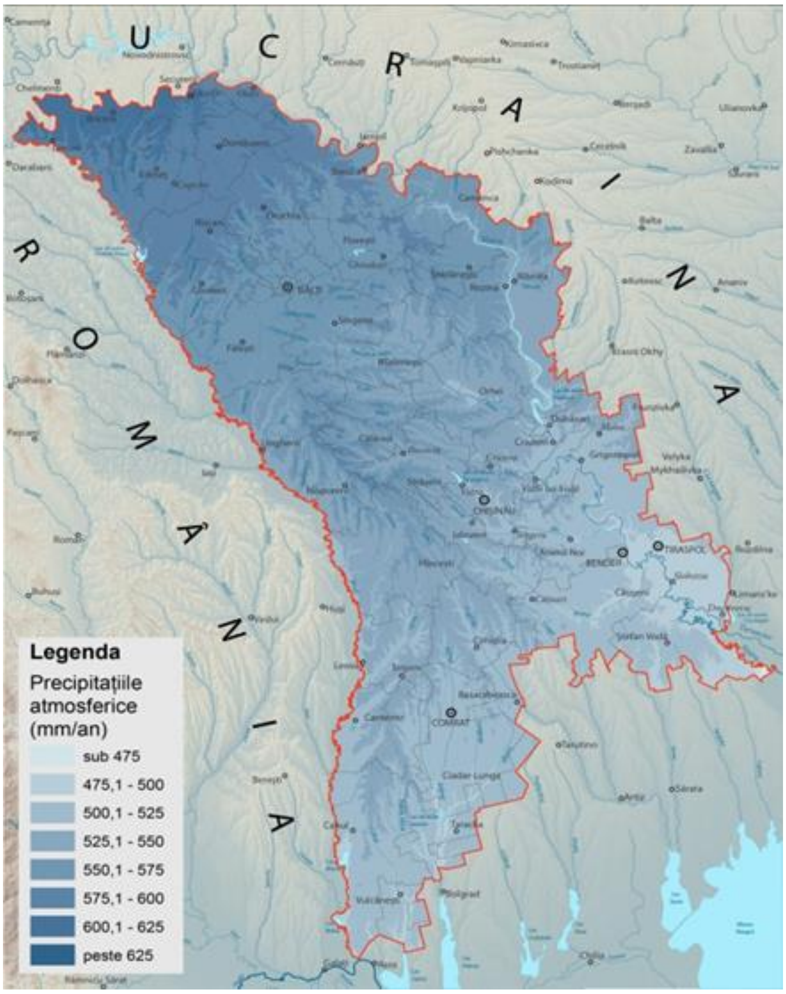


Figure 1.11. The map of the distribution of annual multi-year average precipitation compiled by the regression method [3]

The amount of seasonal precipitation, in **winter**, on the territory of the Republic of Moldova registers an increase of 0.1911 mm compared to 0.2102 mm/year during the years 1891-2010. In 1925 the amount of atmospheric precipitation was only 15 mm, and in 1966 the most significant values of 257 mm were recorded. The year 2010 ranks second in the list of excessively wet winters. We mention that the year 2012 with 173.8 mm also places the winter in the top of excessively wet winters.

Spring on the territory of the Republic of Moldova records a decrease of 0.033 mm in precipitation during the years 1891-2019, so the trend remains unchanged compared to the period 1891-2010. In 1986, the annual amount of atmospheric precipitation was only 23 mm, and, in 1984, the most significant values of 265 mm were recorded. The year 2006 ranks third in the list of excessively wet springs. In fifth place is the year 2017, with the amount of 207.7 mm.

Summer in the country registers an increase of 0.177 mm, which is 0.0614 mm less than the 0.2384 mm/year observed during the years 1891-2010. In 1951, the seasonal amount of atmospheric precipitation was only 42 mm, and in 1948 the most significant values of 531 mm were recorded. The year 2007 ranks fourth in the list of excessively dry summers.

In autumn, the amount of precipitation on the territory of the Republic of Moldova registers an increase of 0.1749 mm compared to 0.2242 mm/year recorded during the years 1891-2010.

In 1963, the seasonal amount of atmospheric precipitation was only 10 mm, and in 2019 the seasonal amount is 35.9 mm, placing this season among the driest autumns. In the fall of 1905, the most significant values (of 343.5) mm were recorded.

Regionally, the contemporary period (1961-2019) was conventionally divided into four stages of 30 years each, the reference periods proposed by the World Meteorological Organization (WMO) and the Intergovernmental Commission on Climate Change (IPCC). For the entire contemporary period in the north of the country, the annual amount of atmospheric precipitation (Table 1.4) is 618.4 mm, in the central part 550.8 mm and in the south 537.7 mm, thus respecting the principle of zonality. The difference between the north and the south of the country is 80.7 mm. The reference period 1961-1990 recorded in the north and center of the Republic of Moldova, values close to the climate norm calculated for the entire contemporary period, which allows us to conclude that the regional climate system during this period was a stable one [14].

Table 1.4. Annual amount of precipitation in different reference periods [12]

Reference periods	Briceni	Kishinev	Cahul
1961-2019	618.4	550.8	537.7
1961-1990	619.7	548.2	556.3
1971-2000	609.9	550.6	544.5
1981-2010	622.5	548.1	509.9
1991-2019	617.0	553.5	518.5
2011-2015	538.4	502.9	551.9
2015-2019	553.3	544.0	495.4

In the south, the annual quantity is higher by 18.6 mm in this period (1961-1990), for the rest of the reference periods, the south registers the lowest numerical values, compared to the rest of the territory. At the same time, for each region in annual aspect, for example, the driest period was in the years 1971-2000, while in the southern part the drier period coincides with the years 1981-2010.

The years 2015-2019 become drier compared to the central and northern part, where there is an increase in the norms for this pentad [14].

Maximum diurnal precipitation falls during the warm period of the year as a result of the intensification of the activity of the Azorean Anticyclone, as well as the oceanic and Mediterranean cyclone. They generate large amounts of water that fall in a very short period, so they have a high intensity and cause very large floods that can have serious consequences on human constructions and settlements, as well as accelerated erosion processes on slopes stripped of forest vegetation. The fundamental processes that lead to the development of synoptic situations, capable of producing large amounts of atmospheric precipitation, are convection and turbulent exchange within air masses.

In the Republic of Moldova, precipitation in the summer season is often of a frontal nature and occurs more during the day, often characterized by downpour. A peculiarity of the territorial distribution of maximum diurnal precipitation (24 hours) is that, in the summer months, the highest amounts on the territory of the republic can be registered in its southeast - a region also influenced by the local atmospheric circulation generated by air masses over the Black Sea [14].

It should be noted that the variability of precipitation over time is very high. Often, the monthly summer average can be made up of a single rainfall.

For example, the heavy rains of August 26-27, 1994, according to the radar data recorded by the "Anti-Hail" Service, constituted 270mm of precipitation within 10 hours in Hâncești, Calmățui.

According to the data of the State Hydrometeorological Service, maximum diurnal precipitation was also recorded in 2005 on May 23, 25, 26 and 31, when, for one hour, the maximum rainfall was 40mm.

On the night of August 18 to 19 in the northern and central districts, according to the data recorded at the Costești, Râșcani, Dumeni hydrometeorological stations, 140-160 mm or almost 3 monthly norms fell during the night.

On the night of June 3, 2007, against the background of the establishment of a devastating drought in the region, in the southeast of the republic towards the morning of June 4, more than a monthly precipitation norm fell in Comrat.

So, torrential rains (rain showers) are characterized by a large amount of water falling in a very short time, a fact that implies a high intensity and possibly serious consequences by producing local rapid floods, accompanied by very high rain erosion [14].

The most recent studies published in the field of possible changes in precipitation under climate change conditions were carried out in the work *Vulnerability Assessment and Climate Change Impacts in the Republic of Moldova* [15] published in 2018.

RCP8.5 and RCP2.6 scenarios project a slight increase in precipitation around 0.6-2% across the country by 2016-2035. In contrast, under the RCP4.5 scenario, a small decrease of 1.5% to 2% is expected for the north and center of the country compared to the reference period (1986-2005). Annual changes in precipitation become much more differentiated in 2100. The RCP8.5 scenario shows that the country will witness an overall annual decrease in precipitation, from 9.9% in the north to 13.4% in the southern EEZs (Figure 1.12).

The RCP8.5 scenario shows that, in the Republic of Moldova, there will be a general annual decrease in precipitation, ranging from 9.9% in the north to 13.4% in the south of the country. Controversially, a moderate increase in precipitation is projected under the RCP2.6 scenario, from 3.1% in the north of the country to 5.1% in the south, by the year 2100, compared to the reference period 1986-2005 [15].

The scenarios RCP8.5, RCP4.5 and RCP2.6 predict that the country, as a whole, will see an increase in precipitation during winter and spring. Winters are projected to be wetter by the end of the 21st century. The ensemble projections reveal the largest increase in precipitation towards 2100, from 4.0% (RCP2.6) to 11.8% (RCP8.5) in winter in the north of the country; and the smallest increase, from 3.0% (RCP2.6) to 7.4% (RCP8.5), in the central parts of the country [15].

The three RCP scenarios indicate that the precipitation reduction will be more considerable during summer and autumn. The RCP8.5 scenario projects the largest summer precipitation reduction of 25.1% in the center of the country and the smallest of 18.1% in the north. The RCP2.6 scenario denotes a slight decrease in precipitation, by 0.7% over the center of the country, to an increase of 8.0% in the south, towards the year 2100 compared to the reference period 1986-2005 [15].

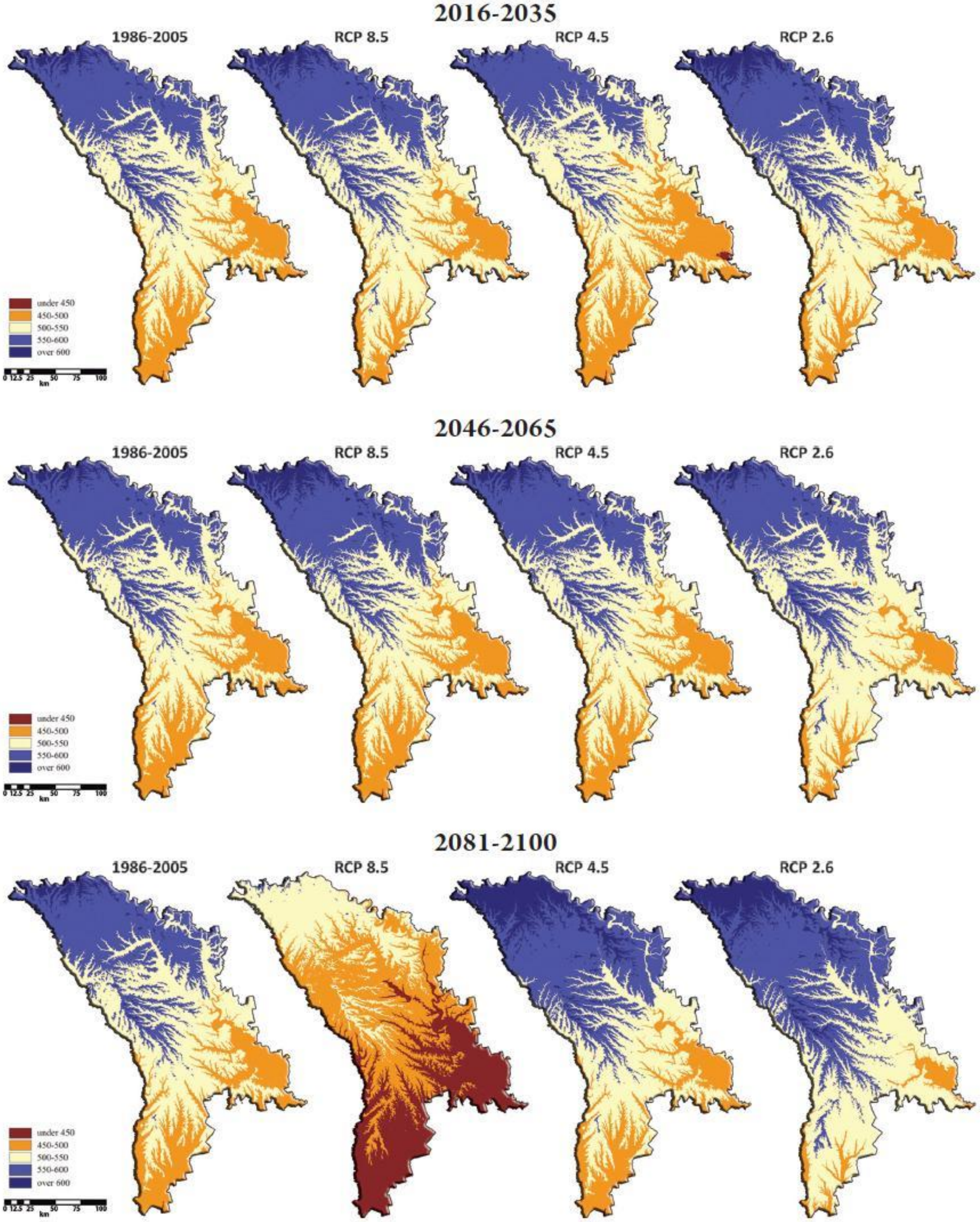


Figure 1.12. Projections of change in mean annual precipitation under RCP2.6, RCP4.5 and RCP8.5 scenarios for different time intervals [13]

1.4.2 Process and results of sector selection

The water resources sector (due to its economic importance for agriculture, health, etc., social) is prioritized in the policy documents regarding adaptation to climate change: The Climate Change Adaptation Strategy; climate documents of the Determined National Contribution (2020) and Intended (2015) type; sustainable development documents - Moldova 2030, in the Environmental Strategy of the Republic of Moldova and the Employment Country Program with the Green Fund for Climate.

Moldova's water reserves (described in more detail previously) do not currently represent a major constraint for the country's development. Moldova has sufficient water resources, which are reliably available to meet demand in full, with only 5% of renewable water resources being used annually, but also under various development scenarios by 2030. However, it is likely that climate change, which brings an increase in average temperatures and greater variability of precipitation, has a drying effect.

About 44% of the country's population does not have access to safe drinking water. Although all cities and municipalities and more than 65% of rural settlements have centralized drinking water supply systems, only 50 percent are in satisfactory technical condition, the rest require major repairs or reconstruction.

The most exposed to water scarcity is the southern part of the country, where during drought years the risk of surface water resources drying up increases (as happened in 2007, when many reservoirs and ponds dried up. However, drought becomes endemic for other regions of the country and increasingly affects the level of existence and rural development.

Moldova is the European country with the greatest climate vulnerability (Notre Dame Global Adaptation Initiative (ND-GAIN). 2020), and this vulnerability will increase with climate change. The problems of the Republic of Moldova regarding the management of water resources appear, because of a lack of investment in infrastructure, financing, management capabilities and enabling policies [12].

Climate change will have an impact on many sectors, and its effects are pronounced in the case of agriculture, due to the increasing demand for water for irrigation. These are likely to lead to an expansion of water availability stress hotspots in the northern and middle areas of the Prut Basin, as well as in the south-east and south-west of the country, and trade-offs will be required between the demand’s ecological runoff and irrigation water demand in May years. A range of measures can be leveraged to manage the insecurity of water supplies for livelihoods and the economy, for example adaptive irrigation practices and climate resilient agronomic practices, demand management and water use efficiency, allocation to high value uses and seasonal storage.

The sustainable management of water resources in the Republic of Moldova is threatened by the lack of infrastructure, financing, management capacities and enabling policies. The country needs a complex and long-term approach to deal with these challenges, so that accelerated investments lead to better water supply, sanitation and irrigation services, to the existence of management capacities to ensure the sustainable use of water resources now and in the future and building resilience into the system.

The Republic of Moldova has great benefits obtained using water resources, but the existing barriers limit the scale and efficiency of the use of this natural resource on the one hand and increase the cost of the final product and the effort invested in the given sector.

Agriculture remains an important pillar of the economy, accounting for 10% of gross domestic product (GDP) in 2019. Its importance in job creation is significant, employing a third of the country's workforce. Agricultural products and foodstuffs account for 45 percent of exports. Moldova's largely rain-fed agriculture remains vulnerable to droughts, with volatile yields exposing the economy and affecting the livelihoods of the rural population.

Despite the challenges, the agricultural sector of the Republic of Moldova can be an engine for diversification and growth in the future. Although Moldova is transitioning to a more diversified economy, the opportunities in higher value agriculture are not being fully realized. This is partly the result of underinvestment and poor irrigation management by centralized irrigation systems, most of which are now dysfunctional. The systems rehabilitated in 2010 with the support of the Millennium Challenge Corporation (MCC) have not yet achieved their intended benefits. Towards the end of the 1990s, the surface of irrigated lands was about 300 thousand ha. Currently, according to superficial assessments, there are about 40 thousand ha of irrigated land, the target and objectives of the national development strategies being the restoration of the irrigated areas in the past.

Water resources are used to produce heat and power through thermal cooling, are used in many industrial processes such as textiles, metals, food processing and machinery. However, business productivity is compromised by the lack of reliable water supply services in cities, with disruptions affecting business and manufacturing processes.

Moldova is subject to a high risk of floods and drought, a risk due to the high interannual and annual variability of atmospheric precipitation. Climatic extremes, channeled through the hydrological cycle, impose great economic losses. Average economic losses due to flooding are estimated at 100 million USD annually (0.1–0.2 percent of GDP), directly or indirectly affecting 70,000 Moldovans [12].

Large disparities continue to exist in access to and quality of water and sanitation services in urban and rural areas. Only one in three people in rural areas have access to water from a public network and only one in eight has flush toilets. The low level of access to sanitation and the lack of adequate treatment directly imposes a high pressure on the inhabitants in terms of health. It is estimated that almost one million Moldovans use water from polluted shallow wells, and 80 percent of the wells do not comply with sanitary water standards. Reliable water and sanitation services are vital for businesses, including tourism, to thrive and to ensure a decent living environment. Realizing citizens' aspirations for better conditions of water supply, sanitation and hygiene are essential for social stability and resistance to pandemics.

In other words, water resources deserve special attention due to its importance and major role in the national economy, the life of citizens, as well as the maintenance of natural ecosystems, and for these reasons the given sector has become a priority in the TNA process.

Chapter 2 Institutional arrangement for the TNA and for stakeholder involvement

The TNA process needs to be a **legitimate country-driven process**. Legitimacy and ownership require ample representation from different stakeholders, to adapt the process to the specific context of each country. An inclusive space for stakeholders with local capacity and knowledge that can provide useful insight to the process is necessary.

Stakeholder consultations are an important source of information that help to improve and shape project design and allow detecting and controlling external sources of risk. Consultation can lead to the development of strong partnerships and form the basis for future collaboration, particularly when stakeholders are given the opportunity to engage in the process by raising concerns and asking questions, giving them the breadth to help shape the project either directly or indirectly.

By government decision No. 444 of 01-07-2020 regarding the establishment of the mechanism for coordinating activities in the field of climate change, the National Commission on Climate Change was established.

The national commission is made up of 17 members: 10 representatives of central and local public administration authorities and 7 representatives of educational and scientific institutions, non-governmental organizations and the private sector:

The intersectoral coordination mechanism of the climate change adaptation process is made up of:

1. The national climate change adaptation process (NAP), which represents a continuous, iterative, participatory, transparent, socially inclusive and gender-sensitive planning process. Through this, medium and long-term adaptation needs are identified at the national and which facilitates the integration in a coherent way of adaptation to climate change in the relevant strategic documents (strategies, programs, action plans) in all national sectors.

2. The sectoral climate change adaptation plan (PSA), which represents one or more sectoral development policy documents (strategies, programs, action plans). These contain the climate risks and vulnerabilities of a sector and establish the adaptation needs of the respective sector, expressed in adaptation measures/actions incorporated in the strategic document. They fully ensure the planning of a sustainable and climate-resilient development of the respective sector.

The National Commission on Climate Change jointly with the central public administration authorities provides the institutional framework for planning and implementing adaptation to climate change. The national commission fulfills the following duties:

1. Coordinates the process of planning, implementation, monitoring and evaluation of the PNA and PSA in collaboration with the central public authorities, the private sector and civil society.

2. Recommends the authorities of the central public administration and the local public authorities to take the necessary measures to identify climate vulnerabilities and risks, as well as climate change adaptation actions and their integration in the sectoral strategic development documents.

3. Recommends the central public administration authorities to present the content of the PSA for four years based on the sectoral and national level policy documents.

4. Approves the roadmap for the implementation of the PNA, which is developed based on the PSA.

Central public authorities perform the following duties:

1. Identify and describe sectoral climate risks and vulnerabilities and include them in sectoral strategic development documents.

2. Establish the priority measures/activities to adapt the sector to climate change and incorporate them into the sectoral strategic development documents.

3. Based on the measures/activities of adaptation of the sector established, prepare and present to the National PSA Commission once every four years.

4. Carry out the PSA and reports to the National Commission regarding its implementation.

Local public authorities are advised to:

1. Identify the priority measures/activities to adapt to climate change and incorporate them into the socioeconomic and other development programs of the respective local public authority.

2. Carry out climate change adaptation measures/activities and report the results obtained to the National Commission.

3. NAPs are subject to systematic evaluation, including from the point of view of the impact on various social groups, especially those vulnerable to climate change, to ensure coherence with national priorities and objectives.

2.1 National TNA team

The TNA team is organized by the project coordinator (UNDP) and guided by the team leader (Figure 2.1) with the participation of the capacity development consultant, the national sector consultants, as well as the members of the Sector Working Group

The functional responsibilities of the process participants are described as follows:

National experts (hired through the contract system) have responsibilities over the process of collecting activity data, selecting assessment methods, sector-level assessment, taking corrective action in response to verification, quality control and quality assurance activities, as and on the development of some TNA reports.

National experts are responsible for coordinating the work of the working groups. They supervise the evaluation process at the sector level, are responsible for the interpretation of the obtained results, the coordination of activities to identify and prioritize climate change adaptation technologies.

The members of the working groups are selected according to their competence in the field of water resources, their professional activity and the positions they hold in the field of water resources.

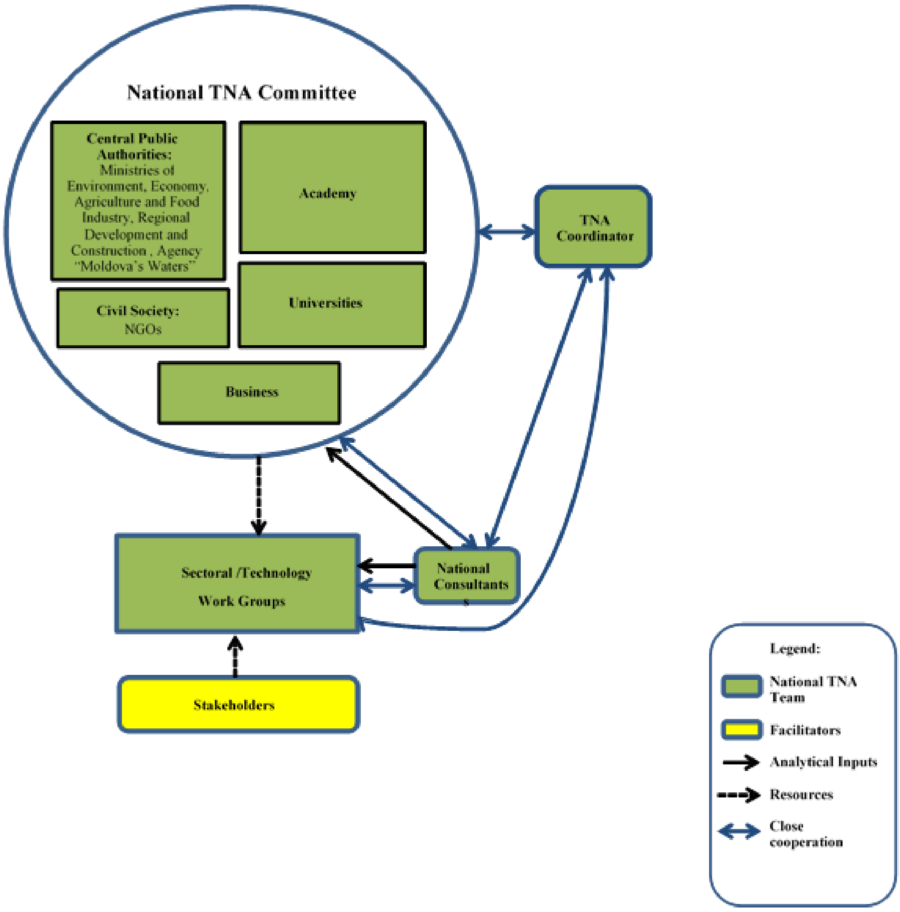


Figure 2.1. The Institutional Structure of TNA

2.2 Stakeholder engagement process followed in the TNA

The main actors in the field of water resources (development of policies in the field, monitoring, evaluation and management, use and provision of different services, implementation of projects) were organized into several groups. The highlighting of these groups was done according to its role in relation to water resources. Without the involvement of these actors, it is impossible to carry out the TNA process in the field of water resources.

Obviously, the use of water resources has a tangent with practically all human activities on the one hand and with all the Earth's geospheres on the other. From these criteria, a short list of climate change adaptation technologies was selected based on the subjective criteria – **Role, Potential, Professionalism** and **Interest** shown in the field of water resources. These four criteria can be the basis for the selection of the main institutions involved in the assessment of the impact of climate change in the sector and the assessment of adaptation technologies and more.

Central public administration bodies. Here, the main institutions are:

Government of the Republic of Moldova. The main attributions of the Government, in which references to the water resources sector can be found are that it:

- ensures the implementation of laws, regardless of the field regulated by them;
- exercises the function of general management and control over the activity of the specialized central bodies;
- carries out the economic and social development programs of the country;
- undertakes any management and management activity in matters concerning the whole society.

The Ministry of the Environment is the central specialized body of the public administration that develops and promotes state policy in the field of environmental protection and rational use of natural resources, waste management, biodiversity conservation, geological research, use and protection of the subsoil, water improvement, water resource management, regulation nuclear and radiological activities, state ecological control, hydrometeorology and environmental quality monitoring.

The Ministry of Foreign Affairs and European Integration (MAEIE) is one of the ministries that are part of the Government of the Republic of Moldova, which promotes the state policy in the field of foreign relations. MAEIE carries out its activity in accordance with the Constitution and laws of the Republic of Moldova, as well as with other normative acts, treaties and international agreements to which the Republic of Moldova is a party.

The activities related to the management of the water resources of the transboundary rivers (Dniester and Prut) are specifically coordinated by this ministry.

Central public administration bodies represent the set of state institutions that develop policies and normative acts that directly or indirectly relate to the country's water resources and cross-border ones.

The role of these structures is important in the rational management of water resources, but the potential and interest in this sector is low for objective and subjective reasons.

The implementation of new water resource management technologies as an adaptation measure can be found through the implementation of republican-scale climate change adaptation projects.

Local public administration bodies have more effective levers and tools in the implementation of new water resource management technologies through local climate change adaptation projects. The role of these institutions is huge, because it is precisely at this level that water resources are managed. Their potential is reduced due to the financial resources available, but which, with increased interest, can materialize through national and international support projects in the application of good water resource management practices and adaptation to new environmental conditions.

Public institutions in the field of environment represent the main instrument for implementing state policies in the water resources sector. Their role varies depending on the tangentiality of the institution's activity to water resources. The chronic staff shortage that all state institutions face also diminishes the role and interest in the adaptations of the water resources sector to climate change. It should be noted that these institutions manage most water resources in the Republic of Moldova.

The Academic Environment represents the set of institutions that are best known with the new technologies and best practices of managing water resources through the prism of the scientific and applied research they carry out, as well as through the training and education of young specialists. Their role is smaller but the potential and interest is enormous.

Environmental NGOs – Public environmental organizations are very active, with a high potential for implementing technologies and good practices in the field of water resources and with an increased interest in this sector. Their role, however, is reduced due to its status as well as material resources. Their involvement is more often focused on demonstration projects implementing good practices.

Private Sector – In most cases, the private sector manages and even markets water resources in the Republic of Moldova. This sector reacts promptly to the implementation of new technologies and good practices in the management of water resources. However, this whole sector, depending on the commercial interest, sometimes neglects the rational use of water resources.

From the long list, according to the role of the potential and the interest shown towards the implementation of new technologies in water management, the short list was selected, partly made up of the subdivisions of the institutions, which are directly involved in the water management process, and from here the implementation team (working group) was formed of TNA:

From the local public administration bodies, town halls and district councils are not indicated, because from their long list it is difficult to identify any concrete ones and it remains during the activities to identify a few structures (2-3 members from town halls or district councils in the country), which manifest increased interest in adaptations to climate change through the implementation of new technologies and good practices. Practice indicates that from all the town halls in the country there are more advanced representatives in the field of climate change, who, as a rule, already have experience in the implementation of local projects in this segment, and it is with them that we must continue to work (annex 1):

1. The "Integrated water resource management policies" department of MADRM, which directly deals with the development of policies in the given sector.

2. Representatives from 1-2 district councils or 1-2 town halls in the country. Only more active representatives from the given structures will be invited.

3. The "Bilateral Treaties" section of the Ministry of Foreign Affairs and European Integration. The management of transboundary water resources of the Dniester and Prut rivers requires support at the ministry level.

4. The Meteorological Center and the Hydrological Center of the State Hydrometeorological Service. It should be noted that monitoring and developing forecasts and warnings becomes difficult without the use of contemporary technologies. This institution is crucial in the implementation of new technologies for monitoring and evaluating water resources.

1. The "Environmental Quality Monitoring" Department of the Environmental Agency. This direction has an extremely high mandate in the management of the quality of water resources, but the potential (both of the direction and of the Agency as a whole) is currently very limited. This can be explained a period of painful reforms of organization and administration that has been undertaken.

5. The "Water Resources Management" Directorate of the "Moldova Waters" Agency. In this unit the situation is similar to that in the Environment Agency. The assessment and management of water resources is within the competence of this unit. However, staff insufficiency limits the efforts made.

6. The "Geological" Directorate of the Agency for Geology and Mineral Resources. Groundwater is monitored and assessed through this facility. Unfortunately, the institutional potential of the entity is minimal.

7. The "Control Management of Water and Atmospheric Air Resources" Directorate of the Environmental Protection Inspectorate. Important unit by identifying the main polluters of water resources. The contribution of this unit in the implementation of water resources management technologies is a crucial moment in the activity of identifying good practices.

8. Representatives from the North, Center, South and UTA Gagauzia Regional Development Agencies. These agencies, through the implementation of development projects, are directly involved in the promotion of good practices and new technologies.

9. The "Geography of Landscapes" Laboratory from the Institute of Ecology and Geography. The representatives of the academic environment are the main generators of ideas in the application of new technologies for managing water resources in the conditions of environmental transformations. This laboratory is concerned with solving problems related to hydrological problems.

10. The "Hydrogeology" Laboratory of the Institute of Geology and Seismology. Groundwater is scientifically researched by that unit. At the moment, the only human resources who are familiar with the new technologies for adapting to climate change in the underground water segment are concentrated here.

11. Representatives from the faculty of "Cadastre and Law" from the State Agrarian University of Moldova. That faculty represents the rudiments of the former hydrotechnical faculty. Unfortunately, hydrotechnicians - who a priori should be on the tip of the arrow oriented towards new practices in hydrotechnical constructions (their design and management) - are no longer educated in the Republic of Moldova. Only here have teachers been preserved who understand the role of innovative ideas for adapting water management to climate change and their potential is worth exploiting.

12. Representatives from the "Geography" faculty of the State University of Tiraspol. Currently, the faculty of geography is developing new specialties focused on geographical information systems and is trying to implement new courses in the segment of hydrology and hydrological calculations. It is here that new ideas and trends for the implementation of good practices in water management are promoted.

13. Representatives from environmental NGOs (Ecocontact, Oikumena, Ecotiras). These environmental NGOs have manifested themselves through the implementation (or participation in the implementation) of a series of projects oriented towards climate change adaptations in the field of water resources. We believe that the accumulated experience can be useful in achieving our goals.

14. Representatives from the joint-stock company "Apa-Canal". The private environment is the main tool for implementing good practices. The representatives in the territory of this enterprise have rich experience in the water supply of localities and we consider their opinion to be timely.

The Republic of Moldova is a small country in terms of population, and there are relatively few specialists working in the field of water resources. Accordingly, it was not difficult for the sector consultant to communicate on a personal level with each of them. The representatives from the interested parties were informed about the activities carried out within the project by email. After identifying the members of the working group, they were sent the necessary materials for the identification and prioritization of the selected technologies. If necessary, individual discussions were held with the members of the working group (in total 15 members of the working group were identified).

During the activity, two meetings of the working group were organized. Initially, suggestions and opinions regarding new technologies that would be useful for the Republic of Moldova were collected through various methods (email, zoom, skype and even telephone). A long list of technologies was outlined – 27 in number. Next, the day and time convenient for all to hold the virtual meeting of the working group on the water resources sector was agreed with the members of the working group.

As a result of the first meeting of the working group, 12 technologies were selected from the long list of 27 proposed technologies. Next, we worked individually (using contemporary on-line communication technologies) with each member to train them to carry out the technology prioritization exercise.

As a result of the next meeting, the members of the working group, having the detailed technology sheets for each of the 12 technologies previously identified, applying the predefined criteria and scoring and prioritized the proposed technologies.

2.3 Consideration of Gender Aspects in the TNA process

The Republic of Moldova adopted the Strategy for ensuring equality between women and men (xx-yy), which aims to achieve parity between women and men in all spheres of society's life by legally ensuring equal rights and opportunities for women and men, as well as eliminating discrimination gender and eliminating the imbalance between women's and men's opportunities to exercise equal rights conferred on them by the Constitution and laws of the Republic of Moldova.

Climate change affects women and men differently, because in all countries it has a greater impact on those sections of the population that are most dependent on natural resources for their livelihoods and/or have the least capacity to respond to natural hazards, such as droughts, landslides, floods, etc.

In the Republic of Moldova, there are no discrepancies in access to water resources focused on gender differences. What is more, in most institutions, for example, those that manage water resources, women predominate (for example, the Water Resources Directorate within the Ministry of the Environment is made up only of women, and at SHS and the Environment Agency there are also subdivisions made up solely of women).

The TNA National Team consists of both men and women. All members of the national TNA team were familiarized with the "Guide for a Gender-Sensitive Technology Needs Assessment" to ensure familiarity with gender analysis tools and processes.

Women were involved in the decision-making process at all stages of the technology needs assessment in the Republic of Moldova. In the working group "water resources", the ratio between men and women is as follows: 81.3% men, 18.8%. The National Consultant ensured that the behaviors, aspirations and needs of women and men are equally considered, valued and favored, as well as ensuring the full and effective participation of women and equal opportunities for leadership at all levels of decision-making in the process assessment of technological needs.

The stakeholder consultation process ensured that both women and men had the opportunity to express their opinions, contribute to the TNA process, participate in activities, make decisions, as well as use the opportunities and perspectives created.

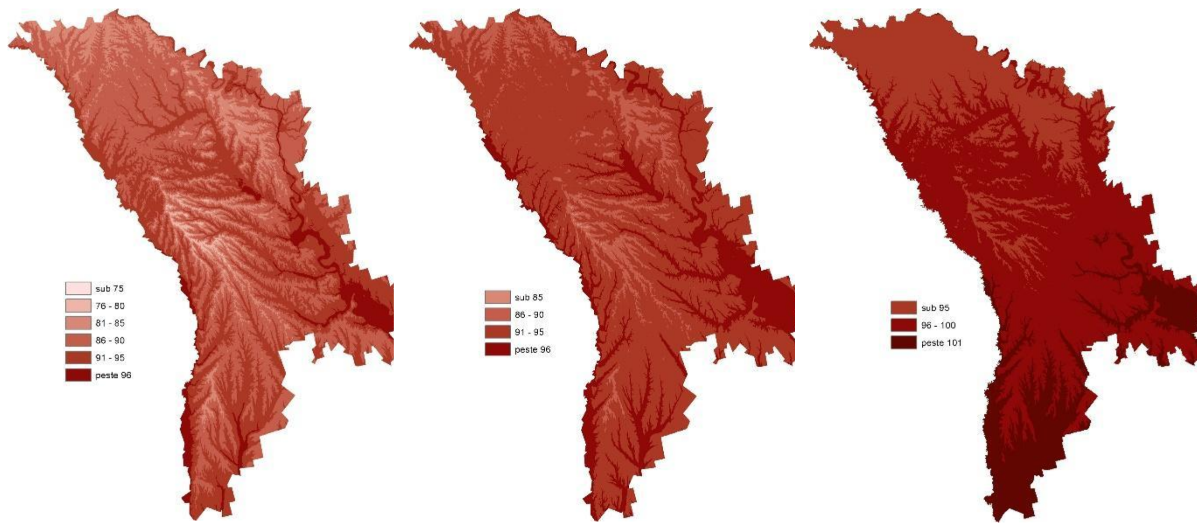
Chapter 3 Technology prioritization for Water resources sector

3.1 Key Climate Change Vulnerabilities in the Water resources sector

In article 1 of the Framework Convention on Climate Change (UNFCCC), climate change is defined as "climate changes that are directly or indirectly attributable to human activity that alters the composition of the atmosphere at a global level and that adds to the natural variability of the climate, observed during comparable periods". The UNFCCC, therefore, makes a distinction between climate change attributed to human activities in changing the atmospheric composition and climate variability attributed to natural causes, and sees human activity as the main driver of climate change.

For the Republic of Moldova, climate change represents one of the biggest threats to sustainable development and constitutes one of the biggest environmental problems, with negative consequences on various daily activities. The accelerated pace of climate changes and society's inability to quickly adapt to them, the lack of sectoral strategies for adapting to current and expected climate changes, the agrarian orientation of the national economy, which largely depends on the weather and climate, determine the development of a set of practical guidelines for the rational use of natural resources, especially water resources (for example, Rainwater harvesting in agriculture for adaptation to climate change [2]).

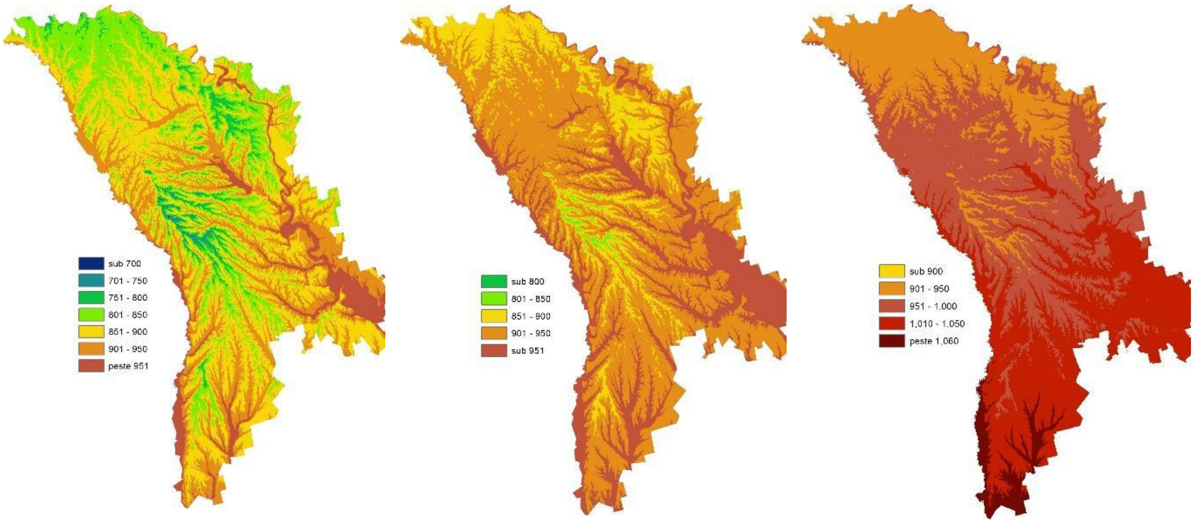
In the evaluations of the National Communications to CONUSC (UNFCCC) it was determined that the water resources sector is particularly vulnerable to climate change in terms of **increasing temperatures,** especially during the warm period of the year, the dynamics of which are illustrated by the maps in Figure 3.1(updated by the author).



a) 1971-2000 b) 1981-2010 c) 1991-2020

Figure 3.1. Sum of temperatures in the warm period of the year, t°C (May-September)

Against the backdrop of rising temperatures, evaporation also increases, which, in the case of small river basins, represents the main source of runoff losses (if we refer to the water balance). The maximum possible evaporation (E_m) is a considerable increase, which is manifested throughout the country (Figure 3.2, created by the author).



a) 1971-2000 b) 1981-2010 c) 1991-2020

Figure 3.2. Maximum possible evaporation, Emax, mm

The evaporation analyzed for three consecutive time periods of 10 years each illustrates a significant increase in the losses of water resources from small catchment basins.

Surface runoff change scenarios

Based on the processing of the information analyzed in the previous chapters, 3 sets of maps were built [15], which represent the value of the average annual climate runoff for three different scenarios and three-time intervals – up to 2035, 2085 and 2100, (Figure 3.3).

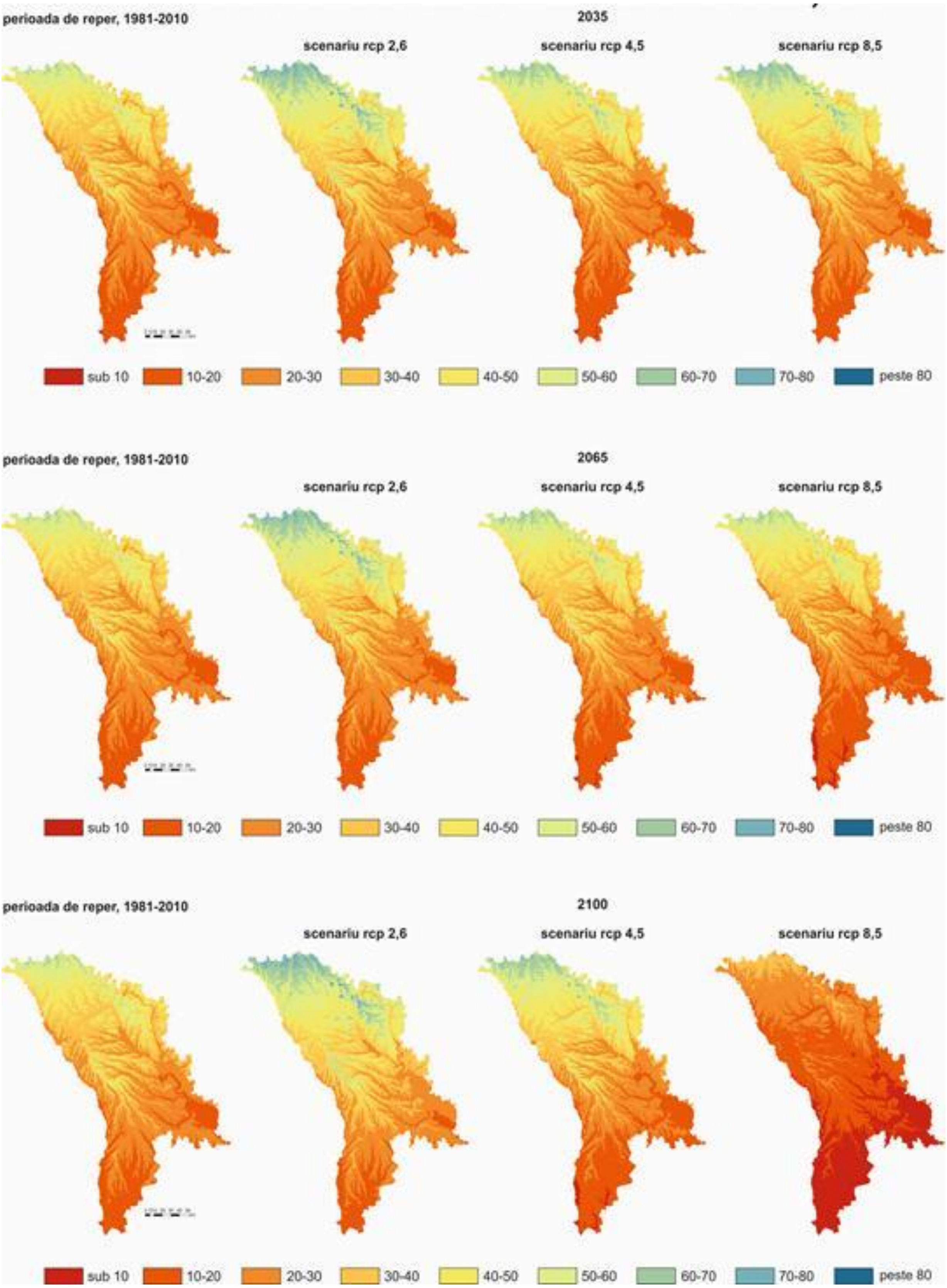


Figure 3.3. Average annual climate runoff layer, according to RCP2.6 scenarios; RCP4.5 and RCP8.5

From these maps (Figure 3.3) we can determine the natural runoff from the proposed time intervals based on the calculated climatic runoff.

The water resources of the Republic of Moldova are presented by surface water runoff (permanent and intermittent watercourses), by water transported by rivers, and by underground water resources. These resources are often not enough to meet different demands (most often agricultural) in the case of moving away from the source of water supply: From the river, lake or water intake.

In the 19th century, the famous Russian climatologist Voeikov wrote that rivers are a product of the climate. In other words, in the conditions of a humid climate, the water resources of the territory are rich and, in the case of an arid climate, very limited.

Generalizing the above, we mention that the water resources sector is **particularly vulnerable to rising temperatures** (especially during the warm period of the year), which results in an increase in evaporation, representing the main item of surface runoff losses. This is manifested in all RCP scenarios analyzed [7,6] and we can say for sure that the main measures to adapt the water resources sector to climate change must be focused on technologies to reduce surface runoff losses (Table 3.1).

Table 3.1. Possible projections of annual mean runoff layer changes (%) according to RCP8.5, RCP4.5 and RCP2.6 scenarios compared to the reference period (1981-2010) [5]

Period	Scenarios	ZAE North	ZAE Center	ZAE South	RM
2016-2035	RCP2.6	21.5	7.4	1.9	14.7
	RCP4.5	9.6	-2.3	-7.8	3.8
	RCP8.5	15.6	3.3	0.4	9.9
2046-2065	RCP2.6	19.7	2.2	3.9	12.3
	RCP4.5	5.8	1.2	-11.1	2.4
	RCP8.5	3.4	-13.8	-22.3	-5.2
2081-2100	RCP2.6	23.5	17.0	8.1	19.7
	RCP4.5	13.2	-6.0	-18.4	3.2
	RCP8.5	-45.0	-54.8	-64.5	-50.5

It should be noted that the specifics of the water resources sector in terms of vulnerability can be outlined in three major areas:

Surplus moisture conditioned by hydrological risk phenomena, i.e. floods. This can be created in two different ways: Generated by overflowing rivers or by heavy torrential rains (flashflood).

The territory of the Republic of Moldova is periodically exposed to the phenomenon of intense precipitation, especially in summer. In connection with this, practically 1/3 of the country's territory is flooded annually, generating considerable moral and material damage.

Significant floods on the Dniester and Prut rivers, often caused by human intervention, are characterized by the flooding of extensive areas. This fact was observed in the years 1969, 1980, 2008, 2010. Given that most of the localities of the Republic of Moldova are in the valleys of the water courses and river meadows, during the floods, most of the houses and social buildings are flooded.

Even though there is a complex system of hydrotechnical constructions to protect localities from floods, the damage caused by these natural calamities increases from year to year, and the consequences of floods are often catastrophic. The degree of exposure of the Republic of Moldova to floods is more than 40%, and in some regions of the country it reaches 70-80%.

We mention that the floods of 1991 and 1994 in the Răut and Călmătui river basins took the lives of 50 people and caused damage to the country's economy of 1678.9 million lei.

In the Republic of Moldova, the flood protection infrastructure consists of protective dikes on the Dniester and Prut rivers and on the other smaller rivers. There are approximately 60 networks of protective dikes with a total length of approximately 1014 km, protecting around 95,000 ha of land.

The length of the breakwater network is:

1. 530 km of dikes on the Dniester River, protecting approximately 40,000 ha of land.

2. 270 km of dikes on the Prut River, protecting about 25,000 ha of land.

3. 214 km of dikes on smaller rivers, protecting nearly 30,000 ha of land.

Floods are a significant natural hazard in the Republic of Moldova. There are floodplains on the Prut River and the Dniester River, most of which are protected against flooding and used for agriculture. About 8,000 ponds and reservoirs are arranged on the territory of the country.

After the significant floods in the years 1991 and 1994 in the Răut, Ciorna and Călmătui river basins, which took the lives of 50 people and caused economic damage to the country in the amount of 1678.9 million lei, the Government approved the Scheme for the Protection of Localities in Republic of Moldova against floods (Government Decision no. 1030 of October 13, 2000). The main purpose of the Scheme was the evaluation of the causes of the flooding of localities, the consequences of the flood, the development of technical-engineering measures for the protection of localities against floods, the determination of the cost and the economic efficiency of the established measures.

As a result of the examination of all the localities, lakes and hydrotechnical constructions with an eminent risk of flooding, the examination of the technical-engineering works carried out in the basins of the watercourses, it was found that 659 localities are in the areas at risk of flooding, with 32,267 residential houses with a population of about 103.3 thousand inhabitants.

One of the causes of the significant floods in 2008 and 2010 was non-compliance with the rules for the exploitation of the Novodnestrovsk and Costești-Stânca reservoirs. Since the capacity of the reservoirs did not allow a large amount of water, water was discharged in quantities that exceeded the calculated sizes (for the Dniester River - 2600 m^3/s and for the Prut River - 700 m^3/s). During this period, the discharge flows were exceeded, thus 3000 m^3/s was recorded for the Dniester River, and 830 m^3/s for the Prut River.

If the cause of the floods in 2008 was the overflow of water over the protection dike, then in 2010 the dike on the Prut River failed, which indicates that the dikes are in an unsatisfactory condition (for example, the dikes in the village of Nemțeni, district Hâncești, and Gotești village, Cantemir district). One of the causes of the break of protective dikes is the presence in the body of the dike of some longitudinal and transverse cracks, burrows of wild animals and poor settlement of the soil during construction.

As the protection dikes were built until 1970, due to the lack of financial funds no major repairs were made to the protection dikes. Therefore, in some areas the level of the ridge decreased by 1.5-2 m.

The condition of flood defense levees has an important impact on flood risk. In the Republic of Moldova, flood protection dikes have not been maintained since 1990, and in some areas their condition is precarious.

Following the Preliminary Flood Risk Assessment, carried out in the period 2013-2016, within the boundaries of the Dniester River Basin district, the events of 1969, 1970, 1974, 1980, 1998, 2008 and 2010 on the Dniester River were identified as significant flood events, and those from 1948 on small rivers (Botna, Bâc, Durlești, Ichel, etc.). Areas with potentially significant flood risk were identified and 2,924 thousand km of river with high flood risk were identified within the boundaries of the Dniester hydrographic basin district, these are also the areas with potentially significant flood risk.

Within the limits of the Danube-Prut and Black Sea hydrographic basin district, those of 1969, 1974, 1980, 2008 and 2010 on the Prut River, and those of 1994 on the small rivers (Călmățui, Lăpușna, etc.) were identified as significant flood events. An important role in reducing the number of significant flood events is played by the construction of the Costești-Stânca dam on the Prut River in 1978, which led to a 50% decrease in flow in some cases.

Based on the Preliminary Flood Risk Assessment, 1,376 thousand km of high flood risk river were identified within the boundaries of the Danube-Prut and Black Sea hydrographic basin district, these being the areas with potentially significant flood risk. Within the limits of the Prut River Basin, downstream of the Costești - Stânca dam, there are most areas with potentially significant flood risk - Ungheni, Hâncești, Cantemir, Cahul.

The evaluation results are presented on the MOLDOVA-MAP information portal (http://moldova-map.md/#/viewer/openlayers/693).

Despite the provisions of the Scheme for the protection of localities against floods, the data on the leveling of the protection dikes and the projects of the automated warning systems, the necessary works were not executed due to the lack of financial means. The territory of the Republic of Moldova is particularly vulnerable to flash floods, which occur during the warm period of the year practically throughout the country. Their main cause is very intensive rains. Dozens of flash floods occur in the country's small river basins practically every year. Structural measures to combat them do not exist in the country.

Currently, the reduction of flood vulnerability can be achieved through structural (e.g. hydraulic constructions) and non-structural (e.g. qualitative forecasts and alerts) measures. It is also necessary to update the vulnerability analysis of the country's territory to floods and flash floods.

Moisture deficit resulting in hydrological droughts and even the total drying up of small watercourses.

The specific feature of the climate of the Republic of Moldova are the periodic droughts, typical for the entire territory of the Republic of Moldova, which in recent decades have intensified due to climate change. The amount of precipitation equal to or less than 50% of the climatic norm of precipitation (in this case we can speak of severe drought) occurs on the territory of the country with a probability of 11-41%. Well, based on this indicator, in the last decades (1992-2020) meteorological droughts were recorded in 1990, 1992, 1994, 1996, 1999, 2000, 2001, 2003, 2007, 2012, 2015, 2019.

According to the data of the Water Risk Atlas portal (https://www.wri.org/applications/aqueduct/water-risk-atlas/), the Republic of Moldova is among the most vulnerable countries to drought in Europe (Figure 3.4).

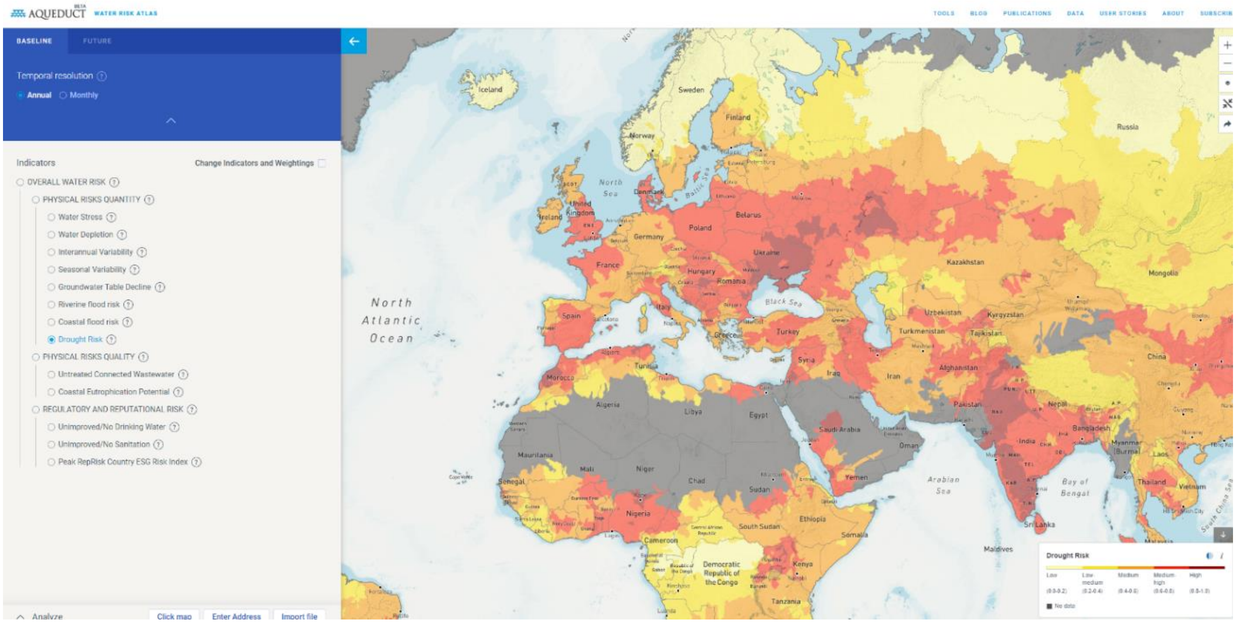


Figure 3.4. Drought risk in Europe (WRA)

The specificity of the last decades is also the increasing frequency of drought events and their intensity. Thus, only in the period 2000–2015 in Moldova there were 5 devastating droughts (2000, 2003, 2007, 2012, 2015, 2019) affecting 75% of the country's territory. The most affected was the south of Moldova with 5 droughts recorded, 2-3 dry periods were recorded in the center of the country. The north of the country was the least affected.

From the series of droughts mentioned above, the drought of 2007 stands out. This can be compared with the one of 1946, the most disastrous in the existing collective memory, when the precipitation in the spring-summer period was well below 50% of the climatic norm.

Likewise, the 2012 drought ranks among the most severe droughts in recent years. The temperatures in June were 3.7-5.1C higher than the national average. Precipitation represents only 15-60% of the average, and soil temperatures have reached a record level causing an agricultural drought of proportions, affecting 80% of the country's territory in the summer-autumn period.

Regarding hydrological droughts, according to the National Hydrometeorological Data Fund of the State Hydrometeorological Service, in a period of 10 years (2008-2017) four hydrological droughts were identified.

Degradation of ecosystems due to lack of water resources and/or poor water quality.

In the event of a reduction of the average and minimum discharge towards the middle of the 21st century, we can expect a general decrease in water quality. This is due to the reduction of the dilution capacity of the watercourses, including in the lower course of the Dniester and Prut, and especially on the small rivers, where the reduction in water intake cannot in principle be compensated by discharges from reservoirs. The increase in water temperature, the reduction in the speed of the stream and the exchange of water will inevitably lead to a decrease in the oxygen content and the activation of unfavorable processes inside the water bodies (the eutrophication of the reservoirs Dubăsari, Cuciurgan, Ghidighici etc. became a reality a long time ago).

The intensification of precipitation and flooding, and the increase of winter temperatures can also lead to the penetration of additional amounts of pollutants into the water together with rain and snow runoff. Namely, the intensification of heavy and intensive precipitation requires a review, improvement of the realization of forecasts and early alerts. This is because they generate those rapid pluvial floods that affect practically the entire territory of the country.

Despite the significant changes in the character and distribution of wetlands due to the construction and exploitation of the hydrotechnical nodes at Dubăsari, Dnestrovsk and Costesti Stânca, territories with willow, poplar and oak meadow forests have been preserved downstream. They grow in the form of narrow strips along riverbeds in sectors with stable moisture. Wet and dry meadow communities are also associated with river valleys. The functioning of these ecosystems is under the direct influence of the hydrological regime of the river meadow, the future of which is determined by climatic parameters and water management. A significant and long-lasting deterioration in the moisture regime in the lands of the river meadow may lead to the lowering of the groundwater level and partial or complete drying of some wetlands of the Dniester, Prut and other internal rivers. Currently, the surface water balance is assessed as negative or close to zero. As a result of worsening vegetation growth conditions and a possible worsening of soil degradation, the biological productivity and resistance of forest areas (e.g. the "Pădurea Domnească" reserve) and of some special species may be reduced; some native species could even be eliminated by invasive, aggressive species that are more resistant to aridity.

The unique natural complexes also include the vast wetlands of the Lower Dniester, with ecosystems preserved in their natural state, restored meadow forests and floodplains, ponds and lakes as well as the ecosystems of the river terraces adjacent to them. The reduction of the area of the floodplains in the lower reaches of the Dniester and the Prut and the degradation of the remaining ones, caused by the change in the hydrological regime as a result of the construction of power plants and holiday villas, have already drastically reduced the number of migratory bird species, led to the disappearance of nesting sites of the carp spawn, the habitats of the red-bellied loggerhead, the loggerhead turtle, etc. In the case of continued degradation or complete disappearance of shallow floodplains, for many water and wading birds (such as gypsies, shovelers, yellow and red herons) as well as for amphibians and reptiles, the preservation of historic habitats will become virtually impossible.

In the event of a change in the hydrological regime, ecosystems in shallow waters will be the most vulnerable: in the event of a constant reduction in runoff and water level, they are threatened by total drying, and their adaptation could prove to be impossible in principle. The meadow and marsh ecosystems are also threatened by the change in the character of the fallen precipitation and the intensification of the erosion-accumulation action of the rapid pluvial floods; of inundation as a result of floods with higher water levels and water retention for a period longer than that which can be supported by the existing flora communities, and a probable oscillation of the groundwater level. Taking measures against these changes is not possible without regulating the water regime, in the direction of approaching the natural one.

The reduction of local runoff, the increase in air temperature and the intensification of evaporation from the water surface will worsen the living conditions in rivers and reservoirs due to the change in their thermal, hydrological and hydrochemical regime. Communities in aquatic areas are sensitive to temperature change, which affects their distribution and structural and functional organization (growth, development, productivity, competitive relations, etc.). Moreover, under the influence of climate change, there is also a simplification of the structure of hydrobiont communities, a reduction in the diversity of their species and the populations of several species until the disappearance of the rare ones, and a reduction in the oxygen content. Climate change can also be associated with biogenic pollution of water bodies due to the mass reproduction of algae (‘water blooms’).

The shift of climatic seasons should be highlighted (spring starts earlier, autumn later. Respectively some seasons become longer, others shorter). Although, in the case of water-supplied ecosystems, an increase in primary production is most likely, and in case of insufficient moisture, the impact of shifting seasons on the status of several species can be quite unfavorable. The shift in the phenological timing of plant development can cause the deviation of space and time parameters of ecological niches of invertebrates and reflect on the richness of species and diversity of communities. A local shortage of plant nutrients is also possible, as well as the activation of pests and disease pathogens.

The change of climate, including the thermal regime and the dynamics of hydrological processes associated with it (for example, the reduction of the water level in the river and floodplains) is one of the important factors of transformation of the ichthyofauna of rivers. Rising water temperatures can have a negative impact on the reproduction and development of many fish species – especially rare ones. The drying up and reduction of the areas of the ponds in the floodplains during the dry years, which occur more and more frequently, also explains the reduction in the number of phytophilous species – sea bream, carp, crucian carp and others. Further lowering of water levels in rivers may result in the loss of spawning grounds in the remaining meadows.

Each of the listed processes reduces the stability of ecosystems, which together form the basis of the ecological stability of the natural slope of the receiving basins with respect to climate change. These changes overlap with adverse non-climatic processes that further undermine the survivability of ecosystems and their natural adaptive capacities.

3.2 Decision context

According to the 2020 Development Strategy of the Republic of Moldova, "the strategic vision of the Government in the medium and long term is the reconciliation between the need for accelerated economic development and environmental protection in accordance with European standards. This will take place by: (i) achieving a rate of economic development that allows the increasing financing of environmental protection measures and (ii) balanced regulation of the business environment, both from the point of view of economic impact and the point of view of the impact on the environment". The commitment to implement European standards regarding adaptation to climate change was established in the Association Agreement of the

Republic of Moldova with the European Union through chapter 17. The Republic of Moldova committed to progressively bring its legislation closer to that of the EU, as well as to international instruments in the changes climatic. Meanwhile, in September 2015, the Republic of Moldova developed and presented to the XXI Conference of the Parties the document "Intended National Contribution" (CND-1) for the new Paris Climate Agreement, ratifying it in 2017. Later, CND-2 was also developed. It is worth noting that the climate change adaptation objectives of the Republic of Moldova are also achieved through the implementation of the priority economic, social and environmental policies approved until the signing of the Association Agreement between the Republic of Moldova and the EU and the declaration of the country's CNDI. In this regard, a series of laws and respective strategies were approved.

Also, aspects of adaptation to climate change continue to be reflected in several country policies currently in the development process or in the draft phase for public debates.

Of the sectoral projects that contributed to strengthening the decision-making environment, the ones listed below deserve special attention.

The project "Consolidation of the institutional framework in the water supply and sanitation sector in the Republic of Moldova ", supported by the Swiss Agency for Development and Cooperation (SDC) and the Austrian Development Agency (ADA).

Implementation period: May 13, 2016 – August 31, 2019.

General goal: It is expected that the Project will contribute to the following change at the level of impact (General Development Goal): "The population of Moldova has improved its health status regarding water-related diseases".

Achieving this objective must lead to significant progress in the following:

- Implementation of integrated water management strategies at local, sub-basin, main-basin and national levels, including participatory decision-making and capacity building on integrated water resources management.

- Provision of drinking water supply, sanitation and hygiene services in an accessible, responsible and progressively financially and environmentally sustainable manner.

- Ensuring the existence of the regulatory and administrative framework in force, for the management of water resources, the development of infrastructure and the provision of services and the enhancement of the performance of the responsible public authorities and the operators of water supply and sanitation services within them.

- Consolidation of knowledge transfer, skills development; access to information in the field of water.

The "European Union Water Initiative Plus" (EUWI+) project. Regional project implemented in 6 countries of the Eastern Partnership (Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine), with financial support from the European Commission, implementing partners being the UN Economic Commission for Europe (UNECE), the Organization for Cooperation and Development Economic (OECD) and the Consortium of Member States (Austria and France).

Implementation period: September 2016 – August 2020.

As a continuation, the EUWI+ Project, launched in 2016, aims to address existing challenges both in the development and in achieving the efficient management of water resources. Specifically, the project will support Eastern Partnership countries to move towards the EU acquis in the field of water management, with a focus on transboundary management of river basins, as provided by the EU Water Framework Directive.

The "Social and environmental impact study of the Nistrean Hydropower Complex" project, implemented by UNDP with the support of the Swedish Embassy in the Republic of Moldova.

The project was launched in September 2018.

The main goal of the project is to evaluate the socio-economic and environmental impact of the operation of the Nistrean Hydropower Complex (CHE). The expected results of the project are:

- Result 1. Development of a detailed study on the current and potential environmental impacts and the socio-economic impact on the territory of the Republic of Moldova, resulting from the operation of the hydropower complex built on the Dniester River.

- Result 2. Strengthening the capacities of the team of negotiators from Moldova on the Agreement for the operation of the Hydropower Complex, by providing the necessary support (legal support and support in negotiations).

- Result 3. Public awareness, scientifically substantiated information on the current and potential impact of the Nistrean HPP operation presented to the public.

The decision-making contribution of the given project consists in identifying the role of the Nistrean CHP in the redistribution of the Dniester River runoff in the conditions of climate change.

The "Diagnostic Study and Perspectives in the field of Water Security in the Republic of Moldova" project, supported by the World Bank (year 2019).

The purpose of the Study is to inform which strategic interventions and investment options are critical to mobilize and support Moldova's water resources, mitigating water risks and delivering various water services - drinking water, water for industry, water for irrigation – to optimize the benefits for the economy, the population and the environment.

In the context of global and regional trends, such as climate change, urbanization, migration, economic development trajectories and cooperation with riparian countries regarding transboundary waters, the Diagnostic tends to influence Moldova's development vision through a consultative and evidence-based approach. This study aims to provide a holistic review of water management opportunities to mobilize the best outcomes for the environment, economy and population.
The EU4Climate project. The objective of the project is to support the development and implementation of climate-related policies by Eastern Partnership countries that contribute to

low-emission development and climate resilience, in accordance with the Paris Agreement on Climate Change. It identifies key actions and outcomes in line with the Paris Agreement, the EP's "20 Deliverables for 2020" and the key global policy goals set by the UN 2030 Agenda for Sustainable Development. The project will also translate into the action priorities presented in the Ministerial Declaration on Cooperation in the Field of Environment and Climate Change within the Eastern Partnership from October 2016. The following results will be achieved:

- Nationally determined contributions and mid-term national strategies completed/updated and communicated to the United Nations Framework Convention on Climate Change (UNFCCC).

- Improving awareness and inter-institutional coordination at the political and technical level of the Paris Agreement and corresponding national commitments: Established or strengthened monitoring, reporting and verification (MRV) systems with countries that comply with the transparency requirements of the Paris Agreement.

- Elaboration of concrete sectoral guidelines for the implementation of the Paris Agreement in each country of the Eastern Partnership, especially in the field of energy.

- Advanced alignment with the EU acquis, provided for in the bilateral agreements with the EU and in the context of the Energy Community Treaty.

- Increased mobilization of climate finance.

The "Consolidation of cross-border cooperation and integrated management of water resources in the Dniester River Basin" project.

The project is funded by the Global Environment Facility (GEF) in the amount of USD 1,950,000.

The project is implemented for the Republic of Moldova and Ukraine by the OSCE in cooperation with UNDP and UNECE.

The aim of the mentioned project is to contribute to the promotion of the integrated management of water resources in the Dniester River Basin to strengthen sustainable development by updating the cross-border diagnostic analysis. The project has 3 components:

- Component 1: Analysis of water resources, relevant ecosystems and their use.

- Component 2: Development of the political, legal and institutional structure, mandate and authority of the River Basin Commission for the development of cooperation at the river basin level.

- Component 3: Improving monitoring of water resources and biodiversity, their rational use and information exchange within the Dniester River Basin.

The implementation period of the project is: 2017 – 2020. The decisional contribution of the given project consists in strengthening the efforts of the states in the Dniester River Basin in the common sustainable management of water resources in the conditions of climate change.

It should be noted that, against the backdrop of infrastructure and institutional projects in the water resources sector, efforts are still needed to carry out activities related to the management of water resources focused on:

- the population's awareness of the effects of climate change;
- promoting campaigns for reduced water consumption for different uses;
- collection of surplus rainwater;
- improving rainwater drainage networks;
- contemporary studies of the vulnerability of the sector to climate change and the assessment of water resources;
- implementation of flood early warning systems, especially rapid rain floods;
- applying contemporary methods in making and disseminating hydrological forecasts;
- provision of "climate services" in the field of water resources.

3.3 Overview of Existing Technologies in the Water Resources Sector

The implementation of activities in the field of water resources at the sector level is carried out in accordance with the plans of the national and sectoral strategic documents. One of these documents aimed at the actions of the water resources sector is the Climate Change Adaptation Strategy of the Republic of Moldova (SASC) (2014-2020).

The SASC of the Republic of Moldova by 2020 predicted 5 actions (technologies) for the water resources management sector, which have been implemented or partially implemented [10]:

Carrying out studies to assess the available water resources, determine their vulnerability to climate change, water requirements and needs for the main consumption categories.

Ensuring the availability of water at the source by developing the infrastructure to transform hydrological resources into socioeconomic resources is a sector priority outlined in the ASC Strategy (2014-2020), which aims to overcome the risks of water supply and the vulnerability of the population's reduced access to water sources, especially in periods of high temperatures with deep hydrological drought. To overcome these risks and vulnerabilities, several techniques, practices and technologies are applied at the sector level:

- Over 200 water storage basins with a capacity of ~5000 m^3 have been built in Moldova since 2014.
- 10 basins have been created for the collection and storage of rainwater in the districts of Cantemir, Criuleni, Hîncești, Leova and Ungheni (2 operational from the end of 2020 and 8 to start operations in mid-summer 2021). These basins represent a solution for the adaptation of rural communities to climate change and are built with financial

assistance by ADA within the project "Climate change and disaster risk reduction", implemented by UNDP.

- In Moldova, large sections of the lower Prut River have been taken under protection and management plans are being developed. The floodplain of the Lower Prut in Moldova, with a total area of 19,125 ha, contains approximately 6,114 ha of wetlands that are officially designated under the Ramsar Convention as a wetland of international importance. The reserve, with a total area of 1,691 ha, is an important component of the largest freshwater program in the region, called the Lower Danube Green Corridor (LDGC).

- A new management plan is being implemented at Beleu Lake Scientific Reserve. This first attempt at integrated wetland management will be extended to the Lower Prut area as part of a trilateral biosphere reserve between Moldova, Romania and Ukraine.

- The main projects that supported the implementation of this objective: The Inclusive Rural Economic and Climate Resilience Program (IFAD VI, 2014-2020); Consolidation of the institutional framework in the water supply and sanitation sector in the Republic of Moldova (SDC/ADA 2016-2021); Improving the climate resistance of the "Prutul de Jos" Biosphere Reserve (ADA, 2019).

Ensuring integrated water management based on the hydrographic basin principle is a direction of development in response to the risks and sectoral vulnerability of fragmented management of water resources and the lack of a decision-making framework in support of the integrated management of water resources to strengthen the decision-making framework ptu integrated management, a series of measures and actions have been undertaken:

- Water Law no. 272/2011 (last amended in November 2018 with the support of EUWI +) and 20 regulations on its implementation, establish the legal framework for the integrated management, protection and efficient use of water resources in the Republic of Moldova (in force since 2013).

- River basin management plans for the Dniester and Danube-Prut-Black Sea River basins developed and approved by the Government (second cycle of PMDBH 2022-2027) in the process of being developed.

- Law no. 303/2013 on the public service of water supply and sewage (last amended in 2019).

- GD 950/2013 for the approval of the Regulation regarding the requirements for the collection, purification and discharge of wastewater in the sewage system and/or in water bodies for urban and rural localities (last amended by GD 90 / 19.02.2020).

- Law no. 182/2019 on the quality of drinking water (in force from 03.01.2021).

- Regulation on the prevention of water pollution from agricultural sources, approved by HG 836 / 29.10.2013.

- Risk areas identified and a Flood Protection Master Plan developed in 2015 (with EIB support) to guide priority investments in this area (although not formally adopted).

- HG 590/21.06.2018 regarding the approval of the Concept of the reform of the national system for managing, preventing and reducing the consequences of floods.

- 71 km of reconstructed / reinforced dams.

- The flood warning and forecasting system has been installed: SHS publishes daily forecasts (codes from green to red).

- Operational communication and regular exchange of information is established between the commissions of Moldova, Romania and Ukraine (a hotline between the directors of the water resources management institutions of the three countries).

- Discharges (m^3/sec) from the Novodnestrovsk reservoir are ensured daily.

- The National Drought Plan of the Republic of Moldova, developed within the framework of the UN Convention to Combat Desertification (UNCCD), the Drought Initiative, and published in June 2019 https://www.researchgate.net/publication/342708583_Planul_National_privind_Seceta_in_Republica_Moldova_ROM

- Drought risk management measures - integrated in the new cycle of the two river basin management plans 2022-2027 - under development.

- AAC projects under implementation (with the support of development partners and national funds).

The purpose of these actions lies in facilitating adaptation to climate change in the water resources sector, thus contributing to "the development of climate resilience by reducing by at least 50% the risks of climate change by the year 2020". According to the conclusions, the evaluation of this percentage value was not possible due to the lack of information and monitoring reports available, thus not being carried out by sector experts.

In addition, several technologies, with direct influence on water resources, have already been implemented:

- The creation of a regional coordination body with neighboring countries (Ukraine and Romania) to establish the connection between the activities regarding the management of the risks of natural disasters, including climatic ones. *The intergovernmental hydrotechnical commission* for the implementation of the Agreement between the Government of the Republic of Moldova and the Government of Romania regarding cooperation for the protection and sustainable use of the Prut and Danube rivers, signed in Chisinau on June 28, 2010. *The Commission for the Sustainable Use and Protection of the Dniester River (Dniester Commission)*, created in 2018 based on the Agreement between the Government of the Republic of Moldova and the Cabinet of Ministers of Ukraine regarding cooperation in the field of protection and sustainable development of the Dniester River Basin, signed in Rome on November 29, 2012. The first meeting of the Commission took place in Chisinau on September 17, 2018; the second meeting - during April 4-5, 2019, in Kyiv. Five working groups operate within the Dniester Commission, including a Working Group for Emergency Situations.

- Creation of the mechanism of cooperation and coordination with neighboring countries to correlate disaster and climate risk management activities. Three large international projects supported integrated river basin management planning and strengthened cooperation with Romania and Ukraine in natural disaster risk management:

    1. "Climate change and security in the Dniester River Basin" (regional component of the project "Climate change and security in Eastern Europe, Central Asia and the Caucasus") - implemented in Moldova and Ukraine between 2013 and 2017, with the support of the UN Economic Commission for Europe (UNECE) and the Organization for Security and Cooperation in Europe (OSCE), with financial assistance from the EU and ADA. The main results of this project were the development of the "Strategic Directions for Adaptation to Climate Change in the Dniester River Basin" (2015) and the implementation of selected priority measures for adaptation to climate change in both countries (2017).

    2. "Strengthening transboundary cooperation and integrated management of water resources in the Dniester River Basin" (2017-2021), financed by the Global Environment Facility (GEF) and implemented by the OSCE and the United Nations Development Program (UNDP) in partnership with the Economic Commission of United Nations for Europe (UNECE). The project provided support for the development and implementation (jointly by the Republic of Moldova and Ukraine) of the Integrated Management Plan for the Dniester River Basin. Adaptation to climate change considerations were an underlying element of the Dniester River Basin Project, including issues of risk management and disaster prevention related to climate issues. Pressures to water resources in the basin and other such issues related to climate change were addressed, and this has been a special focus of the institutions engaged in the Project. There have been several products and activities dealing with adaptation, such as development of adaptation project proposals, scenarios and models for water demand in a climate change context, etc. This focus notwithstanding, several stakeholders have indicated that more attention needs to be paid to this issue in the Dniester Basin due to its growing impact on water resources and on development associated with these issues vis-à-vis climate change.

    3. The EU-funded water initiative for the countries of the Eastern Partnership (EUWI +), implemented by the OECD, UNECE, the Austrian Environment Agency and the International Office for Water, France, in the period 2017-2021, provided support for the integrated management of the Danube River Basin and Prut-Black Sea (together with Romania). The management plan for the Nârnova river basin was also developed.

Connecting the national early warning system for natural disasters, including climatic ones, to the regional early warning system for natural disasters of climatic origin. The State Hydrometeorological Service (SHS) became a member of the European network EUMetNet (2015); Conducted tests for the SHS operationalization of the EU early warning platform (www.meteoalarm.eu) (2016); National early warning system - established and connected to the European Union early warning system - EuMetNet (2017).

Temporal and spatial assessment of the impacts of climate change on surface, groundwater and groundwater.

Studies, evaluations and mapping of surface and underground waters were carried out in the context of the preparation and updating of the integrated management plans for the Dniester watershed and for the Danube-Prut-Black Sea watershed district:

- A general flood risk management plan and flood hazard maps developed for the whole country within the project "Management and technical assistance for flood protection in Moldova", financed by the European Investment Bank (EIB) under the Assistance Trust Fund technical framework for the Eastern Partnership (EPTATF).

- National Drought Management Plan developed under the drought initiative of the United Nations Convention to Combat Desertification (UNCCD).

- Vulnerability assessment and climate change impact study carried out in the context of the 4th National Communication (Chapter 5: Potential impact of CC on water resources).

Creation of an early warning system regarding natural hazards of climatic origin, which provides public access to data and information necessary for the assessment of climate risks and impacts:

- Under the Climate and Disaster Risk Management Project (supported by WB) 2010-2016: The capacity for severe weather forecasting, early warning, disaster management and the use of agro-meteorological information was strengthened.

- The EU-funded program for the prevention, preparedness and response to natural and man-made disasters in Eastern Partnership countries (PPRD East 2 Programme), phase 2 (2014-2017), with assistance aimed at improving civil protection capacities, including in legislative, administrative and operational, as well as increasing access to information on risk exposure and stakeholder engagement. The concept of the national early warning system developed to enable the dissemination of reliable and timely warnings.

- The EU-funded ClimaEast Initiative and the "Moldova Climate Risk and Disaster Management (DCRMP)" project have delivered numerous initiatives related to the development of the early warning system, including strengthening the capacity of the State Hydrometeorological Service to forecast severe weather, as well as establishing a Emergency Command Center; creating an informed National Observatory on disasters and strengthening the relevant capacities.

- CPESS is designated as the responsible authority for public alerting, while SHS provides operational meteorological and hydrological forecasts to all relevant authorities and the public. Although the SHS has strengthened its operational capacity in recent years, hydrological forecasts are still based on outdated empirical models, while there is no operational hydrological modeling system and flash flood forecasts are not yet provided.

Despite recent progress, no functional early warning system has been reported in local, territorial or state disaster and civil protection plans.

3.4 Adaptation Technology Options for Sector Water resources and Their Main Adaptation benefits

The impact of climate change on the water resources sector, described in the previous sub-chapters, clearly indicates and characterizes the sector's vulnerabilities. To reduce or even eliminate these vulnerabilities to the impact of current and anticipated climate changes, concrete and large-scale actions are needed that would bring transformations at the sector level with economic, ecosystem and social benefits, which would increase community resilience both in rural areas, as well as urban ones. To achieve these goals, within the ENT/TNA component, several technologies, practices and activities have been identified, through the implementation of which transformative changes would be produced that would increase climate resilience at the sector level and with a real perception of benefits by the population. GLS members were involved in their identification, who came up with proposals and suggestions, but also with objections and comments, which were incorporated into the final set of technological measures to adapt to climate change focused on the main climate impacts, as follows:

Climate impact 1. REDUCTION OF DAMAGE FROM MAJOR FLOODS

1. **Improving the monitoring and forecasting of runoff, water quality and the efficient exchange of information between various institutions**. The technology provides for the optimization of the hydrological observation network, the adaptation of the methodologies to EU requirements and the implementation of new technologies for making hydrological forecasts of different durations. The operational exchange mechanism with the data collected between the branch institutions will be developed. The hydrometric observation stations will be modernized by equipping them with constructions and monitoring equipment. The assessment of water resources and their future forecasts are impossible without the analysis of data collected in the field. Based on the analysis of these data, decisions will be made in planning the rational use of water resources. The technology will favor the production of higher quality forecasts of different durations.

2. **Inventory of the protection infrastructure to make flood control more efficient**. The technology provides for the inventory and permanent updating of the technical parameters of the hydrotechnical constructions related to flood control: Dams and protective dikes. Knowing their location and condition will make flood management more efficient. The collected data will be stored in the Automated Information System "State Cadastre of Waters".

3. **Analysis and mapping of flood risk at the level of commune, municipality.** The technology provides analysis and modeling of floods (river overflow floods and flash floods). The modeling results will be mapped on a large scale (1:10000) and will be introduced in the Urban Development Plans for rural and urban localities. These maps will serve as a support for the planning of the development of localities by precisely indicating the lands subject to floods with different probability of overflow. They will also contain the flood risk assessment with a high level of detail, which will be considered in planning the spatial development of the locality.

4. **Development and implementation of flood early warning systems.** The technology provides for the development and implementation of the early warning system. The system will be based on rapid interaction with the SHS, which elaborates early flood forecasts then transmitted to the Civil Protection and Emergency Situations Service, which immediately forwards them to concrete LPAs for information. Also, the population in areas subject to flooding will be alerted in other ways. The main benefit consists in informing the population about the possible risk of the flood, which will be informed in time with the possibility to react according to the predetermined plans or to save their own lives and some of their material possessions.

5. **Updating and complying with the rules for the exploitation of reservoirs.** The technology provides for the updating of the normative acts related to the rules for the exploitation of reservoirs. Focus will be on the minimum (ecological and healthy) flows discharged from the lake. It will come up with practical recommendations for verification, control and penalties in case of non-compliance with these recommendations. The implementation of this technology will allow the protection of water resources of small rivers, especially affected by chain dams (cascade). Small reservoirs and ponds, in the case of incorrect exploitation, reduce water resources, especially through additional evaporation from the water table. Compliance with minimum water discharge requirements will allow the minimum discharge of these rivers to be maintained. Thus, they will be protected from drought or even extinction.

6. **Restoring and optimizing the system of protection constructions through polders and locks**. The technology provides for the modernization of flood control measures through the controlled overflow of surplus water from the Dniester and Prut riverbeds through sluices into specially designated volumes - polders. Retention of these volumes reduces the volume of the flood, thus protecting the lands downstream. This technology, in conjunction with other flood protection measures, will reduce their risk. Secondary benefits consist in supporting the maintenance of wet areas through the water reserves stored in the polder.

7. **Updating and implementing plans for exceptional situations caused by flood disasters.** The action plans in case of exceptional situations represent an algorithm of measures, which must be carried out before the occurrence of the phenomenon, during the manifestation and after the flood. Updating these plans, including for administrations at all levels, will be a legal and necessary support for decision-making. The frequency and strength of floods is evolving with climate change. The approval of these plans will facilitate decision-making as a whole and considering the local specifics of each flooded territory. The major benefit lies in understanding the necessary actions to take at the right time.

8. **Flood and drought risk insurance (including with support from the state).** The given technology involves the development and approval of normative acts that hold the implementation of insurance procedures against floods and droughts predominantly in agriculture, for farmers. In case of material losses, the beneficiaries will be able to compensate their losses. Knowing that the intensity and frequency of droughts is increasing, as well as rain floods, this technology can be a useful tool for adapting to climate change.

9. **Rehabilitation and construction of rainwater drainage systems**. The given technology involves the design and construction/reconstruction of rainwater drainage systems in the country's localities. It should be noted that many localities have these systems already outdated or do not have them at all. Even for Chisinau, every heavy rain leads to the flooding of the streets in the lower part of the city due to the small potential of rainwater drainage. Especially the technology is worth applying for the urban development plan of Chisinau. The technology is expensive, and if these systems are to be set up all over the country, the amount will be tens of times higher than indicated. But the presence of these systems will greatly reduce the damage caused by torrential rains. Rural localities are the most vulnerable and are prioritized in the arrangement with these systems.

Climate impact 2. REDUCTION OF DAMAGE DUE TO WATER SHORTAGE

10. **Improving the sustainable management of water resources by applying the water management balance sheet.** The technology is based on the development of a software for the analysis and calculation of the balance of water management by water resource management sectors. The given tool will allow to give a quick answer regarding the available water resources both on water resource management sectors and for a specific water body. Issuing permits for special water use is impossible without knowing the resources available now and in the future. It represents a technology for adaptation by recording water resources and making decisions for their use in the short and medium term, and will enable the correct and informed management of water resources at the sector level as well as at the water body level.

11. **Drought risk assessment and mapping.** The technology is based on the vulnerability of the country's territory to drought. Areas with increased risk of drought will be identified. Of course, these areas will be small and very dispersed. It will serve primarily as a support for the agricultural insurance system. It will become clear which agricultural lands require investment and recommendations of different kinds in increasing the potential for adaptation to droughts.

12. **Carrying out studies, investigations and analysis of the assessment of water resources: Natural, real, ecological, available (of different assurance)**. The result of the study will in principle be a support, an update of the normative document - the Code of Practice in constructions CP D.01.05-2012, Determination of hydrological characteristics for the conditions of the Republic of Moldova. This STAS must be updated periodically and, in the conditions of climate change, more often. The obtained calculation data will give the answer; where, and how much, available water we have in the country. The updated set of parameters and coefficients will serve the designers (all hydrotechnical constructions need these data in the planning and organization of its operation) in the accurate assessment of water resources. The new data will serve both the private and public sectors.

13. **Updating and complying with the rules for operating the system of reservoirs on the Dniester and Prut rivers**. Both rivers are transboundary. If for the Novodnestrovsk hydrotechnical node negotiations have been going on for years regarding the optimization of the exploitation rules, then for the Prut River the updating of the document has not even started. The application of technology will allow the development of new exploitation rules, which will take climate change into account.

The essence of these new rules is to cover the water deficit in the Dniester River through controlled discharges from the Dnestrovsk reservoir. Compliance with the exploitation rules will have a beneficial effect. First, on the hydrological regime of the rivers and, consequently, on their ecology under the conditions of climate change.

14. **Implementation of water retention and conservation agricultural techniques**. The technology allows moisture to be retained in the topsoil by reducing the rate of runoff from the slopes. It is proposed to apply both classical methods and those used in arid regions: for instance in Central Asia and North Africa. For example, horizontal furrows, semicircular and trapezoidal waves, small runoff concentration basins, runoff retention strips, etc. Reducing the rate of runoff from slopes will allow more water to infiltrate into the soil. This will increase soil moisture and replenish underground water reserves. The impact of these technologies is great in the conditions of climate aridification.

15. **Implementation of technologies for collecting runoff from the slopes in surface accumulations**. The technology allows rainwater and slope runoff to be collected into small ponds. In its essence, it is supposed to block ravines, ravines or other negative linear forms of relief, where intensive runoff occurs during rains. The water retained here can be used during the dry season for various uses. Collecting rainwater in small ponds will allow their use in agriculture to irrigate land up to 5 ha. The relief of the country and the intensive rainfall create good premises for the creation of water reserves, which can be used during the dry season.

16. **Implementation of water collection technologies from roofs**. The technology allows rainwater to be collected from roofs. The water drained from the roof, through the downspouts, and is collected in surface or underground tanks. The water is mechanically filtered up to the tank and if it is operated with a power supply, it can be treated using simple methods. The collection of rainwater from the roofs is intended for the sector of small private households (houses, buildings, greenhouses). Water can be collected from any roof and requires minimal treatment. It can be used for different purposes: Irrigation of gardens, food, as technical water, etc. It is a safe and cheap source of water.

17. **Implementation of collection, purification and treatment technologies of urban rainwater**. The technology enables the collection of water in urban areas, its purification and treatment. Urban rainwater will be collected through the drainage networks, will be subjected to simple purification and treatment. For this, special reservoirs will be built in the lower part of the towns. The treated water will be discharged into the river or used as technical water. The major benefit is protecting ecosystems from pollution (rainfall from cities is highly polluted). The secondary benefit is that it would be an additional source of technical water supply in the localities.

18. **Implementation of afforestation and greening technologies in small catchment areas**. The relatively simple technology consists of grassing the (predominantly degraded) land and maintaining grasslands. Its essence is to retain surface runoff and allow it to infiltrate into the soil. The impact is to slow the rate of runoff from the slopes and allow water to infiltrate into the soil. The direct benefit is brought to the soil and groundwater by increasing humidity. Indirectly, the improvement of ecosystems.

19. **Optimization of number of reservoirs based on hydrological indicators.**. This is completely new technology in the Republic of Moldova. The methodology for identifying the reservoirs intended for liquidation has already been developed. In its essence, multi-criteria analysis identifies the lake that no longer fulfills the function for which it was built. For example, it has become clogged, or is completely covered with swamp vegetation, etc. It is approved by the "Apele Moldovei" Agency and MADRM. The legal basis and procedural mechanisms are to be prepared. A reservoir built by damming and completely clogged is nothing more than an additional water evaporator. Its liquidation will only benefit the river and the ecosystems in its meadow. It will increase the volume of available water resources by reducing water losses.

20. **Awareness of the population about climate change and its contribution to the management, collection and consumption of water at household and locality level**. The technology itself includes a complex of measures aimed at understanding the phenomenon of climate change in the field of water resources and making the population aware that adaptation is the most effective measure of survival. Technology includes seminars, on-line, paper publications, television shows, training courses for water specialists, etc. Understanding adaptation to climate change is the most important step in the realization of all technologies and measures aimed at the protection and rational use of climate resources.

21. **Modernization of irrigation systems by decentralizing them and targeting different water sources**. The technology provides for the modernization of irrigation systems with water captured from the Dniester and Prut rivers on the one hand, and on the other hand the organization of small irrigation systems from other sources: Storage lakes with over 1 million m^3 of water. The modernization will consist in the use of new water transport technologies from the source to the land intended for irrigation. The benefit consists in the support of agriculture (especially the small one) with water resources, and the applied technologies will reduce losses when transporting water on agricultural land.

22. **Increasing the storage volumes of the lakes (cleaning them of silt).** The technology provides for the expansion of the storage volumes of the lakes. Two procedures are envisaged: Raising the crest of the dam and/or excavating the alluvium from the lake basin. The excavated alluvium (if it meets the sanitary and ecological requirements) can be used in agriculture or in the field of construction. Many reservoirs in the country have already exceeded their operational term by being clogged (filled with silt) but the available water resources allow their continued operation. Their rehabilitation will provide available volumes of water for different uses.

Climate impact 3. REDUCING LOSSES FROM DECLINED WATER QUALITY AND RESTORATION OF ECOSYSTEMS

23. **Improving the monitoring of ecosystems and biological resources and the exchange of information (including cross-border)**. The technology provides for the modernization of the ecosystem monitoring network. It is proposed to create fixed observation points in the protected areas (they already exist in the reserves) and to increase the periodicity of the measurements. The data collected will favor a deeper understanding of changes in ecosystems and their dissemination at the transboundary level. It will allow decision-making in the management of transboundary river basins.

The impact will be felt through the dissemination of information to all interested structures, including neighboring states. The benefit of this will be in understanding the evolution of ecosystems under climate change conditions.

24. **Rehabilitation of the natural courses of small rivers.** The technology provides for the restoration of water flow through the natural beds of small rivers. Many segments of natural beds were canalized, barred and dammed in the 1950s-70s. Now (on the segments where possible), their rehabilitation is proposed. The impact will be felt through an increase in water resources. The major benefits will be in creating wetlands and improving the state of ecosystems.

25. **Fighting poaching and invasive species.** The technology involves identifying and mapping fish concentration areas (for wintering, for example) in rivers and areas vulnerable to the spread of invasive species. By changing the legal framework, the penalties for poaching and the procedures for their application will be tightened. Procedures to combat invasive species will be implemented. The impact will be felt through an increase in water resources. The major benefit will be in maintaining biodiversity and improving the state of ecosystems.

26. **Expansion of urban green spaces**. The technology provides for the expansion of green spaces by liquidating land without grass cover. It will tend towards greening, planting trees and shrubs on the bare surfaces. The impact will be felt through a growth in areas covered with vegetation (especially grass), which will reduce surface runoff, increase soil infiltration and contribute to increased humidity in urban areas. The major benefit of which is increased summer humidity, increased soil moisture resources and reduced stormwater runoff.

27. **Restoration of forests, meadows and wetlands related to watercourses**. The technology provides for the application of afforestation and reforestation practices in the sectors related to rivers. In the places where it is possible, it is planned to restore the groves and meadows. The impact will be felt by increasing the areas covered with vegetation (especially trees), which will reduce surface runoff, increase soil infiltration and contribute to increased humidity in wetlands. The major benefit consists in increasing the humidity during the summer period, increasing the moisture resources in the soil. It will increase the quality of the state of meadow ecosystems, maintain and increase biodiversity. The expanded areas will be a supplement to the expansion of the recreation areas.

3.5 Criteria and process of technology prioritization

The identification and evaluation of technologies for adapting to climate change is a complex, dynamic process, and it was carried out according to the TNA methodology:

Adaptation itself is characterized by many uncertainties and extends far beyond typical project cycles.

Technology development and transfer is an area of increasing priority on the country's international and national climate change adaptation agenda. The methodological and operational aspects of climate change adaptation technologies are relatively underdeveloped, with several prevailing challenges, including much clearer definition and operationalization of the concept of adaptation technologies; developing methodologies for assessing and prioritizing technologies for further adaptation and ensuring that available relevant information and knowledge are fully utilized and integrated into climate change adaptation processes.

The identification and prioritization of climate change adaptation technologies were carried out in compliance with the recommendations of the Technology Needs Assessment Project (https://tech-action.unepdtu.org/the-project/), published in Determining technologies for climate change adaptation (A hands-on guidance to multi criteria analysis (MCA) and the identification and assessment of related criteria).

The multi-criteria evaluation process did not start from scratch. However, the completion of the first round of activity of the sectoral working group (water resources) resulted in the identification of 12 priority adaptation to climate change technologies (Table 3.2, Annex 2), to proceed with the development of the TFS for them. The technologies were grouped according to three major climate impacts that would generate the main sectoral vulnerabilities, respectively, the proposed technological measures will contribute to their reduction.

Table 3.2. Adaptation technologies selected by members of the Water Resources Working Group

No.	The name of the technology	Accumulated votes
REDUCTION OF DAMAGES DUE TO MAJOR FLOODS		
1	Analysis and mapping of flood risk at the commune, municipality level	11 votes (84.6%)
2	Improving monitoring and forecasting of runoff, water quality, and effective information sharing between various institutions	9 votes (69.2%)
3	Rehabilitation and construction of rainwater drainage systems	9 votes (69.2%)
4	Updating and complying with the rules for the exploitation of reservoirs	8 votes (61.5%)
REDUCTION OF DAMAGE DUE TO WATER SHORTAGE		
5	Improving the sustainable management of water resources by applying the water management balance sheet	8 votes (61.5%)
6	Optimization of number of reservoirs based on hydrological indicators.	8 votes (61.5%)
7	Modernizing irrigation systems by decentralizing them and targeting different water sources	8 votes (61.5%)
8	Carrying out studies, investigations and analysis of the assessment of water resources: Natural, real, ecological, available (of different assurance)	6 votes (46.2%)
9	Implementation of water retention and conservation agrotechniques	6 votes (46.2%)
10	Implementation of water collection technologies from roofs	6 votes (46.2%)
REDUCING LOSSES FROM DECLINED WATER QUALITY AND RESTORATION OF ECOSYSTEMS		
11	Rehabilitation of natural courses of small rivers	11 votes (84.6%)
12	Restoration of forests, meadows and watercourse wetlands	6 votes (46.2%)

The specificity of the water resources sector requires the grouping of technologies according to climate impacts focused on *surplus, insufficiency* (deficit) and *ecosystem degradation*.

Surplus water results in floods, high waters and floods, as hydrological phenomena, which through its action on the natural environment are beneficial. But society and the economy are affected by material or even human losses, due to the triggering of these phenomena. Adaptation to this climate impact requires considerable efforts and therefore its weight will be estimated by 40 points.

The water deficit conditioned by natural factors: The intensification and severity of droughts in the country affects both the natural and the socio-human framework. Even if there were no human losses in the country due to the lack of water, the material losses here are enormous. Adaptation to this climate impact is an urgent necessity and its weight is comparable to the previous impact – 40 points.

The degradation of aquatic ecosystems formulated as "Reducing losses (of water resources) due to the reduction of water quality and restoring ecosystems" does not have a direct impact on the socio-human framework, only on the natural environment. For these reasons, adaptation to this climate impact was assigned 20 points.

Following the TNA recommendations (https://tech-action.unepdtu.org/the-project/) the EXCEl file developed as a mini-calculation system for technology prioritization, adapted for the water resources sector, was used. In the evaluation, 7 criteria were used grouped by:

- Costs (investment and maintenance)
- Benefits (economic, social, environmental and climate-related)

Investment and maintenance costs for each previously selected technology (Table 1) were identified based on bibliographic sources and from consultations with specialists in the field, who work in state institutions and NGOs (Ministry of the Environment, "Apele Moldovei" Agency, State Hydrometeorological Service, Environmental Agency, etc., OIKUMENA Public Association, EcoContact, etc.). Many of the consulted specialists are part of the sectoral working group and their input in identifying the criteria was considerable.

The major problem was in the comparability of the evaluation of the criteria.

The costs (the only group of criteria that can be evaluated in monetary units) were estimated in USD, and for the unification and comparability of the results with other criteria, they were calculated for pilot projects, which include restricted areas of implementation (reception basin of a river small, water resource management sector, administrative district, municipality, etc.). These financial estimates were included in the developed TFSs, which each member of the sectoral working group received for analysis.

The benefits of the technology were divided into 5 separate criteria:

Economic:

1. Reducing the risk produced by technology on climate impact. (The value of the given criterion can be appreciated by understanding whether the applied technology (directly or indirectly) will favor the reduction of damage caused by extreme hydrological phenomena – floods, rapid rainstorms, etc.)

2. Favoring the increase in the volumes of water resources produced by technology. (The importance of the criterion lies in the assessment of the role of the proposed technology in increasing the available water resources. Will the technology facilitate, directly or indirectly, the rational, sustainable use, perhaps even the reduction of excessive human pressure on the available water resources).

Social:

3. Creation of new jobs, because of the application of technology. (Important and easy to evaluate criterion – how many permanent or seasonal or periodic jobs will be created in the process of applying the technology, or because of its application).

Environmental:

4. Improving the quality of aquatic ecosystems, because of the application of technology. (Criteria related to the assessment of the ecological state of water bodies, primarily its quality. It is proposed to assess the role of technology in improving the quality of the environment in water bodies and riparian spaces, for example wetlands).

Climate related:

5. Reduction of losses of water resources, because of the application of technology. (The criterion is complex and very difficult to evaluate in financial units, because the benefit of the application of the technology can only be appreciated indirectly. For example: The aridification of the climate and the increase of evaporation during the summer period has the consequence of increasing the loss of surface water resources through additional evaporation. proposes the evaluation of the role of technology (directly or indirectly) in reducing the losses due to the aridification of the climate).

As it was not possible to have exact units of measure for the criteria showing the benefits, the scoring approach was applied on a scale of 0 to 100. Members of the Sectoral Working Group were asked to assign a score for each technology to the respective criterion based on experience accumulated during the professional activity in the field. Thus, by allocating points in the Performance Matrix, the situation of the lack of measurement units for the benefit indicators was overcome. To facilitate the prioritization exercise, a guideline (guide) for completing the excel sheet was developed (Table 3.3, Table 3.4).

Table 3.3. Guidelines for completing the climate change adaptation technologies/measures performance matrix

Introduction. By completing the following tables (Performance Matrix), the members of the Working Group participate in the selection of the most appropriate technologies/measures for adapting to climate change with the application of Multicriteria Analysis (MCA). After completing the respective tables, they will be sent to the Sectoral Consultant for their integration into the MCA model, and the results obtained through the participation of all members of the Working Group will be analyzed and validated at the Workshop organized afterwards. The proposed set of technologies and technological actions is responsive to climate impact factors; therefore, the proposed technologies have been grouped by major climate impact

factors. Respectively, the prioritization of technologies will be done within each climate impact.

The Performance Matrix contains the information regarding the technological options proposed for prioritization (column B) in the annex, as well as the criteria, based on which the prioritization will be carried out. For some criteria the numerical values (costs) are known, for others not. For the criteria where the values are not known (for example in money, or m^3, etc.), **it is necessary to assign points on a scale from 0 to 100, based on your experience, knowledge and skills, as well as the information provided in The Technical Data Sheets (TFSs) sent previously.** Thus, members of the Working Group **will only fill in free cells (green color)** by allocating points from the scale indicated below:

Table 3.4. Reference explanations on the allocation of points

0	Used when information about a technology does not apply to specific criteria
1-20	Extremely poor performance; strongly unfavorable
21-40	Poor performance, needs major improvements
41-60	At or above an acceptable level
61-80	Very favorable performance but still in need of improvement
81-100	Clearly outstanding performance that is far above the norm

The presented guide accompanies an excel file, the sample of which was also sent to each member of the sectoral working group for completion (Figure 3.5, Figure 1.1).

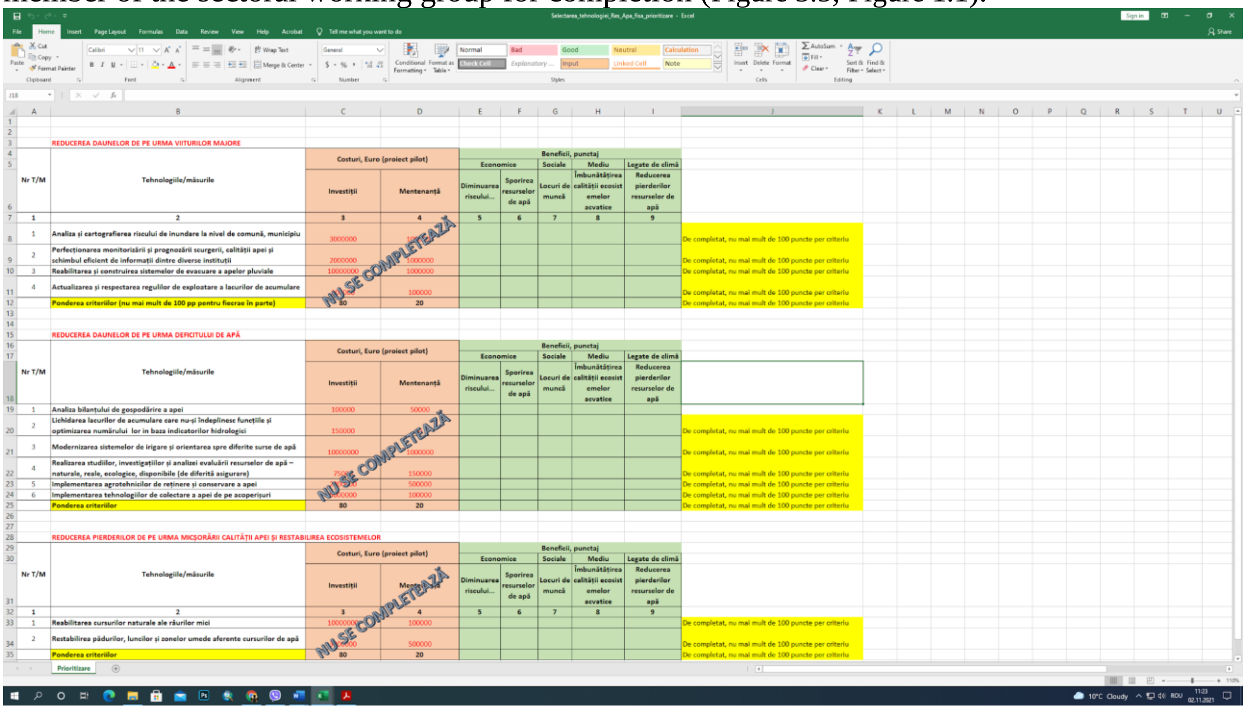


Figure 3.5. Excel file sent to each member of the water resources working group (sample)

In a dedicated workshop, together with GLS, the criteria weighting exercise was applied. Obviously, an equal approach could have been applied to all criteria, but reality shows that certain criteria have a greater contextual weight. Therefore, each individual criterion was discussed with GLS and a score was assigned on a scale from 0 -100. The allocation of points was negotiated, until a consensus was reached (Table 3.5).

Table 3.5. Assigning weight to the criteria

Investment costs	Maintenance costs	Reducing risk	Increasing water resources	Jobs	Improving the quality of ecosystems	Reducing losses of water resources
REDUCTION OF DAMAGES DUE TO MAJOR FLOODS						
19.51	9.76	17.07	17.07	12.20	24.39	19.51
REDUCTION OF DAMAGE DUE TO WATER SHORTAGE						
18.60	6.98	18.60	23.26	16.28	16.28	18.60
REDUCING LOSSES FROM DECLINED WATER QUALITY AND RESTORATION OF ECOSYSTEMS						
18.60	6.98	16.28	18.60	16.28	23.26	18.60

Later, based on the weight of the criteria and the score assigned to the technologies, calculations are made to produce the Decision Matrix, where the prioritization (rating) of the technologies is obtained.

3.6 Results of technology prioritisation

The members of the sectoral working group participated in the exercise of multi-criteria analysis and prioritization of technologies for adapting the water resources sector to climate change:

1. Ministry of the Environment, Directorate of Integrated Management of Water Resources.
2. South Regional Development Agency.
3. Agency for Geology and Mineral Resources, Geological Directorate.
4. State Hydrometeorological Service, Hydrology Center.
5. EcoContact Public Association.
6. "Apele Moldovei" Agency, Water Resources Management Directorate.
7. Institute of Ecology and Geography, Landscape Geography Laboratory.
8. Institute of Geology, Hydrogeology Laboratory.

As a result of the analysis, 2 technologies were identified as priorities, which accumulated maximum points:

1. **Improving the sustainable management of water resources by applying the water management balance** – 120.4 points.

Nr T/M	Tehnologiile/măsurile	Costuri		Beneficii				Legate de climă	TOTAL	Nivelul de prioritate al T/M
				Economice	Sociale	Mediu	Altele			
		Investiții	Mentenanță	Diminuarea riscului...	Sporirea resurselor de apă	Locuri de muncă	Îmbunătățirea calității ecosistemelor acvatice	Reducerea pierderilor resurselor de apă		
1	2	3	4	5	6	7	8	9	10	11
1	Analiza bilanțului de gospodărire a apei	18.6	6.6	18.6	23.3	13.8	16.3	23.3	120.4	1
2	Lichidarea lacurilor de acumulare care nu-și îndeplinesc funcțiile și optimizarea numărului lor in baza indicatorilor hidrologici	18.5	7.0	14.0	4.2	6.0	5.8	13.3	68.7	2
3	Modernizarea sistemelor de irigare și orientarea spre diferite surse de apă	0.0	0.0	13.1	2.1	16.3	7.7	9.5	48.7	5
4	Realizarea studiilor, investigațiilor și analizei evaluării resurselor de apă – naturale, reale, ecologice, disponibile (de diferită asigurare)	18.6	5.9	4.9	0.0	0.0	11.3	0.0	40.8	6
5	Implementarea agrotehnicilor de reținere și conservare a apei	15.0	3.5	7.0	11.0	1.5	0.8	12.5	51.4	4
6	Implementarea tehnologiilor de colectare a apei de pe a	9.4	6.3	0.0	12.6	16.0	16.3	4.3	64.8	3

Figure 3.6. The results of the calculation of the score for the climate impact "Reducing damage from water scarcity"

2. **Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions** – 110.9 points.

Nr T/M	Tehnologiile/măsurile	Costuri		Beneficii				Legate de climă	TOTAL	Nivelul de prioritate al T/M
				Economice	Sociale	Mediu	Altele			
		Investiții	Mentenanță	Diminuarea riscului...	Sporirea resurselor de apă	Locuri de muncă	Îmbunătățirea calității ecosistemel	Reducerea pierderilor		
1	2	3	4	5	6	7	8	9	10	11
1	Analiza și cartografierea riscului de inundare la nivel de comună, municipiu	13.8	0.0	2.1	0.4	8.0	4.2	0.0	28.6	3
2	Perfecționarea monitorizării și prognozării scurgerii, calității apei și schimbul eficient de informații dintre diverse instituții	15.8	0.0	17.1	17.1	12.2	24.4	24.4	110.9	1
3	Reabilitarea și construirea sistemelor de evacuare a apelor pluviale	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	4
4	Actualizarea și respectarea regulilor de exploatare a lacurilor de acumulare	19.5	9.8	13.9	15.9	6.7	3.7	17.0	86.5	2

Figure 3.7. The results of the calculation of the score for the climate impact "Major flood damage reduction"

Thus, by prioritizing these two technologies that will be worked with in the next stages of the TNA, a technological response to two diametrically opposed climate impacts – the surplus (floods) and the insufficiency (droughts) of water resources – has been outlined. The members of the sectoral working group were informed about the selected technologies.
The TFS developed for the technologies prioritized, because of the multi-criteria analysis, are presented in Annex 2.

Although the technologies prioritized by applying the MCA tool correspond to major risks and vulnerabilities caused by climate impacts, to test their robustness, the awareness exercise was applied.

The sensitivity exercise carried out focused on the fact that the climatic impacts identified as major have a relative character, which could change depending on the dynamics and amplitude of external climatic factors, as well as different economic and social aspects within the sector/country. Respectively, the predefined weights of climate impacts (Surplus of water – 40; Deficit of water – 40; Protection of aquatic ecosystems – 20) could change.

It is obvious that most important, in the case of water resources, are floods, with their extremely negative consequences for the human frame and the water deficit, mainly due to droughts.

If the share of water surplus is increased - 50 points, from the account of water deficit - 30 points, aquatic ecosystems receiving the same - 20 points, a hierarchy of technologies can be seen:

1. **Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions.**

2. Updating and complying with the rules for the exploitation of reservoirs.

3. **Improving the sustainable management of water resources by applying the water balance sheet.**

If the weight of the water surplus is reduced – 30 points, from the account of the water deficit – 50 points, the aquatic ecosystems receiving the same - 20 points, then the following hierarchy is seen:

1. **Improving the sustainable management of water resources by applying the water management balance sheet.**

2. Optimization of number of reservoirs based on hydrological indicators..

3. **Improving the monitoring and forecasting of runoff, water quality and the effective exchange of information between various institutions.**

If the weight of the water surplus is reduced – 30 points, the water deficit remains intact - 40 points and the weight of aquatic ecosystems is increased to 30 points, this results in the following hierarchy:

1. **Improving the sustainable management of water resources by applying the water management balance sheet.**

2. **Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions.**

3. Optimization of number of reservoirs based on hydrological indicators..

If the weight of the water surplus remains intact – 40 points, the water deficit assigned 30 points, the weight of aquatic ecosystems increased to 30 points, then the following hierarchy results:

1. **Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions.**

2. **Improving the sustainable management of water resources by applying the water management balance sheet.**

3. Updating and complying with the rules for the exploitation of reservoirs.

Based on the sensitization exercise, we can conclude that the technologies selected in the process of the prioritization exercise are in the Top 3 positions. In the last 2 cases, even, in the Top 2 positions, those that confirm correct prioritization in terms of their robustness in several climatic conditions.

The Long List of technologies proposed for adaptation to climate change in the water resources sector

1. Improving the monitoring and forecasting of runoff, water quality and efficient information exchange between various institutions
2. Inventory of the protection infrastructure in order to make flood control more efficient
3. Analysis and mapping of flood risk at the commune, municipality level
4. Development and implementation of flood early warning systems
5. Updating and complying with the rules for the exploitation of reservoirs
6. Restoring and optimizing the system of protection constructions through polders and locks
7. Updating and implementing plans for exceptional situations caused by flood disasters
8. Flood and drought risk insurance (including with state support)
9. Rehabilitation and construction of rainwater drainage systems
10. Analysis of the household water balance
11. Drought risk assessment and mapping
12. Carrying out studies, investigations and analysis of the assessment of water resources - natural, real, ecological, available (of different assurance)
13. Updating and complying with the rules for operating the system of reservoirs on the Dniester and Prut rivers
14. Implementation of water retention and conservation agrotechniques
15. Implementation of slope runoff collection technologies in surface impoundments
16. Implementation of water collection technologies from roofs
17. Implementation of urban rainwater collection, purification and treatment technologies
18. Implementation of afforestation and afforestation technologies in small catchment areas
19. Liquidation of reservoirs that do not fulfill their functions and optimization of their number based on hydrological indicators
20. Raising awareness of the population about climate change and its contribution to the management, collection and consumption of water at the household and locality level
21. Modernizing irrigation systems by decentralizing them and targeting different water sources
22. Increasing the storage volumes of lakes (cleaning them of silt)
23. Improving the monitoring of ecosystems and biological resources and the exchange of information (including transboundary)
24. Rehabilitation of natural courses of small rivers
25. Fighting poaching and invasive species
26. Expansion of urban green spaces
27. Restoration of forests, meadows and watercourse wetlands

TECHNOLOGY FACT SHEETS, short format

Brief description of the proposed technologies in the long list .

Sector / sub sector	Water resources
TNA technology name	**1. Improving the monitoring and forecasting of runoff, water quality and the efficient exchange of information between various institutions**
The national political framework supporting the technology	• Water Law no. 272 of 23.12.2011 • The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013 • Decision no. 932 of 20.11.2013 for the approval of the Regulation on monitoring and systematic record of the state of surface waters and underground water • Strategy of the Republic of Moldova for adapting to climate change until 2020 • Decision no. 491 of 23-10-2019 regarding the approval of the Automated Information System Concept "State Cadastre of Waters"
Brief technological description of the option	The technology provides for the optimization of the hydrological observation network, the adaptation of the methodologies to EU requirements and the implementation of new technologies for making hydrological forecasts of different durations. The operational exchange mechanism with the data collected between the branch institutions will be developed. The hydrometric observation stations will be modernized by equipping them with constructions and monitoring equipment.
Cost and profitability (estimated)	2,000,000.00 EUR
Market potential (scalability)	SHS, AGRM and the Environment Agency, MADRM and other relevant ministries, national experts, donors and climate investors will be the main beneficiaries. The data and information will be available to all institutions active in the field of environment and to other interested institutions.
Adaptation impacts and benefits	The assessment of water resources and their future forecasts are impossible without the analysis of data collected in the field. Based on the analysis of these data, decisions will be made in planning the rational use of water resources. The technology will favor the production of higher quality forecasts of different durations.

Sector / sub sector	Water resources
TNA technology name	**2. Inventory of the protection infrastructure in order to make flood control more efficient**

The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013 ● Decision no. 932 of 20.11.2013 for the approval of the Regulation on monitoring and systematic record of the state of surface waters and underground water ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Decision no. 491 of 23-10-2019 regarding the approval of the Concept of the Automated Information System "State Cadastre of Waters" ● Government Decision no. 433 of 18.06.2012 for the approval of the Regulation on flood protection dykes
Brief technological description of the option	The technology provides for the inventory and permanent updating of the technical parameters of the hydrotechnical constructions related to flood control - dams and protective dykes.
Cost and profitability (estimated)	300,000 EUR
Market potential (scalability)	SHS, AGRM and the "Apele Moldovei" Agency will be the main beneficiaries, as well as other agencies in the field. Data and information will be available to all institutions active in the field of environment.
Adaptation impacts and benefits	Knowing their location and condition will make flood management more efficient. The collected data will be kept in the Automated Information System "State Cadastre of Waters"

Sector / sub sector	Water resources
TNA technology name	**3. Analysis and mapping of flood risk at the commune, municipality level**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013 ● Decision no. 932 of 20.11.2013 for the approval of the Regulation on monitoring and systematic record of the state of surface waters and underground water ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Decision no. 491 of 23-10-2019 regarding the approval of the Concept of the Automated Information System "State Cadastre of Waters" ● Decision no. 977 of 16.08.2016 regarding the approval of the standard Regulation for the exploitation of reservoirs/ponds ● Government Decision no. 433 of 18.06.2012 for the approval of the Regulation on flood protection dykes

Brief technological description of the option	The technology provides analysis and modeling of floods (river overflow floods and flash floods). The results of the modeling will be mapped on a large scale (1:10000) and will be entered into the Urban Development Plans for rural and urban localities
Cost and profitability (estimated)	3 000 000 EUR
Market potential (scalability)	The Civil Protection and Emergency Situations Service, SHS, the "Apele Moldovei" Agency and the LPAs will be the main beneficiaries. The set of maps will be developed for the entire territory of the country and will serve as benchmarks not only for the water resources sector but also others.
Adaptation impacts and benefits	These maps will serve as a support for the planning of the development of localities by precisely indicating the lands subject to floods with different probability of overflow. They will also contain the flood risk assessment with a high level of detail, which will be taken into account in planning the spatial development of the locality.

Sector / sub sector	Water resources
TNA technology name	**4. Development and implementation of flood early warning systems**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013 ● Decision no. 932 of 20.11.2013 for the approval of the Regulation on monitoring and systematic record of the state of surface waters and underground water ● Strategy of the Republic of Moldova for adapting to climate change until 2020
Brief technological description of the option	The technology provides for the development and implementation of the early warning system. The system will be based on rapid interaction with the SHS, which elaborates early flood forecasts then transmitted to the Civil Protection and Emergency Situations Service, which immediately forwards them to concrete LPAs for information. Also, the population in areas subject to flooding will be alerted in other ways.
Cost and profitability (estimated)	2 000 000 EUR
Market potential (scalability)	The Civil Protection and Emergency Situations Service, SHS, the "Apele Moldovei" Agency and the LPAs will be the main beneficiaries. The activities will include all the communes in the country.
Adaptation impacts and benefits	The main benefit consists in informing the population about the possible risk of the flood, which will be informed in time with the possibility to react according to the predetermined plans or to save their own lives and some of their material possessions.

Sector / sub sector	Water resources
TNA technology name	**5. Updating and complying with the rules for the exploitation of reservoirs**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013 ● Decision no. 932 of 20.11.2013 for the approval of the Regulation on monitoring and systematic record of the state of surface waters and underground water ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Decision no. 977 of 16.08.2016 regarding the approval of the standard Regulation for the exploitation of reservoirs/ponds
Brief technological description of the option	The technology provides for the updating of the normative acts related to the rules for the exploitation of reservoirs. The main focus will be on the minimum (ecological and healthy) flows discharged from the lake. It will come up with practical recommendations for verification, control and penalties in case of non-compliance with these recommendations. The implementation of this technology will allow the protection of water resources of small rivers, especially affected by chain dams (cascade)
Cost and profitability (estimated)	100,000 EUR
Market potential (scalability)	The "Apele Moldovei" Agency and the Environment Agency will be the main beneficiaries. The activities will cover all the catchment areas in the country.
Adaptation impacts and benefits	Small reservoirs and ponds, in the case of incorrect exploitation, reduce water resources, especially through additional evaporation from the water table. Compliance with minimum water discharge requirements will allow the minimum discharge of these rivers to be maintained. Thus they will be protected from drought or even extinction.

Sector / sub sector	Water resources
TNA technology name	**6. Restoration and optimization of the flood protection construction system through polders and locks**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Decision no. 932 of 20.11.2013 for the approval of the Regulation on monitoring and systematic record of the state of surface waters and underground water ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Decision no. 977 of 16.08.2016 regarding the approval of the standard Regulation for the exploitation of reservoirs/ponds

	● Government Decision no. 433 of 18.06.2012 for the approval of the Regulation on flood protection dykes
Brief technological description of the option	The technology provides for the modernization of flood control measures through the controlled overflow of surplus water from the Dniester and Prut riverbeds through sluices into specially designated volumes - polders. Retention of these volumes reduces the volume of the flood, thus protecting the lands downstream.
Cost and profitability (estimated)	3 000 000 EUR
Market potential (scalability)	The Civil Protection and Emergency Situations Service, SHS, the "Apele Moldovei" Agency and the LPAs will be the main beneficiaries. The activities will include the lower reaches of the Dniester and the Prut and the Prut sector from the village of Criva to Pererâta .
Adaptation impacts and benefits	This technology, in conjunction with other flood protection measures, will reduce their risk. Secondary benefits consist in supporting the maintenance of wet areas through the water reserves stored in the polder.

Sector / sub sector	Water resources
TNA technology name	**7. Updating and implementing plans for exceptional situations caused by flood disasters**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Decision no. 932 of 20.11.2013 for the approval of the Regulation on monitoring and systematic record of the state of surface waters and underground water ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Government Decision no. 433 of 18.06.2012 for the approval of the Regulation on flood protection dykes
Brief technological description of the option	The action plans in case of exceptional situations represent an algorithm of measures, which must be carried out before the occurrence of the phenomenon, during the manifestation and after the flood. Updating these plans, including for administrations at all levels, will be a legal and necessary support for decision-making.
Cost and profitability (estimated)	EUR 500,000
Market potential (scalability)	The Civil Protection and Emergency Situations Service, SHS, the "Apele Moldovei" Agency and the LPAs will be the main beneficiaries.
Adaptation impacts and benefits	The frequency and strength of floods is evolving with climate change. The approval of these plans will facilitate decision-making as a whole and taking into account the local specifics of each flooded territory. The major benefit lies in understanding the necessary actions to take at the right time.

Sector / sub sector	Water resources
TNA technology name	**8. Flood and drought risk insurance (including with support from the state)**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Decision no. 894 of 12.11.2013 for the approval of the Regulation on the organization and operation of the one-stop shop in the field of environmental authorization of the special use of water ● Decision no. 835 of 29.10.2013 on the approval of the Regulation on the record and reporting of water used ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013
Brief technological description of the option	The given technology involves the elaboration and approval of normative acts that hold the implementation of insurance procedures against floods and droughts predominantly in agriculture, for farmers.
Cost and profitability (estimated)	250,000 EUR
Market potential (scalability)	The technology can apply to natural and legal persons active in the agricultural sector, but it can also be transposed for the water supply and sanitation sector, and construction (housing). Insurance agencies in the country will participate in the technology implementation.
Adaptation impacts and benefits	In case of material losses, the beneficiaries will be able to compensate their losses. Knowing that the intensity and frequency of droughts is increasing, as well as rain floods, this technology can be a useful tool for adapting to climate change.

Sector / sub sector	Water resources
TNA technology name	**9. Rehabilitation and construction of rainwater drainage systems**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013 ● Decision no. 950 of 25.11.2013 for the approval of the Regulation on the requirements for the collection, purification and discharge of waste water in the sewage system and/or water bodies for urban and rural localities

Brief technological description of the option	The given technology involves the design and construction/reconstruction of rainwater drainage systems in the country's localities. It should be noted that many localities have these systems already outdated or do not have them at all. Even for Chisinau, every heavy rain leads to the flooding of the streets in the lower part of the city due to the small potential of rainwater drainage. Especially the technology is worth applying for the urban development plan of Chisinau.
Cost and profitability (estimated)	EUR 10,000,000
Market potential (scalability)	The main beneficiaries will be LPAs, especially those in big cities, Chisinau, Balti, Cahul, Soroca, Orhei. It will apply throughout the country, especially in localities with an increased risk of rapid rain floods.
Adaptation impacts and benefits	The technology is expensive, and if these systems are to be set up all over the country, the amount will be tens of times higher than indicated. But the presence of these systems will greatly reduce the damage caused by torrential rains. Rural localities are the most vulnerable and are prioritized in the arrangement with these systems.

Sector / sub sector	Water resources
TNA technology name	**10. Analysis of the water management balance**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Law on public water supply and sewerage service no. 303 of 13.12.2013 ● Law on associations of water users for irrigation no. 171 of 09.07.2010 ● Decision no. 977 of 16.08.2016 regarding the approval of the standard Regulation for the exploitation of reservoirs/ponds ● Decision no. 835 of 29.10.2013 on the approval of the Regulation on the record and reporting of water used ● Decision no. 894 of 12.11.2013 for the approval of the Regulation on the organization and operation of the one-stop shop in the field of environmental authorization of the special use of water
Brief technological description of the option	The technology is based on the development of a software for the analysis and calculation of the balance of water management by water resource management sectors. The given tool will allow to give a quick answer regarding the available water resources both on water resource management sectors and for a specific water body.
Cost and profitability (estimated)	100,000 EUR

Market potential (scalability)	With this support, the "Apele Moldovei" agency will manage water resources more efficiently.
Adaptation impacts and benefits	Issuing permits for special water use is impossible without knowing the resources available now and in the future. It represents an adaptation technology by recording water resources and making decisions for their use in the short and medium term and will enable the correct and informed management of water resources at the sector level as well as at the water body level. .

Sector / sub sector	Water resources
TNA technology name	**11. Drought risk assessment and mapping**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Decision no. 835 of 29.10.2013 on the approval of the Regulation on the record and reporting of water used ● Decision no. 894 of 12.11.2013 for the approval of the Regulation on the organization and operation of the one-stop shop in the field of environmental authorization of the special use of water
Brief technological description of the option	The technology is based on the vulnerability of the country's territory to drought. Areas with increased risk of drought will be identified, of course these areas will be small in size and very dispersed in space.
Cost and profitability (estimated)	100,000 EUR
Market potential (scalability)	"Apele Moldovei" Agency, SHS. The environmental agency with this support will manage water resources more efficiently in drought conditions as well as the agricultural sector, LPAs , exposed communities, the local private sector.
Adaptation impacts and benefits	It will serve primarily as a support for the agricultural insurance system. It will become clear which agricultural lands require investments and recommendations of different kinds in increasing the potential for adaptation to droughts.

Sector / sub sector	Water resources
TNA technology name	**12. Carrying out studies, investigations and analysis of the assessment of water resources - natural, real, ecological, available (of different assurance)**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020
Brief technological description of the option	The result of the study will in principle be a support, an update of the normative document - the Code of Practice in constructions CP D.01.05-2012, Determination of hydrological characteristics

	for the conditions of the Republic of Moldova. This STAS must be updated periodically, and in the conditions of climate change – more often. The obtained calculation data will give the answer - where and how much available water we have in the country.
Cost and profitability (estimated)	75,000 EUR
Market potential (scalability)	MADRM, the "Apele Moldovei" Agency, SHS, AGRM, the Institute of Ecology and Geography will be able to carry out this study and benefit from its products. Universities, colleges, academia, designers and LPAs, the private sector will benefit from data needed for analysis, research, synthesis and decision making.
Adaptation impacts and benefits	The updated set of parameters and coefficients will serve designers (all hydrotechnical constructions need these data in the planning and organization of its operation) in the accurate assessment of water resources. The new data will serve both the private sector - and the public sector.

Sector / sub sector	Water resources
TNA technology name	**13. Updating and observing the rules for operating the system of reservoirs on the Dniester and Prut rivers**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013 ● Government Decision no. 433 of 18.06.2012 for the approval of the Regulation on flood protection dykes ● Government Decision no. 977 of 16.08.2016 regarding the approval of the standard Regulation for the exploitation of reservoirs/ponds
Brief technological description of the option	Both rivers are transboundary. If for the Novodnestrovsk hydrotechnical node negotiations have been going on for years regarding the optimization of the exploitation rules, then for the Prut river the updating of the document has not even started. The application of technology will allow the development of new exploitation rules, which will take climate change into account. The essence of these new rules is to cover the water deficit in the Dniester river through controlled discharges from the Dnestrovsk reservoir.
Cost and profitability (estimated)	EUR 250,000,000
Market potential (scalability)	MADRM, "Apele Moldovei" Agency, SHS, AGRM. The activities will only concern the management of the hydrological regime of the Prut and Dniester rivers.
Adaptation impacts and benefits	Compliance with the exploitation rules will have a beneficial effect, first of all, on the hydrological regime of the rivers and

	consequently on their ecology in the conditions of climate change.

Sector / sub sector	Water resources
TNA technology name	**14. Implementation of water retention and conservation agricultural techniques**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● The law regarding areas and river water and water basin protection sheets no. 440 of 27.04.95
Brief technological description of the option	The technology allows moisture to be retained in the topsoil by reducing the rate of runoff from the slopes. It is proposed to apply both classical methods and those used in arid regions - Central Asia, North Africa. For example horizontal furrows, semicircular and trapezoidal waves, small runoff concentration basins, runoff retention strips, etc.
Cost and profitability (estimated)	2 000 000 EUR
Market potential (scalability)	MADRM, "Apele Moldovei" Agency, Environment Agency. The technology can be applied throughout the country and combined with other technologies to increase moisture in agricultural land.
Adaptation impacts and benefits	Reducing the rate of runoff from slopes will allow more water to infiltrate into the soil. This will increase soil moisture and replenish underground water reserves. The impact of these technologies is great in the conditions of climate aridification .

Sector / sub sector	Water resources
TNA technology name	**15. Implementation of technologies for collecting runoff from the slopes in surface accumulations**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● The law regarding areas and river water and water basin protection sheets no. 440 of 27.04.95 ● Government Decision no. 977 of 16.08.2016 regarding the approval of the standard Regulation for the exploitation of reservoirs/ponds
Brief technological description of the option	The technology allows rainwater and slope runoff to be collected into small ponds. In its essence, it is supposed to block ravines, ravines or other negative linear forms of relief, where intensive runoff occurs during rains. The water retained here can be used during the dry season for various uses.
Cost and profitability (estimated)	3 000 000 EUR

Market potential (scalability)	MADRM, "Apele Moldovei" Agency, Environment Agency. The technology can be applied throughout the country and combined with other technologies to increase moisture in agricultural land. The technology is already being applied in the central and southern region of the country.
Adaptation impacts and benefits	Collecting rainwater in small ponds will allow their use in agriculture to irrigate land up to 5 ha. The relief of the country and the intensive rainfall create good premises for the creation of water reserves, which can be used during the dry season.

Sector / sub sector	Water resources
TNA technology name	**16. Implementation of water collection technologies from roofs**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014 Decision No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems
Brief technological description of the option	The technology allows rainwater to be collected from roofs. The water drained from the roof, through the downspouts, is collected in surface or underground tanks. The water is mechanically filtered up to the tank and if it will be used for power supply - it can be treated by simple methods.
Cost and profitability (estimated)	EUR 5,000,000
Market potential (scalability)	MADRM, "Apele Moldovei" Agency, Environment Agency. The technology can be applied throughout the country and combined with other rainwater harvesting technologies. The technology is already being applied in all regions of the country. It can be used both in private households and on the territory of enterprises. Any building, home - can be transformed into a water collection surface.
Adaptation impacts and benefits	The collection of rainwater from the roofs is intended for the sector of small private households (houses, buildings, greenhouses). Water can be collected from any roof and requires minimal treatment. It can be used for different purposes – irrigation of gardens, food, as technical water, etc. It is a safe and cheap source of water.

Sector / sub sector	Water resources
TNA technology name	**17. Implementation of collection, purification and treatment technologies of urban rainwater**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020

	• The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014 Decision No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems • Government Decision no. 890 of 12.11.2013 for the approval of the Regulation on environmental quality requirements for surface waters • Government Decision no. 950 of 25.11.2013 for the approval of the Regulation on the requirements for the collection, purification and discharge of waste water in the sewage system and/or water bodies for urban and rural localities
Brief technological description of the option	The technology enables the collection of water in urban areas, its purification and treatment. Urban rainwater will be collected through the drainage networks, will be subjected to simple purification and treatment. For this, special reservoirs will be built in the lower part of the towns. The treated water will be discharged into the river or used as technical water.
Cost and profitability (estimated)	EUR 20,000,000
Market potential (scalability)	MADRM, "Apele Moldovei" Agency, Environment Agency, Municipalities. The technology can be applied in all cities and even if it is expensive it can also provide benefits in other sectors related to the use of water.
Adaptation impacts and benefits	The major benefit is protecting ecosystems from pollution (rainfall from cities is highly polluted). The secondary benefit – it will be an additional source of technical water supply in the localities.

Sector / sub sector	Water resources
TNA technology name	**18. Implementation of afforestation and greening technologies in small catchment areas**
The national political framework supporting the technology	• Water Law no. 272 of 23.12.2011 • Strategy of the Republic of Moldova for adapting to climate change until 2020 • The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014 Decision No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems • The law regarding areas and river water protection sheets and water basins no. 440 of 27.04.95 • Decision no. 932 of 20.11.2013 for the approval of the Regulation on monitoring and systematic record of the state of surface waters and underground water

	• Decision no. 836 of 29.10.2013 for the approval of the Regulation on the prevention of water pollution from agricultural activities
Brief technological description of the option	The relatively simple technology consists of grassing the (predominantly degraded) land and maintaining grasslands. Its essence is to retain surface runoff and allow it to infiltrate into the soil.
Cost and profitability (estimated)	EUR 1,000,000
Market potential (scalability)	MADRM, "Apele Moldovei" Agency, Environment Agency, APL. The technology can be applied to all degraded lands and grasslands in the country. It can be successfully applied to riparian protection strips.
Adaptation impacts and benefits	The impact is to slow the rate of runoff from the slopes and allow water to infiltrate into the soil. The direct benefit is brought to the soil and groundwater by increasing humidity, indirectly – the improvement of ecosystems.

Sector / sub sector	Water resources
TNA technology name	**19. Liquidation of reservoirs that do not fulfill their functions and optimization of their number based on hydrological indicators**
The national political framework supporting the technology	• Water Law no. 272 of 23.12.2011 • Strategy of the Republic of Moldova for adapting to climate change until 2020 • The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014 Decision No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems • The law regarding areas and river water protection sheets and water basins no. 440 of 27.04.95 • Decision no. 932 of 20.11.2013 for the approval of the Regulation on monitoring and systematic record of the state of surface waters and underground water
Brief technological description of the option	Absolutely new technology in the Republic of Moldova. The methodology for identifying the reservoirs intended for liquidation has already been developed. In its essence, multi-criteria analysis identifies the lake that no longer fulfills the function for which it was built. For example, it has become clogged, or is completely covered with swamp vegetation, etc. It is approved by the "Apele Moldovei" Agency and MADRM. The legal basis and procedural mechanisms are to be prepared.
Cost and profitability (estimated)	150,000 EUR

Market potential (scalability)	MADRM, "Apele Moldovei" Agency, Environment Agency, APL. The technology can be applied to all water courses in the Republic of Moldova.
Adaptation impacts and benefits	A reservoir built by damming and completely clogged is nothing more than an additional water evaporator. Its liquidation will only benefit the river and the ecosystems in its meadow. It will increase the volume of available water resources by reducing water losses.

Sector / sub sector	Water resources
TNA technology name	**20. Awareness of the population about climate change and its contribution to the management, collection and consumption of water at household and locality level**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● The strategy of the Republic of Moldova for adapting to climate change until 2020 ● The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014 Decision No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems
Brief technological description of the option	The technology itself includes a complex of measures aimed at understanding the phenomenon of climate change in the field of water resources and making the population aware that adaptation is the most effective measure of survival. Technology includes: seminars, on-line, paper publications, television shows, training courses for water specialists, etc.
Cost and profitability (estimated)	EUR 500,000
Market potential (scalability)	All social strata in the country
Adaptation impacts and benefits	Understanding adaptation to climate change is the most important step in the realization of all technologies and measures aimed at the protection and rational use of climate resources.

Sector / sub sector	Water resources
TNA technology name	**21. Modernization of irrigation systems by decentralizing them and targeting different water sources**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014 Decision No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems

	● Law on associations of water users for irrigation no. 171 of 09.07.2010 ● Government Decision no. 835 of 29.10.2013 on the approval of the Regulation on the record and reporting of water used
Brief technological description of the option	The technology provides for the modernization of irrigation systems with water captured from the Dniester and Prut rivers, on the one hand, and on the other, the organization of small irrigation systems from other sources - storage lakes over 1 million m^3 of water. The modernization will consist in the use of new water transport technologies from the source to the land intended for irrigation.
Cost and profitability (estimated)	EUR 10,000,000
Market potential (scalability)	MADRM, "Apele Moldovei" Agency. Coverage area – the whole country and primarily farmers' associations and independent farmers will be involved.
Adaptation impacts and benefits	The benefit consists in the support of agriculture (especially the small one) with water resources, and the applied technologies will reduce losses when transporting water on agricultural land.

Sector / sub sector	Water resources
TNA technology name	**22. Increasing the storage volumes of the lakes (cleaning them of silt)**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014 Decision No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems ● Government Decision no. 977 of 16.08.2016 regarding the approval of the standard Regulation for the exploitation of reservoirs/ponds
Brief technological description of the option	The technology provides for the expansion of the storage volumes of the lakes. Two procedures are envisaged – raising the crest of the dam and/or excavating the alluvium from the lake basin. The excavated alluvium (if it meets the sanitary and ecological requirements) can be used in agriculture or in the field of construction.
Cost and profitability (estimated)	3 000 000 EUR
Market potential (scalability)	MADRM, "Apele Moldovei" Agency. Also the LPAs at community and municipality level. Associations of farmers and individual farmers. Coverage area – the whole country.

Adaptation impacts and benefits	Many reservoirs in the country have already exceeded their operational term by being clogged (filled with silt), but the available water resources allow their continued operation. Their rehabilitation will provide available volumes of water for different uses.

Sector / sub sector	Water resources
TNA technology name	**23. Improving the monitoring of ecosystems and biological resources and the exchange of information (including cross-border)**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014 Decision No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems ● Government Decision no. 890 of 12.11.2013 for the approval of the Regulation on environmental quality requirements for surface waters ● Government Decision no. 931 of 20.11.2013 on the approval of the Regulation on the quality requirements of underground water
Brief technological description of the option	The technology provides for the modernization of the ecosystem monitoring network. It is proposed to create fixed observation points in protected areas (they already exist in reserves) and to increase the frequency of measurements. The collected data will favor a deeper understanding of changes in ecosystems and their dissemination at the transboundary level - will allow decision-making in the management of transboundary river basins.
Cost and profitability (estimated)	EUR 500,000
Market potential (scalability)	MADRM, Environmental Agency, " Moldsilva " Agency. Coverage area – the whole country.
Adaptation impacts and benefits	The impact will be felt through the dissemination of information to all interested structures - including neighboring states, and the benefit will consist in understanding the evolution of ecosystems under climate change conditions.

Sector / sub sector	Water resources
TNA technology name	**24. Rehabilitation of the natural courses of small rivers**

The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Law on the protection zones and strips of the waters of rivers and water basins no. 440 of 27.04.95 ● Government Decision no. 881 of 07.11.2013 for the approval of the Methodology regarding the identification, delimitation and classification of water bodies
Brief technological description of the option	The technology provides for the restoration of water flow through the natural beds of small rivers. Many segments of natural beds were canalized, barred and dammed in the 50-70s of the century. 20th Now (on the segments where possible) their rehabilitation is proposed.
Cost and profitability (estimated)	EUR 10,000,000
Market potential (scalability)	MADRM, Environmental Agency, " Moldsilva " Agency. Coverage area – small river basins throughout the country.
Adaptation impacts and benefits	The impact will be felt by increasing the amount of water resources, and the major benefit – by creating wetlands and improving the state of ecosystems.

Sector / sub sector	Water resources
TNA technology name	**25. Optimizing/improving the biodiversity of water ecosystems by applying anti-poaching measures**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Law on fish stock, fishing and fish farming no. 149 of 08.06.2006
Brief technological description of the option	The technology involves identifying and mapping fish concentration areas (for wintering, for example) in rivers and areas vulnerable to the spread of invasive species. By changing the legal framework, the penalties for poaching and the procedures for their application will be tightened. Procedures to combat invasive species will be implemented.
Cost and profitability (estimated)	EUR 500,000
Market potential (scalability)	MADRM, Environmental Agency, " Moldsilva " Agency, Fisheries Service. Coverage area – Dniester and Prut rivers.
Adaptation impacts and benefits	The impact will be felt by increasing the amount of water resources, and the major benefit – by maintaining biodiversity and improving the state of ecosystems.

Sector / sub sector	Water resources

TNA technology name	**26. Expansion of urban green spaces**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020
Brief technological description of the option	The technology provides for the expansion of green spaces by liquidating land without grass cover. It will tend towards greening, planting trees and shrubs on the bare surfaces.
Cost and profitability (estimated)	EUR 1,000,000
Market potential (scalability)	MADRM, Environmental Agency, " Moldsilva " Agency, Ministry of Health, APL. Coverage area – the whole country.
Adaptation impacts and benefits	The impact will be felt by increasing the areas covered with vegetation (especially grass), which will reduce surface runoff, increase soil infiltration and contribute to increased humidity in urban areas. The major benefit is increased summer humidity, increased soil moisture resources and reduced stormwater runoff.

Sector / sub sector	Water resources
TNA technology name	**27. Restoration of forests, meadows and wetlands related to watercourses**
The national political framework supporting the technology	● Water Law no. 272 of 23.12.2011 ● Strategy of the Republic of Moldova for adapting to climate change until 2020 ● Law on the protection zones and strips of the waters of rivers and water basins no. 440 of 27.04.95 ● Government Decision no. 890 of 12.11.2013 for the approval of the Regulation on environmental quality requirements for surface waters
Brief technological description of the option	The technology provides for the application of afforestation and reforestation practices in the sectors related to rivers. In the places where it is possible, it is planned to restore the groves and meadows.
Cost and profitability (estimated)	3 000 000 EUR
Market potential (scalability)	MADRM, Environmental Agency, " Moldsilva " Agency, APL. Coverage area – river meadows and wetlands across the country.
Adaptation impacts and benefits	The impact will be felt by increasing the areas covered with vegetation (especially trees), which will reduce surface runoff, increase soil infiltration and contribute to increased humidity in wetlands. The major benefit consists in increasing the humidity during the summer period, increasing the moisture resources in the soil. It will increase the quality of the state of meadow ecosystems, maintain and increase biodiversity. The expanded areas will be a supplement to the expansion of the recreation areas.

TECHNOLOGY FACT SHEETS, elaborated format.

Description of Technological Characteristics of Shortlist Technological Options to Adapt the Water Sector to Climate Change

General information	
Section	**WATER RESOURCES**
Category	**REDUCTION OF DAMAGES DUE TO MAJOR FLOODS**
The name technology	**ANALYSIS AND MAPPING OF FLOOD RISK AT THE COMMUNE, MUNICIPALITY LEVEL**
Description summary of the technology option	Floods in the Republic of Moldova according to their genesis and manifestation can be conventionally divided into two large categories: - Caused by overflowing rivers (here the floods from the large cross-border rivers Dniester and Prut must be highlighted separately from the floods from the small internal rivers); - Rapid rain floods (flash- floods), caused by very intensive precipitation and which are triggered not only on small watercourses but also on any negative linear landforms - ravines, ravines, etc. The proposed technology provides for the analysis and modeling of both types of floods. The results of the modeling will be mapped on a large scale (1:10000) and will be introduced in the Urban Development Plans for rural and urban localities. In both cases the most important and expensive thing will be the creation of a numerical model of the terrain with a high precision (resolution) - approximately 1m x 1m. Topographic data collection will be based on lidar scanning of the relief. Based on the hydrological data collected from the SHS, the water levels will be calculated in case of floods with probabilities of repeating 1 case in 100, 500 and 1000 years. Then the flood "maca" will be modeled, which will indicate the areas covered by water for each flood. The risk will be calculated based on the assessment of infrastructure objects located in areas subject to flooding. The methodology applied and the results obtained will be similar to those presented on the portal http://moldova-map.md/#/viewer/openlayers/693 where the areas with increased flood risk are indicated, but with insufficient resolution (200m x 200m) , intended only to highlight regions at risk of flooding. Further mapping of these flood risk areas will allow identifying, for example, which part of a citizen's household may be subject to flooding and what its risk will be.
Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
Priority of the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood risk management (Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation).
Priority climate of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring flood risk management by implementing appropriate measures. Development of an integrated action plan to prevent and reduce the consequences of floods, mentioned in the National Determined Contribution, 2020.

Adaptation needs . How does it contribute?	In the conditions of climate change, the frequency and severity of floods in the Republic of Moldova is increasing. The proposed technology will provide APL with large-scale flood risk maps, which will allow adaptation to their manifestation through: - land use planning ; - actions to prevent economic and even human losses; - state-backed flood insurance; - increasing the climate resilience of localities in the country.
Implementation assumptions and scale of applicability	A pilot project will be launched focusing on a catchment basin or sub-basin from an administrative district or development region. Then the activities will expand throughout the country.
Technology features	
Capital costs	EUR 3 million
Operating costs and management (O&M)	Flood risk modeling and mapping requires continuous updating approximately every 10 years. In the case of the presence of the already elaborated flood modeling system, only the system input data will be changed, those that require lower maintenance costs compared to the initial ones. Estimated cost EUR 1 million (EUR 100 thousand annually).
Safety, reliability	Any modeling is a simulation of the phenomenon, which assumes an error below 10%. For these reasons, the accuracy of the elaborated maps is considered sufficient.
Availability and Maturity	The set of developed maps will be available for each APL and APC (at the level of ministries and subordinate institutions) as well as on the INDS portal (moldova-map.md).
Country specific applicability	
Institutional capacity	In the Republic of Moldova, there is experience in flood modeling and mapping at the level of state structures (e.g. National Institute of Ecology and Geography, SHS), NGOs (e.g. OIKUMENA) or private companies. Making decisions by applying them does not require special knowledge, because the maps explicitly indicate the areas of increased risk.
Scale of applicability	All localities in the Republic of Moldova (60 cities and 1614 communes and villages). The extravillain will not shape and map.
Time horizon - On term short / medium / long	The duration of the objectives is a function of the coverage area. For the whole country, modeling and mapping will take no more than 2 years. Technology implementation has no time limit.
Status of technology in the country	Technology is a priority for the country. The technology implementation is based on the use of open- source modeling software , for example the software used by the US Soil Conservation Service – HEC-RAS.
Acceptability for local peopale	100% acceptability.
The impact on the gender.	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps; - In implementing the technology, gender equality policies in the country and sector will be taken into account; - In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural

	communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as potential market)	Multiple, from increasing the informatization of the population to planning the infrastructure of the locality. The technology will be useful for design work.
The potential for a paradigm shift	
Extensibility , replicability and application	In total, a set of maps will be developed for each locality in the Republic of Moldova, respectively it has coverage at the country level.
Potential for knowledge exchange and consolidation capacity	The technology aims to strengthen the capacities of local communities to adapt to hydrological risk phenomena (floods) under climate change conditions.
Potential for enabling environment for technology diffusion	Flood risk modeling and mapping technologies are in constant development and the products made are becoming more qualitative and accurate. They can be implemented by state institutions, private companies and even academia. Thus, technology adoption can be achieved at the state and private sector level.
Potential contribution to setting the regulatory and policy framework	The major contribution consists in the support for the establishment of the legal framework in the use of land and the organization of the infrastructure at the locality level. It will favor the modification of the legal framework in the field of insurance.
Economic benefits	
Employment workforce	The re-planning of land use and infrastructure will contribute to the creation of new jobs.
Investment	Flood-safe areas where economic investments can be made will be identified and secured.
Expenses publicly and private	In the medium and long term, the costs of flood risk reduction will be reduced. In the implementation of the technology additional expenses are not foreseen. The implementation of the respective technology relies on external climate donors.
Social benefits	
Income	It can offer significant savings to households and businesses that are currently located in areas at risk of flooding.
Learning	Understanding and awareness by the population of the process of adapting to climate change manifested by reducing the risk of flooding.
Health	The risk of loss of human life will be reduced. On the other hand, the relocation of potential objectives that pollute the water in the risk area will have a beneficial effect in improving health.
Developmental impacts, indirect benefits	
Environmental benefits	Any flood is a natural phenomenon (except man-made ones), basically beneficial for the natural environment. If there are no infrastructure objects or residential spaces in the areas subject to flooding, nature will only benefit from the given phenomenon. The result of the application of the mapping technology through the subsequent planning of the sustainable management of flood risk areas will have a beneficial effect on the natural environment.

Information generous	
Section	**WATER RESOURCES**
Category	**HYDROLOGICAL MONITORING AND FORECASTS**

The name technology	**IMPROVING THE MONITORING AND FORECASTING OF RUNOFF, WATER QUALITY AND EFFICIENT INFORMATION EXCHANGE BETWEEN VARIOUS INSTITUTIONS**
Description summary of the technology option	● The technology provides for the optimization of the hydrological observation network, the adaptation of the methodologies to EU requirements and the implementation of new technologies for making hydrological forecasts of different durations. The main focus will be on the automation of hydrological monitoring stations and the application of digital models in the development of hydrological forecasts. Contemporary flash flood forecasting systems will be applied through the application of contemporary techniques (especially radar data), something that has not been done in the Republic of Moldova until now. ● The operational exchange mechanism with the data collected between the branch institutions will be developed. Even if the State Water Cadastre Automated Information System is already implemented, it does not provide for the operative updating of the information. He relies more on average data and indicators. It is proposed to develop and implement an operative data exchange mechanism between the institutions related to the monitoring and management of water resources. The development and dissemination of forecasts, bulletins and hydrological alerts, water quality is considered. ● The hydrometric observation stations will be modernized by equipping them with constructions and contemporary monitoring equipment. Currently, only the stations on the Dniester and Prut rivers and a few internal rivers are equipped with contemporary equipment. Along with the total automation of the hydrological observation network, the classic equipment, necessary for calibrating the automatic stations, will also be modernized. ● Automated hydrochemical stations are extremely expensive to operate and will be replaced by mobile sampling laboratories.
Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
Priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment
Priority climate of the country	In the regulation regarding monitoring and systematic record of the state of surface waters and underground waters, this technology is provided as a multi-annual complex system of quantitative and qualitative assessment of surface waters and of underground ones by using the procedures and technical measures of sampling, analysis and synthesis, for the purpose of sustainable management and exploitation of aquatic resources.
Adaptation needs. How does it contribute? adaptation technology	The overall objective is to obtain operational data of the highest accuracy. Their operative processing and the development of safe forecasts, bulletins and alerts will facilitate mass informatization (from decision-makers to the population of the territory). Easy and free access to data and information, through the computerization of environmental changes, will facilitate the understanding and adaptation to climate change from the APC to the APL level.
Implementation assumptions and scale of applicability	Ideally, all surface and underground water bodies in the country should be monitored. But under the conditions of the application of modeling, simulations and spatial analysis, it is possible to focus only on representative catchment areas or other spatial landmarks.
FEATURES of technology	
Capital costs	2 million EUR
Operating costs and management (O&M)	Operational expenses will be borne by the institutions responsible for monitoring: SHS – hydrological monitoring , Environment Agency – hydrochemical and

	hydrobiological monitoring. Respectively, they will be covered by the budget of the respective institutions. Maintenance expenses include: repair of equipment, buildings, machinery and tools. In the case of hydrochemical monitoring – the reagents are expensive. The maintenance assessment is very approximate and can amount to approximately EUR 300 thousand annually.
Safety , reliability	High data quality ensures truthful forecasts. In some cases, monitoring must also be carried out in the event of the triggering of hydrometeorological risk phenomena. In this case, compliance with the rules of safety techniques in production will ensure the minimization of the risk of carrying out the works.
Availability and Maturity	Adaptations to climate change are impossible without an appreciation of environmental changes and transformations. Forecasts, bulletins, warnings are free for the population. SHS and the Environment Agency are the institutions that, based on the collected data, will also provide climate services.
Application in a specific country	
Institutional capacity	SHS, AGRM and the Environment Agency are the institutions responsible for monitoring water resources. All of them have the institutional capacity to organize effective monitoring, but they are in acute crisis of qualified personnel to carry out the works. It should be noted that for some specialties in the Republic of Moldova, respective cadres are not being prepared, for example forecasters - weather and hydro .
Scale of applicability	The scope will include the whole country, and in the case of the cross-border rivers - Dniester and Prut - there will be collaboration with the neighboring states - Romania and Ukraine.
Time horizon - On term short / medium / long	Technologies are constantly developing, and equipment wears out and becomes obsolete. So the technology can be cataloged in the short term as it will be continuously updated further.
status technology in country (exists or must important , technology transfer)	Priority. In principle - all the equipment must be imported from other countries, because there are no local producers of hydrological equipment in the Republic of Moldova. Permanent training (retraining) of the staff is also necessary.
Acceptability for NATIVE	100% acceptability
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps; - In implementing the technology, gender equality policies in the country and sector will be taken into account; - In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	The market potential is very high, because based on the collected data, climate services can be provided against payment, carried out by the respective institutions.

The potential for a paradigm shift	
Extensibility, replicability and APPLICATION	It is possible to start with a pilot project focused on a river basin or district, with a subsequent expansion throughout the country.
Potential for knowledge exchange and consolidation CAPACITY	The technology aims to strengthen the operational capacities of SHS, AGRM and the Environment Agency. Training existing staff and familiarizing them with the new procedures for making observations and forecasts will increase the quality of the products developed.
Potential for enabling environment for technology diffusion	The technology is in constant development and the results obtained will facilitate the whole range of decisions taken in the field of adapting water resources to climate change.
Potential contribution to setting the regulatory and policy framework	Currently, all normative acts developed and applied in the Republic of Moldova are based on the data and information provided by SHS, AGRM and the Environment Agency. The improvement of the quality of the collected data will certainly be reflected in the necessary normative acts to be developed and implemented for the purpose of the sustainable management of water resources.
Economic BENEFITS	
Employment workforce	The opening of new positions, the creation of mobile sampling groups, the provision of climate services requires the creation of new jobs for highly qualified personnel.
Investment	Investments in high-performance equipment and highly qualified personnel will also ensure a high quality of the products obtained.
Expenses publicly and private	The expenses from the state budget (as well as from other sources) will be compensated by the products obtained, which are free, and the climate services provided will partially compensate the investments made.
Sociable BENEFITS	
Income	The major benefit consists in the informatization of all state structures involved in decision-making on the one hand, and on the other in the informatization of the population with high-quality hydrological and hydrochemical information. Climate services rendered can also produce an income.
Learning	The data and information collected and analyzed will be the basis of computerization and awareness of the population regarding the adaptation of the water resources sector to climate change.
Health	The health of the population depends to a large extent on access to water resources in sufficient volumes and of high quality. State institutions in the field of public health having quality data and information will be able to organize their prevention activities and not only for the purpose of increasing the health of the population, in accordance with the priorities described in the National Development Strategy "Moldova 2030".
Developmental impacts, indirect benefits	
BENEFITS for environment	Environmental benefits will be reflected in decision-making based on qualitative and current environmental information.

Information generous	
Section	**WATER RESOURCES**
Category	**REDUCTION OF DAMAGES DUE TO MAJOR FLOODS**
The name technology	**REHABILITATION AND CONSTRUCTION OF RAINWATER DRAINAGE SYSTEMS**
Description summary of the technology option	The acceleration of meteorological processes, conditioned by climate change, for the Republic of Moldova, in particular, results in the intensification of rain showers and torrential rains during the summer. Consequently, their frequency and intensity is increasing. The large amount of precipitation falling in a short period of time does not allow their infiltration or retention in surface retentions. As a result, rapid pluvial floods are formed, which are triggered not by rivers but by negative linear forms of relief (rivers, ravines, valleys and in the case of localities - even the streets turn into rivers.)

	The given technology involves the design and construction/reconstruction of rainwater drainage systems in the country's localities. It should be noted that many localities have these systems already outdated or do not have them at all. Even for Chisinau, every heavy rain leads to the flooding of the streets in the lower part of the city due to the small potential of rainwater drainage. Especially the technology is worth applying for the urban development plan of Chisinau. The given systems can be of two types – terrestrial and underground, and must be designed and built in the complex. The terrestrial systems are made up of canals (predominantly along the streets), the dimensions of which are calculated according to the length and slope of the sector, but the main criterion is the calculated amount of water, which is formed as a result of heavy rainfall. Underground systems are more expensive and more difficult, but their efficiency is materialized by greater evacuation capacities and the possibility to cross surfaces occupied by buildings. It should be noted that in urban areas these systems are outdated, ruined or generally missing and the need to design and build them is a pressing necessity. In rural areas, in the vast majority of cases, they are generally absent.
Priority of developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority of developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
The country 's environmental development Priority	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood risk management (Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation).
Climate Priority of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring flood risk management by implementing appropriate measures. Development of an integrated action plan to prevent and reduce the consequences of floods, mentioned in the National Determined Contribution, 2020.
Adaptation needs . How does it contribute? adaptation technology	Under the conditions of climate change, the frequency and severity of heavy rainfall in the Republic of Moldova is increasing. The proposed technology will provide APL with effective protection systems against flash floods. The lower sectors of the towns, transport routes, etc., will operate normally even in the event of heavy rains. Thus, localities will become less vulnerable to rain floods.
Implementation assumptions and scale of applicability	A pilot project focused on a few urban and rural localities will be launched. Then the activities will expand throughout the country.
FEATURES technology	
Capital costs	10 million EUR/large city, 5 million/small city, 1 million/village
Operating costs and management (O&M)	Rainwater drainage systems represent specific constructions with an increased risk of damage or even destruction. In the case of rains with an amount over 50 mm and more for 24 hours, the world practice says that no evacuation system is no longer performing its functions, but the frequency of such rains is very low. erosive and transport capacity of water, the systems require repairs and cleaning of silt after each rain. These expenses must be planned in the local budgets (having a special, reserve fund for them), which is very difficult to calculate and can be comparable at most to ½ of the system cost. But as it turns out that the frequency of extreme rains is not high, the maintenance expenses can be estimated annually at 1/10 of the investment expenses, so approx. 1 million EUR annually.

Safety , reliability	The systems only perform their functions up to rainfall of less than 50 mm per 24 hours and ensure maximum protection of downstream areas against rainwater flooding.
Availability and maturity	The technology is safe, mature, confirmed by the practice of use for thousands of years. Its efficiency increases when combined with the collection of rainwater from roofs or the interception of runoff from slopes.
Application specific in a country	
Institutional capacity	In the Republic of Moldova, there is experience in the design and construction of rainwater drainage systems, especially represented by private companies.
Scale of applicability	All localities in the Republic of Moldova (60 cities and 1614 communes and villages). But priority are the localities with a larger population, with a more developed infrastructure and those located in more favorable conditions for the formation of rain floods - on hills with long slopes and high slopes.
Time horizon - On term short / medium / long	The duration of the objectives is a function of the coverage area. For the whole country the implementation of the technology may take time. Technology implementation has no time limit. But with the presence of financial investments, a village can be equipped with a rainwater drainage system for 1 year. A city – from 3 to 5 years.
Status technology in country (exists or must important , technology transfer)	Technology is a priority for the country. The implementation of technologies is based on the use of both traditional and new construction materials on the market – plastic, polymers , etc.
Acceptability for NATIVE	100% acceptability.
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps; - In implementing the technology, gender equality policies in the country and sector will be taken into account; - In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	Multiple, from protecting urban and rural areas from flooding to the possibilities of using collected and discharged water for other needs (as technical water, for example, after minimal treatment).
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	It will start from a few localities that either lack rainwater drainage systems, or that require capital repair. In the future, the technology will be applied to all localities in the country.
Potential for knowledge exchange and consolidation CAPACITY	The technology aims to strengthen the capacities of local communities to adapt to hydrometeorological risk phenomena (rain floods) under climate change conditions.

Potential for enabling environment for technology diffusion	The technology is simple in approach but expensive to implement and maintain. The visible effect, however, and the advantages offered by the protection against rapid rain floods, will allow its rapid expansion for all localities by example. For example, how frequently a neighborhood suffered until and after the implementation (rehabilitation) of the technology.
Potential contribution to setting the regulatory and policy framework	The major contribution consists in the support for the establishment of the legal framework in the use of land (permeable and impermeable areas, green spaces, etc.) within localities, the sustainable management of rainwater and the organization of infrastructure at locality level. It will favor the modification of the legal framework in the field of insurance.
Economic BENEFITS	
employment workforce	The technology provides design work and capital construction, so it will contribute to the creation of new jobs.
investment	Areas subject to flooding will be protected, where economic investments can be made and ensure their security.
Expenses publicly and private	In the medium and long term, the costs of flood risk reduction will be reduced. APL budgets will have permanent expenses for the maintenance of rainwater drainage networks. The implementation of the respective technology relies on external climate donors.
Sociable BENEFITS	
Income	It can offer significant savings to households and businesses that are currently located in flood risk areas.
Learning	The population's understanding and awareness of the process of adapting to climate change manifested by reducing the risk of rain floods.
Health	The risk of loss of human life will be reduced. On the other hand, the relocation of potential objectives that pollute the water in the risk area will have a beneficial effect in improving health.
Developmental impacts, indirect benefits	
BENEFITS for environment	Any flood is a natural phenomenon (except man-made ones), basically beneficial for the natural environment. In the conditions of populated areas (villages and cities) - the surplus rainwater will be discharged directly into the related watercourses, reducing erosion and transport (soil, mud, garbage, etc.) directly into the watercourse, thus protecting its bed from clogging.

Information generous	
Section	**WATER RESOURCES**
Category	**REDUCTION OF DAMAGE DUE TO MAJOR FLOODS / REDUCTION OF DAMAGE DUE TO WATER SHORTAGE**
The name technology	**UPDATING AND COMPLYING WITH THE RULES FOR THE EXPLOITATION OF RESERVOIRS**
Description summary of the technology option	The technology provides for the updating of the normative acts related to the rules for the exploitation of reservoirs. The main focus will be on the minimum (ecological and healthy) flows discharged from the lake. It will come up with practical recommendations for verification, control and penalties in case of non-compliance with these recommendations. The implementation of this technology will allow the protection of water resources of small rivers, especially affected by chain dams (cascade) Each reservoir (pond) has a technical sheet (lake passport) in which, along with technical specifications, the volumes and terms of water discharge from the lake are explicitly described. In other words, a graph of the calculated water discharges is represented, which must be observed depending on the season. The purpose of these indicated water volumes is to ensure the uninterrupted flow of water through the dammed river by the respective hydrotechnical construction. It should be noted that most reservoirs do not have these technical data sheets, if they do have them they are outdated and the most graphic is the fact that many

	lakes generally do not have devices for controlled discharge of water, they only have some evacuators that ensure the discharge of excess water (many don't even have these). In the case of small ponds (but also some reservoirs), especially set up on a cascading river, they interrupt the flow of water through the river bed immediately downstream of the dams. The updating of the technical sheets of the reservoirs and ponds, in parallel with the modification of the legal framework related to control and penalties, will ensure a flow of water through the riverbed, thus increasing the protection of water resources and improving the ecological condition of both rivers and riparian lands . It should be noted that the exposed ones refer to the small rivers in the interior of the country. The rules for the exploitation of reservoirs, set up on transboundary rivers must be updated and respected, taking into account not only their water regime but also international agreements and treaties.
Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in line with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
Priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood risk management (Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation).
Priority climate of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring flood risk management by implementing appropriate measures. Sustainable management of water resources is mentioned in the National Determined Contribution, 2020.
Adaptation needs . How does it contribute? adaptation technology	Under the conditions of climate change, the increased frequency and severity of droughts, the duration of periods of low water is increasing. Regarding the maintenance of the ecological condition of the rivers, it is important not to create additional conditions for their drying up. The implementation of this technology will increase the resistance of rivers to droughts, that is, it will favor the maintenance of their ecological balance, not to mention the fact that it will increase the volume of water resources in small river basins.
Implementation assumptions and scale of applicability	A pilot project will be launched focusing on a small catchment area, on which cascades of ponds (reservoirs) are arranged.
Technology FEATURES	
Capital costs	EUR 100 thousand for the implementation of the technology throughout the country.
Operating costs and management (O&M)	Contemporary, approved methods for calculating the minimal, healthy, ecological leakage exist in the country and are indicated in the specialized normative documents. Updating the technical sheets of the reservoirs is a relatively cheap and necessary procedure to be carried out at least once every 10 years (this requirement is missing in the normative documents). But this does not include the rules for the exploitation of transboundary reservoirs. For them, the updating procedure is dependent on negotiations, working group meetings, bilateral approvals, which have higher expenses behind them. The development of control and penalty procedures are singular measures, so they have no maintenance costs. So the rough estimate of operation and maintenance costs can be below 10 thousand EUR annually at the country level.

Safety , reliability	As mentioned, the technology will in principle increase the volume of water resources in the country's small rivers and favor the maintenance of their good ecological status. But in the conditions of severe drought, resulting in drying up of rivers - the technology will no longer work. Also in the case of abandoned ponds it cannot be applied.
Availability and Maturity	The technology is safe, mature, confirmed by the practice of international use. Its efficiency increases when combined with the liquidation of reservoirs and ponds, which no longer fulfill their functions.
Country Specific Application	
Institutional capacity	In the Republic of Moldova, there are many state and private enterprises, which can quickly, easily and cheaply update the technical sheets of reservoirs and ponds. The ecological inspectorate is the institution that has verification capabilities, and the penalty mechanism belongs to the respective bodies.
Scale of applicability	According to the data from the Automated Information System of the State Cadastre of Waters in the Republic of Moldova there are about 8 thousand reservoirs and ponds. Each of their data sheets must be updated.
Time horizon - On term short / medium / long	The duration of the objectives is a function of the coverage area. For the whole country the implementation of the technology may take time. Technology implementation has no time limit. Update frequency – decimal. So we can consider it a short term.
Status technology in country (exists or must important , technology transfer)	Technology is a priority for the country, but technology imports are not foreseen.
Acceptability for NATIVE	Debatable subject, because the current practice indicates that the owners and managers of the reservoirs on the one hand are in no hurry to update the records of the reservoirs, on the other hand they do not follow the rules of exploitation. From their side the resistance will be tough. The rest of the population will certainly welcome the implementation of the technology. So – 90% acceptability.
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing identified gender deficiencies and gaps; - In implementing the technology, gender equality policies in the country and sector will be taken into account; - In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	Multiple, from increasing the volume of water resources in rivers, to improving and maintaining the ecological condition in the area of application.
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	It will start from a few small reception basins in the country with several cascaded ponds. Next, the technology will be applied to all reservoirs and ponds in the country.

Potential for knowledge exchange and consolidation CAPACITY	The technology aims to strengthen the capacities of local communities to adapt to hydrometeorological risk phenomena (droughts) under climate change conditions.
Potential for enabling environment for technology diffusion	The application of technologies in a small basin and the increase in a short time of ordinary water resources with the improvement of the ecological state of the river will serve as an example for other human communities in all reception basins of small rivers in the Republic of Moldova.
Potential contribution to setting the regulatory and policy framework	The major contribution consists in the support for updating the legal framework in compliance with the rules for exploitation of reservoirs.
Economic BENEFITS	
employment workforce	Technology does not provide for the creation of new jobs.
investment	Investments will be limited only to the redevelopment of hydrotechnical constructions with the necessary equipment.
Expenses publicly and private	The expenses will be borne by the owners or the management of the hydrotechnical constructions in refitting them with the missing devices, as well as updating their technical sheets.
Sociable BENEFITS	
Income	There will be no direct benefits.
Learning	The population's understanding and awareness of the process of adapting to climate change manifested by reducing the risk of water scarcity and improving the ecological situation.
Health	The quality of the environment and especially water will improve.
Developmental impacts, indirect benefits	
BENEFITS for environment	Of the indirect ones: The managers and/or owners of the downstream reservoirs/ponds will have access to more water. By improving the ecological condition of the rivers, the quality of ecosystem benefits will increase .

Information generous	
Section	**WATER RESOURCES**
Category	**REDUCTION OF DAMAGES DUE TO WATER SHORTAGE**
The name technology	**ANALYSIS OF THE WATER MANAGEMENT BALANCE SHEET**
Description summary of the option technology	The technology is based on the development of a software for the analysis and calculation of the balance of water management by water resource management sectors. The given tool will allow you to give a quick answer regarding the available water resources both on water resource management sectors and for a specific water body. The essence of the water balance lies in knowing the difference between intake and consumption of water, that is, in evaluating the available water resources. The forecasting component allows the assessment of available water resources in the future as well. Depending on the presence, insufficiency or lack of water resources, special water use permits will be issued and management activities in the water resources sector will be planned for the near future. Two main input data sets are used to calculate the water balance – water resources and water use. The water balance can be calculated at the point or for some area. For planning the use of water resources, the water balance is calculated for the water resources management sectors (approved by the "Apele Moldovei" Agency). Water resource management sectors are identified at two levels, broad sectors and more detailed sectors. In both cases, the basinal principle is respected . In the calculation of the water balance, one operates not with the measured discharge, but with the assured discharge, with a different probability of exceeding. As a rule P=50% (average runoff year), P=75% (dry year) and P=85, 90 or 95% very dry years. The results of the evaluation will be placed in the Automated Information System of the State Cadastre of Waters. For this, the calculation must be done using

	specialized software, which can be free, commercial or specially developed in the Republic of Moldova. The calculation algorithm is well known, applied all over the world. In the conditions of our country, it is quite a difficult problem to identify the institution and units that will carry out these activities. Currently, the "Apele Moldovei" Agency is mandated to evaluate water resources, but civil servants do not have the specialized training to carry out these works.
Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in line with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
Priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring drought risk management (Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation).
Priority climate of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring flood risk management by implementing appropriate measures. Sustainable management of water resources is mentioned in the National Determined Contribution, 2020.
Adaptation needs . How does it contribute? adaptation technology	Currently, the issuance of special water use authorizations is developed without taking into account the availability of water resources now and in the future. This is not correct, you need to know clearly how much water you have at a given point, on a given river or on a given surface. Knowledge, planning and sustainable management of water use under climate change is inevitable, necessary and a convenient and necessary tool in sustainable management of water resources. The technology is strictly necessary because the time is approaching when refusals to issue authorizations will be applied, due to the insufficiency of water resources, and the "water balance" is a tool that will argue for the issuance of authorizations.
Implementation assumptions and scale of applicability	It will apply to the entire country from the start.
FEATURES of the technology	
Capital costs	EUR 100 thousand for the implementation of the technology throughout the country.
Operating costs and management (O&M)	Operation and maintenance costs are very modest and are reduced only to data collection and water balance reassessment. They can be reduced to the salary of employees and IT specialists who will service the computing system. About 5 thousand EUR annually.
Safety , reliability	The technology will favor the sustainable management of water resources through proper planning measures (knowing exactly the volume of water available), as well as their rational use through the issuance of special water use permits.
Availability and Maturity	The technology is safe, mature, confirmed by the practice of international use. Its efficiency increases in the case of combining the correct planning of the development of the economy, especially in agriculture (irrigation).
Country Specific Application	
Institutional capacity	The Moldavian Water Agency has the institutional capacity to administer the calculation of the water management balance. The State Hydrometeorological Service can provide correct data on surface runoff, AGRM – on underground water reserves, and the National Bureau of Statistics – data on water use.
Scale of applicability	Whole country (water resource management sectors).

Time horizon - On term short / medium / long	Short term – with medium and long term extension.
status technology in country (exists or must important , technology transfer)	Technology is a priority for the country, but technology imports are not foreseen.
Acceptability for NATIVE	100% acceptability.
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps; - In implementing the technology, gender equality policies in the country and sector will be taken into account; - In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	Multiple, from increasing the volume of water resources in rivers, to their correct management in combination with planning in economic activity.
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	It will be developed and applied from the start for the whole country.
Potential for knowledge exchange and consolidation CAPACITY	The technology aims to strengthen the capacities of local communities to adapt to hydrometeorological risk phenomena (droughts) under climate change conditions, as well as the involvement of state institutions, responsible for data collection and water resource management.
Potential for enabling environment for technology diffusion	Protection of water resources will be ensured, especially during dry periods.
Potential contribution to setting the regulatory and policy framework	Water management balance calculations will regulate the sustainable use of water resources according to climate change.
Economic BENEFITS	
employment workforce	Technology does not provide for the creation of new jobs.
investment	Investments will be reduced only to the development of the calculation software.
Expenses publicly and private	Additional expenses will not be.
Sociable BENEFITS	
Income	There will be no direct benefits.
Learning	Understanding and awareness by the population, employees of the institutions responsible for managing water resources, of the process of adapting to climate

	change manifested by reducing the risk of water scarcity and sustainable management of water resources.
Health	The quality of the environment and especially water will improve.
Developmental impacts, indirect benefits	
BENEFITS for environment	Of the indirect ones: The protection of water resources will be favored during periods of moisture deficit.

General information	
Section	**WATER RESOURCES**
Category	**REDUCTION OF DAMAGE DUE TO WATER SHORTAGE**
The name technology	**LIQUIDATION OF RESERVOIRS THAT DO NOT FULFILL THEIR FUNCTIONS AND OPTIMIZATION OF THEIR NUMBER BASED ON HYDROLOGICAL INDICATORS**
Description summary of the option technology	Absolutely new technology in the Republic of Moldova. The methodology for identifying the reservoirs intended for liquidation has already been developed. In its essence, multi-criteria analysis identifies the lake that no longer fulfills the function for which it was built. For example, it has become clogged, or is completely covered with swamp vegetation, etc. It is approved by the "Apele Moldovei" Agency and MADRM. The legal basis and procedural mechanisms are to be prepared. Damping off a small (or even ephemeral) stream of water fed by shallow surface runoff or the few underground sources and being clogged, this pond represents an additional surface for water evaporation. It is known that in arid climate conditions with a shortage of water resources - reservoirs and ponds considerably reduce the flow of rivers, in other words - they directly favor the destruction of rivers both as a water course and as an ecosystem. From the surface of the small, clogged ponds, the collected water is only lost to intensive evaporation, in the conditions of climate change, in the conditions of increasing temperatures in the summer months. First of all, it is necessary to develop and propose for implementation some changes in the legal framework of the Republic of Moldova related to the given subject. The changes are more about procedure, control and responsibilities. Certainly, most of the ponds (because dams of ponds as a hydrotechnical construction are in the sights) are arranged on the lands that belong to the bottom of the waters. Ponds can be managed by APL or legal entities. It is necessary to develop the procedure clearly described and implemented in normative acts, which clearly describes who is responsible for the liquidation of the pond (dam). Another normative act, which needs to be elaborated – the identification of the economic agent responsible for liquidating the lake. It should be noted that the cost of liquidating a pond and reusing the accumulated sludge is a very expensive procedure. It makes more sense to just break the dam, allowing the river to continue to flow naturally. In time it (the river) will restore its natural bed without further human impact. It should be noted that these ponds also present an increased danger in case of floods. The last normative act necessary to be developed and implemented is the control and penalty mechanism. Optimizing the number of reservoirs in a small receiving basin (small river) will reduce the anthropogenic pressure on this river and by reducing additional evaporation losses will increase the volume of water resources in this basin.
Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing

	incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
Priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood risk management (Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation).
Priority climate of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring flood and drought risk management by implementing appropriate measures. Sustainable management of water resources is mentioned in the National Determined Contribution, 2020.
Adaptation needs . How does it contribute? adaptation technology	Under the conditions of climate change, the frequency and severity of droughts in the Republic of Moldova is increasing. The proposed technology is an adaptation tool, which will increase the volume of water resources in small river basins by increasing (or rather restoring) the volume of natural flow of small rivers.
Implementation assumptions and scale of applicability	A pilot project will be launched focusing on a catchment basin or sub-basin from an administrative district or development region. Then the activities will expand throughout the country. Normative acts will be developed for the possibility of application throughout the country.
Technology features	
Capital costs	150,000 EUR
Operating costs and management (O&M)	Operating costs are reduced to the expenses of drafting, granting and approving normative acts. Maintenance costs – when paying the employees who will implement the technology. The liquidation costs of the hydrotechnical constructions are not included here, because there is a legal framework that provides for the liquidation (demolition) procedure and these expenses will be borne by economic agents.
Safety , reliability	The technology is safe and reliable with clear results that will be achieved.
Availability and Maturity	The methodology for identifying aquatic objects that require demolition and liquidation is already developed and approved. Its maturity will be felt in the application, being a new one in the Republic of Moldova.
Country specific applicability	
Institutional capacity	In the Republic of Moldova, there is experience in the development of normative acts (at the level of the ministry, national experts) and their application through the responsible institutions - the "Apele Moldovei" Agency, the Environmental Agency and the Ecological Inspectorate.
Scale of applicability	It will start with a small reception pool, then expand to the entire country. In the Republic of Moldova, according to SIA CSA data, there are about 8,000 reservoirs, of which no less than 3,000 (approximately) should be liquidated.
Time horizon - On term short / medium / long	The duration of the objectives is a function of the coverage area. For a pilot pool, results can be obtained in a very short time (1 year). For a medium-sized catchment area (eg Ichel , Cula, Cogâlnic) plausible results can be obtained for 3-5 years. And the whole country can be "cleaned" of redundant storage lakes for 10 years.
Status of technology in the country	Technology is a priority for the country. The implementation of technologies is based on the broad application of normative acts and compliance with the legal framework.
Acceptability for NATIVE	Debatable subject. There will be enormous resistance from the owners and managers of the respective lands. Even LPAs can resist for various reasons. On the other hand, owners of lakes in good condition will welcome this technology because water resources will increase. The local population will only be happy if the volume of water flowing through the local river increases.

The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps; - In implementing the technology, gender equality policies in the country and sector will be taken into account; In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	If the technology is implemented, it can be an example of good practices in the management of water resources in the region.
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	Overall, no less than 3,000 reservoirs and ponds in the country will be liquidated. The technology can be applied and transposed in neighboring countries (Romania and Ukraine), in regions with similar relief and climate.
Potential for knowledge exchange and consolidation CAPACITY	The technology aims to strengthen the capacities of local communities to adapt to hydrological risk phenomena (floods and droughts) under climate change conditions, as well as to improve the ecological status of small rivers.
Potential for enabling environment for technology diffusion	Improving the ecological status of small rivers and increasing their water resources represents a high potential to increase the quality of the environment.
Potential contribution to setting the regulatory and policy framework	The very involvement of technology will favor the improvement of the legal framework and environmental policies.
Economic benefits	
employment workforce	No new jobs are expected to be created.
investment	The liquidation of lakes and the reduction of their number in a catchment will allow investments to be made in the unclogging, repair and efficient maintenance of an optimal number of lakes on a river.
Expenses publicly and private	It depends on the owner of the hydrotechnical construction (dam). The expenses will be borne by APL or the owners.
Social benefits	
Income	The volumes of water saved from additional evaporation can be used for various purposes (irrigation, for example).
Learning	The population's understanding and awareness of the process of adapting to climate change manifested by increasing the volume of water in rivers.
Health	It will increase the volume of water resources, their quality and the overall quality of the environment.
Developmental impacts, indirect benefits	
Environmental benefits	Obviously, the quality of the environment will be improved by increasing the wetting of the territory, by reducing additional evaporation and restoring (in some sectors) the natural flow of water through the river beds.

General information	
Section	**WATER RESOURCES**
Category	**REDUCTION OF DAMAGE DUE TO WATER SHORTAGE**
The name technology	**MODERNIZATION OF IRRIGATION SYSTEMS AND ORIENTATION TOWARDS DIFFERENT WATER SOURCES**
Description summary A option technology	Currently, the National Strategy for the Development of the Irrigation Sector 2030 is being developed, which is currently subject to public debate and is on the web page of the Parliament of the Republic of Moldova. https://www.parlament.md/ ProcesulLegislativ / Proiectedeacteleslative / tabid /61/ LegislativId /5541/ language / ro -RO/Default.aspx The proposed technology is also partially found in this document and consists of: **Irrigation from large rivers** : Reusing and automating pumping stations by replacing hydromechanical equipment with new techniques, which will reduce water losses during pumping and transportation and lower the cost of water. Use of modern drip technologies to reduce excessive water consumption. Reusing aqueducts by replacing metal, asbestos and concrete pipes with polypropylene pipes , which will reduce installation and operating costs, which will extend their service life. The use of aqueducts built to supply water to towns from the Dniester and Prut rivers for irrigation purposes will be examined. **Irrigation from small rivers and reservoirs** . To review the possibilities of irrigation from these sources, in accordance with the properties of water resources and to stipulate in normative acts the requirements for the quality of irrigation water. It should be noted that the water quality in small rivers and most reservoirs and ponds does not meet the requirements for irrigation water quality. Accordingly, the legal framework will be modified, as well as the procedures for checking and controlling the use of water for irrigation. **Collecting rainwater** and using it in small irrigation. Water will be collected from impermeable surfaces (roofs, asphalted/concrete spaces, greenhouses, etc..) in tanks of various types. As a rule, rainwater is of good quality and treatment is only necessary if the collection surface is polluted. Depending on the volumes collected, small areas of agricultural land can be irrigated. **Arrangement of underground basins for keeping irrigation water** . In the conditions of climate change and the increase in the shortage of quality water for irrigation, it is necessary to orientate towards the practice of the Mediterranean states - the collection and storage of rainwater in underground reservoirs. The collected water can then be used not only for irrigation, but also for other uses – firefighting, for example. In the conditions of the aridification of the climate, this technology in the future will have a wide application in the Republic of Moldova.
priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population.
priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood and drought risk management

	(Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation).
priority climate of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring flood risk management by implementing appropriate measures. The development of an integrated action plan for the prevention and reduction of the consequences of floods, mentioned in the National Determined Contribution, 2020. The national strategy for the development of the irrigation sector 2030 emphasizes the need to reset, rehabilitate the irrigation sector, as well as the possibility of increasing the areas suitable for irrigation by 250 thousand ha up to 300,000 ha irrigated in 2030.
Adaptation needs . How does it contribute? adaptation technology	In the conditions of climate change, the frequency and severity of floods and droughts in the Republic of Moldova is increasing. The proposed technology will provide farmers with centralized and decentralized irrigation systems, as well as water supply possibilities from sources other than transboundary rivers.
Implementation assumptions and scale of applicability	A pilot project will be launched focusing on a catchment basin or sub-basin from an administrative district or development region. Then the activities will expand throughout the country. According to the strategy: *Annually until 2030, about 11 thousand ha of land suitable for irrigation will be built/arranged for irrigation, connected to sustainable sources of quality water for irrigation. This would allow, until 2030, to be additionally arranged for irrigation at least 108 thousand ha in the service area of 77 rehabilitated SCI, the rest of the surfaces to achieve this objective being arranged in the framework of unfinished and private, small-scale centralized irrigation systems.*
Technology features	
Capital costs	EUR 10,000,000 for a rehabilitated irrigation system (approximately 2000 ha). Investments in the amount of approximately 1.9 billion Euros are required for the irrigation development of 250 thousand ha in the period 2021-2030.
Operating costs and management (O&M)	Operating and maintenance costs are difficult to calculate, but they will certainly be high.
Safety , reliability	The technology is safe and reliable
Availability and Maturity	All the technological implementation procedures, as well as the accumulated experience in the irrigation sector, are sufficient for the application of the technology in the Republic of Moldova.
Country specific applicability	
Institutional capacity	Empowering the "Apele Moldovei" Agency with full financial autonomy would highlight its quality as a public institution and, respectively, an administrative authority for the management of water and the lands of the water fund, which ensures the implementation of the policy in the field of water management and water improvement. Currently, AAM has sufficient experience in the implementation of policies in the field of water improvement and water resource management.
Scale of applicability	The national strategy for the development of the irrigation sector 2030 explicitly indicates: "In order to ensure the achievement of the objectives of this Strategy and to obtain stable and high harvests of agricultural crops, the irrigation sector will be modernized, ensuring the necessary quality and quantity of water (approx. 700 million m3 of quality water for the irrigation of approx. 300 thousand ha, of which in the framework of the implementation of this strategy - 250 thousand ha arranged and equipped with high-performance equipment for irrigation until 2030)".
Time horizon - On term short / medium / long	Short term – towards the year 2030.

Status of technology in the country	Technology is a priority for the country.
Acceptability for NATIVE	100% acceptability.
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing identified gender deficiencies and gaps; - In implementing the technology, gender equality policies in the country and sector will be taken into account; In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	The market potential is currently reduced by the water source and the location of the agricultural land. But, in principle, small farming can be applied throughout the country.
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	The accumulated experience and application of new rainwater harvesting technologies and new technologies in irrigation could widen the area of application of the technology.
Potential for knowledge exchange and consolidation CAPACITY	The technology aims to strengthen the capacities of local communities to adapt to hydrological risk phenomena (droughts) under climate change conditions.
Potential for enabling environment for technology diffusion	High. In the conditions of climate aridification - irrigation is one of the most effective adaptation technologies. Diffusion and expansion of technology, especially the use of collected rainwater – can be achieved throughout the country.
Potential contribution to setting the regulatory and policy framework	Facilitating access to water for irrigation by improving/amending the Normative framework. Improving the subsidy system in order to encourage water users to develop the internal infrastructure for the accumulation and use of water. Analysis of water taxes for irrigation and evaluation of post-modernization costs. Stimulating the association of water users for irrigation.
Economic benefits	
employment workforce	The modernization and creation of new irrigation systems will contribute to the creation of new jobs.
investment	The investment for 1 ha rehabilitated up to the hydrant within the SCI in the environment is estimated at 5000 Euro. The rehabilitation of 77 SCI with a service area of 108 thousand ha would require approximately an investment of 543 million Euros to bring water to the hydrant. In addition,

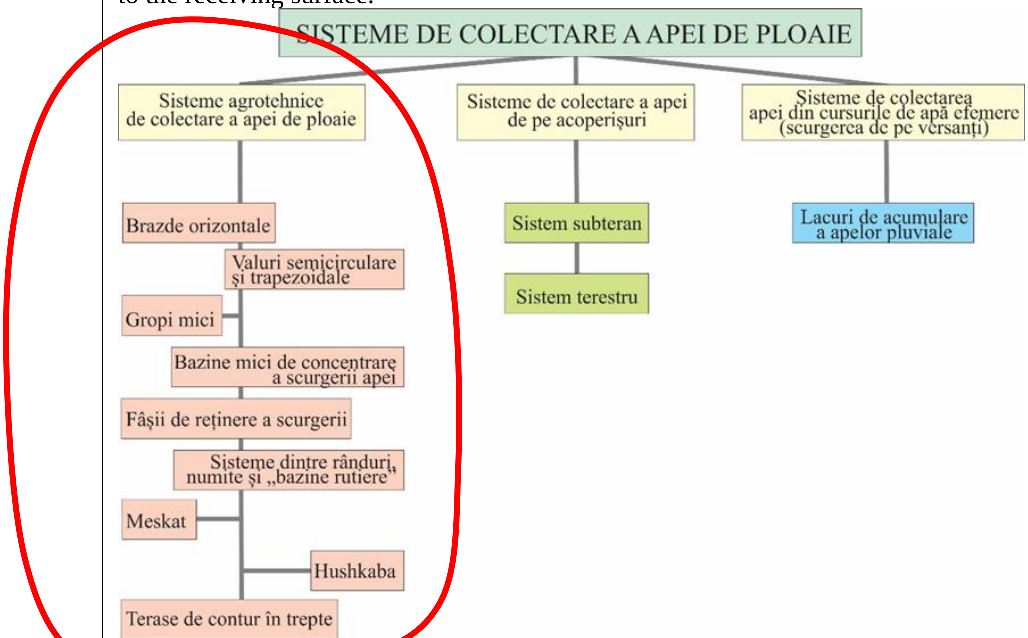
	it is necessary to procure irrigation equipment depending on the culture and the technology used.
Expenses publicly and private	Certainly the expenses will be high and especially from external sources, from different donors.
Social benefits	
Income	The annual gross profit obtained from economic activities estimated on the surface of 250,000 ha (estimated crop structure: full fruit - perennial plantations 50%, vegetables 25% and field crops 25%) is 1.7 billion euros. This will ensure the development of other sectors, the necessary infrastructure, transport, trade, tourism, and directly the recovery of investments fully justifying the investments proposed for the implementation of this strategy. Increasing the economic potential of households will ensure additional revenues to the budget and increase the contribution of the agricultural sector to GDP.
Learning	The population's understanding and awareness of the process of adapting to climate change manifested through the rational use of water resources.
Health	Only indirectly.
Developmental impacts, indirect benefits	
Environmental benefits	-

General information	
Section	**WATER RESOURCES**
Category	**REDUCTION OF DAMAGE DUE TO WATER SHORTAGE / REDUCTION OF DAMAGE DUE TO MAJOR FLOODS**
The name technology	**CARRYING OUT STUDIES, INVESTIGATIONS AND ANALYSIS OF THE ASSESSMENT OF WATER RESOURCES - NATURAL, REAL, ECOLOGICAL, AVAILABLE (OF DIFFERENT ASSURANCE)**
Description summary A of the option technology	The result of the study will in principle be a support, an update of the normative document - the Code of Practice in constructions CP D.01.05-2012, Determination of hydrological characteristics for the conditions of the Republic of Moldova. This normative act must be updated periodically, and in the conditions of climate change - more often. The obtained calculation data will give the answer - where and how much available water we have in the country. In the Republic of Moldova, various state institutions are responsible for collecting data related to the quantity and quality of water resources. SHS – measures water runoff in rivers at hydrometric stations. AGRM – collects data on groundwater reserves. The Environment Agency – collects data on (surface) water quality. ANSP – collects data on water quality but health indicators. "Apele Moldovei" Agency - is the institution responsible for the evaluation and management of waters. Currently, the management of water resources is the prerogative of the "Apele Moldovei" Agency, respectively, the assessment of water resources in the country is also a responsibility of the institution. The management of water resources is carried out on the basin principle , according to the management plans of the hydrographic districts, which are updated every 5 years https://www.legis.md/cautare/getResults?doc_id=102659&lang=ro . The proposed technology provides for the realization of scientific and applied research in view of the evaluation of water resources with a subsequent publication in: - Updating the normative documents related to hydrological calculations; - Management plans of watershed districts; - SIA CSA; - Guides and guidelines related to the assessment of water resources under climate change conditions; - Scientific articles and publications.

	Knowledge of the hydrological situation, of water resources, of their quality requires permanent updating and dissemination, especially in the conditions of environmental transformations, such as climate change.
Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
Priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood and drought risk management (Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation).
Priority climate of the country	The development of an integrated action plan for the sustainable management of water resources is mentioned in the National Determined Contribution, 2020.
Adaptation needs . How does it contribute? adaptation technology	In the conditions of climate change, the variability of the quantity and quality of water resources is very high. The sets of indicators and data collected, at the time of their publication, are already outdated, so the permanent assessment of water resources is necessary, in order to make correct policies and make reasoned decisions. Knowing the problems in the water resources sector already is the most perfect premise to develop adaptation measures.
Implementation assumptions and scale of applicability	Assessment of water resources, investigations and research will be carried out on a national scale.
Technology features	
Capital costs	75,000 EUR
Operating costs and management (O&M)	Operation and maintenance costs are reduced to the salary of scientific researchers who will carry out the activities of synthesizing the processed information, the personnel responsible for data collection, analysis and processing. In principle, EUR 75 thousand (approximately) will be spent every five years.
Safety , reliability	The updated data will be official, correct and recommended to be used for all needs.
Availability and Maturity	Access to the results obtained as a result of the application of the technology will be free. The summary information will serve as official sources for use in hydrological calculations, regulations and policy development.
Country specific applicability	
Institutional capacity	The Institute of Ecology and Geography, the Faculty of Geography at UST, SHS, the "Apele Moldovei" Agency, AGRM, the Environment Agency and ANSP have competent staff to implement the technology and carry out the proposed research.
Scale of applicability	All the territory of the Republic of Moldova. In case of special needs, case studies can be carried out on smaller areas, but more detailed, with specific research objectives.
Time horizon - On term short / medium / long	Every 5 years.
Status of technology in the country	Technology is a priority for the country. The implementation of technologies requires knowledge of the most contemporary methodologies and international practices and will be based on their application in the conditions of the Republic of Moldova.
Acceptability for NATIVE	100% acceptability.
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps; - In implementing the technology, gender equality policies in the country and sector will be taken into account; In order to promote gender equality, the actions, activities, projects through which the technology will be implemented

	will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	Multiple, from increasing the informatization of the population to planning the sustainable management of water resources. Technology will be useful to and for design work.
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	Knowing the correct information and data about water resources can be used in all branches of the national economy and in all areas that have the least tangent with water resources.
Potential for knowledge exchange and consolidation CAPACITY	Technology primarily aims to strengthen the capacities of state institutions, public administration bodies at all levels and society as a whole. The results obtained will favor the understanding of climate change processes that are reflected in the water resources sector in the first place.
Potential for enabling environment for technology diffusion	The information and data obtained will serve as a benchmark for the analysis of water resources, and the calculation methodologies will be found in the normative acts and approved and published state documents.
Potential contribution to setting the regulatory and policy framework	The application of technologies will result in the development of normative documents, Management Plans, etc., and their use in policy development.
Economic benefits	
employment workforce	The creation of new jobs is not foreseen, only perhaps through the expansion of hydrological monitoring stations, where new observers can be hired.
investment	Other than those described are not expected.
Expenses publicly and private	I'm not.
Social benefits	
Income	It can offer significant savings to households and businesses, who will be able to plan their activity taking into account available water resources.
Learning	The population's understanding and awareness of the process of adaptation to climate change manifested by the correct assessment of available, real, ecological and natural water resources.
Health	Not directly, only indirectly, by making policies based on the data of the applied technology.
Developmental impacts, indirect benefits	
Environmental benefits	Knowing the real situation in the field of water resources will favor the development of the legal framework, policies, plans, which will ultimately aim to improve the environmental components, especially the aquatic ones.

General information	
Section	**WATER RESOURCES**
Category	**REDUCTION OF DAMAGE DUE TO WATER SHORTAGE**

The name technology	**IMPLEMENTATION OF WATER RETENTION AND CONSERVATION AGROTECHNIQUES**
Description summary of the option technology	Rainwater harvesting is based on the principle of depriving a sector of land of the amount of precipitation falling to it (small and unproductive) and allocating this amount of moisture to another sector of land. This increases the volume of water accessible to the second sector to the level required by the plants and thus offers the possibility of sustainable agriculture. For example, a territory with an area of 4 ha in a growing season receives 150 mm of rain. If we redirect 150 mm from 2 ha to the other half – the latter will receive 300 mm of rain. This volume of water is already enough to grow many agricultural plants. And if water is collected from 3 ha and directed to 1 ha - the latter will receive 450 mm from the neighboring lands and 150 mm of its own rain, so a total of 600 mm. With a correct distribution of water, the land can have sufficient moisture reserves for the cultivation of a wide spectrum of agricultural crops. Of course, in reality only part of the water can be collected easily and cheaply. Such an accumulation of rainwater is called water harvesting, which can be formulated as follows - "the process of accumulating precipitation by surface runoff and keeping it for efficient use". The collection of rainwater can occur naturally or through human intervention. Natural collection is observed after heavy torrential rains, which form runoff, which accumulates in small natural depressions and can be further used. Harvesting through human involvement involves organizing water runoff with its subsequent accumulation or redirection (or both) for use in the intended sector. Taking into account the fact that collecting water is a very old tradition, which has been applied for thousands of years in most arid areas of the Globe, many different methods and procedures have been developed to collect it. Most of them are intended for irrigation, a part - for water supply to people and animals. The same methods in different regions of the Earth bear different names and vice versa - methods with the same name in practice are absolutely different. Water collection methods are mainly classified according to the form of water use or storage, but most often – according to the receiving surface.  Agrotechnical rainwater harvesting systems deserve a wider use in the territory of the country, especially in non-irrigated lands. Their application will reduce the risk of the crop in drought conditions. They can also be applied on large agricultural lands. The analysis and detailed description of the technology is carried out in the publication placed on the following link: http://www.ucipifad.md/wp-content/uploads/2020/07/Collectare-apei-de-ploaie-in-agricultura-pentru-adaptarea-la-schimbarile-climatice.pdf

Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
Priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood risk management (Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation).
Priority climate of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring flood risk management by implementing appropriate measures. Development of an integrated action plan to prevent and reduce the consequences of droughts, mentioned in the National Determined Contribution, 2020.
Adaptation needs . How does it contribute? adaptation technology	The technology is geared towards increasing surface water resources and is particularly geared towards the agricultural sector, as water will be collected and retained on agricultural land, and the retained moisture will favor increased crop yields. The adaptation consists in the application of rainwater saving procedures in the conditions of agricultural land without irrigation.
Implementation assumptions and scale of applicability	A pilot project will be launched on agricultural lands in different agroclimatic regions . Then the activities will expand throughout the country.
Technology features	
Capital costs	2 million EUR
Operating costs and management (O&M)	The initial costs for setting up an agricultural land with agrotechnical systems is not excessively expensive, it can be organized with the application of the usual agricultural technique or even with the application of manual work. They may be comparable to the usual agricultural tillage costs. If plowing and cultivating costs about 250-300 EUR per hectare, the cost of additional work to implement the technology will be additional by about 100 per hectare. Maintenance costs will be much lower and can be 20-30 Euros per hectare.
Safety , reliability	During the Soviet period, agrotechnical measures were widely applied in agriculture. The technology is safe and allows considerable savings of water resources, especially in the soil.
Availability and Maturity	The proposed technology has been applied for thousands of years in Mediterranean countries . The accumulated experience proves the maturity of the technology.
Country specific applicability	
Institutional capacity	The Republic of Moldova has sufficient experience accumulated by the Institute of Pedology, the Agricultural University and MADRM.
Scale of applicability	In the Republic of Moldova there are 1 million 827.3 thousand ha of agricultural land. We believe that the application of technology can be reasonable on about 2/3 or ½ of them.
Time horizon - On term short / medium / long	The duration of the objectives is a function of the coverage area. For the whole country, the application of the technology can be in the medium term, for pilot projects - in the short term. As a whole, the application of technology has no time limit.
Status of technology in the country	Technology is a priority for the country. The implementation of technologies is based on the implementation of practices from the countries of the Mediterranean region and the rehabilitation of the respective agrotechnical measures still applied during the Soviet period.
Acceptability for NATIVE	100% acceptability.
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps;

	- In implementing the technology, gender equality policies in the country and sector will be taken into account; - In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	The potential of the technology is great because it can be applied not only to agricultural land, but as a principle for accumulating water resources on other lands as well, including in urban and rural areas.
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	It will be applied on land that has slopes from 3^{0} to the steepest slopes. In non-slope regions the return on technology is lower.
Potential for knowledge exchange and consolidation CAPACITY	The technology aims to strengthen the capacities of farmers to adapt to hydrological risk phenomena (droughts) under climate change conditions.
Potential for enabling environment for technology diffusion	The retention of moisture in the upper layer of the soil favors the overall increase in moisture and has a beneficial effect on the environment.
Potential contribution to setting the regulatory and policy framework	Only in the case of subsidizing farmers who will apply these technologies, or obliging them through dedicated normative acts.
Economic benefits	
employment workforce	The realization of additional agrotechnical works will also require the use of additional manpower .
investment	Only financial, for the additional processing of agricultural land. Then there will be maintenance costs.
Expenses publicly and private	Public expenses can only be for the application of these technologies on public lands. Otherwise the farmers will bear the additional expenses, but over time they will become a common practice for the country's territory.
Social benefits	
Income	It can provide significant savings to households and farmers by providing additional moisture to an agricultural plot in the absence of irrigation.
Learning	The population's understanding and awareness of the process of adapting to climate change manifested by increasing resistance to frequent droughts.
Health	-
Developmental impacts, indirect benefits	
Environmental benefits	Indirectly it will increase the capacity to increase the surface runoff and increase the runoff of the rivers, because the runoff is higher from the lands with wetter soil.

General information	
Section	**WATER RESOURCES**
Category	**REDUCTION OF DAMAGE DUE TO WATER SHORTAGE**
The name technology	**IMPLEMENTATION OF WATER COLLECTION TECHNOLOGIES FROM ROOFS**
Description summary of the technology option	It should be noted that, however insufficient the surface water resources may be, water from the river or lake cannot be brought to the plant or house without a minimum infrastructure. This infrastructure implies a certain price for water, which is often unacceptable for the user. An eloquent example can be agriculture without irrigation in the Dniester meadow at a distance of several hundred meters from the river in the absence of the respective infrastructure, or vice versa - farmers and peasants give up water because of the price of transporting it from the river to the plant. Rainwater collection systems are one of the radical ways to reduce water costs in the summer, when watering agricultural land is a strictly necessary activity and you have to pay for the water used. It should be noted that rainwater is clean and soft, which is favorable for plants. Free rainwater can be used not only for watering plants – it can also be used in the home heating system, as well as for other technical requirements in the household. By setting up an autonomous water collection system, installing an accumulation tank equipped with a pump – the collected rainwater can be used further. And contemporary filtration and treatment systems can facilitate the use of these rainwater reserves even for power supply, turning them into drinking water. The use of rainwater in private households in the presence of centralized water supply systems can be a considerable financial support by reducing water consumption and paying lower bills. Households with their own wells, which will use rainwater, will reduce the pressure on underground water reserves, especially groundwater, which are also very vulnerable to climate change. For the Republic of Moldova, such rationalization of private households in the field of water resource use can favor the successful crossing of the dry months, without additional expenses for water. The experience in the collection of rainwater resources in the European Community is guided by directives 91/271/EEC and 2000/60/EC, which resulted in a series of specialized normative acts. The European legal framework has favored the wide spread of urban and rural rainwater harvesting and reuse systems. Rainwater harvesting systems can vary in difficulty from the simplest to sophisticated automated systems. Simple rainwater collection systems are more related to sanitation facilities, since all the outlets from the roofs are connected by pipes (through which the water flows by gravity) to the water tanks. Simple contemporary systems, in principle, do not differ from those of antiquity. It is not strictly necessary to purchase a ready-made system (even though there are many companies that propose this). A small but easy-to-use system can be built independently . The main meaning of a roof rainwater collection system is that the rainwater runs off the roof, passes through the downspout system and is partially or completely directed to the storage tanks. The water from these tanks is used for various purposes – watering, washing dishes and clothes, cleaning, bathing. Depending on the "area" of rainwater use, it can be used "as it was collected", for example for watering plants, etc., or after a prior filtration or even treatment. The number and destination of these stages of water purification already depends on the specifics of its further use. Again, an additional source of water can be useful in case of failures in the centralized water supply system (or poor quality water supply) or very low flow from the household well, etc. Sometimes it can even become the main source of water in the household. For these reasons, it is recommended to equip the system with several storage tanks - for different uses.
Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing

	incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
Priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood risk management (Environmental Strategy for the years 2014-2023 and the Action Plan for its implementation).
Priority climate of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring drought risk management through the implementation of appropriate measures. Development of an integrated action plan to prevent and reduce the consequences of droughts, mentioned in the National Determined Contribution, 2020.
Adaptation needs . How does it contribute? adaptation technology	The reduction of surface water resources conditioned especially by the increase in temperatures and dictated by the increase in evaporation during the warm period of the year requires the search for new sources and technologies in water supply. One adaptation measure is rooftop rainwater harvesting technology, which can provide additional water sources. It should be noted that the intensity of precipitation is currently slightly increasing, as is the amount of annual precipitation.
Implementation assumptions and scale of applicability	Already many private households apply the technology but in country proportions – the technology is not yet applied. It is proposed to start with a few pilot projects, located in the north, center and south of the country, at the level of rural localities, then to be expanded throughout the country.
Technology features	
Capital costs	EUR 5 million at the country level.
Operating costs and management (O&M)	In the simplest version – collecting water from downspouts in a tank – the cost is very low, just under 100-200 EUR for a country house. But depending on the sophistication of the system and the volumes of water collected – it can reach 1500-2000 EUR for the system. Maintenance costs for sophisticated systems can also be considerable (tank cleaning, pump repairs and servicing, water treatment, etc.). At the most approximate valuation they can reach 100-500 EUR per year, depending on the system.
Safety , reliability	Maximum safety and reliability.
Availability and Maturity	The technology has been known since ancient times. The components for assembling the system are on the market of the country.
Country specific applicability	
Institutional capacity	In the Republic of Moldova there are companies specialized in the installation and arrangement of rainwater collection systems according to the head-tail principle.
Scale of applicability	All localities in the Republic of Moldova (60 cities and 1614 communes and villages).
Time horizon - On term short / medium / long	The duration of the technology implementation depends on the coverage area. The implementation of technologies has no time limit, because urban and rural spaces are constantly expanding. It is recommended to be implemented in the nearest period of time.
Status of technology in the country	Technology is a priority for the country. It does not need to be imported as a working principle. Only some parts of the system will be imported, which may be different depending on the degree of sophistication (pumps, tanks, filters, etc.).
Acceptability for NATIVE	100% acceptability.
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps;

	- In implementing the technology, gender equality policies in the country and sector will be taken into account; - In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	The market potential is relatively high because there are very few houses equipped with rainwater collection systems and even fewer – with sophisticated systems.
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	The technology can be applied not only to households, but to all edifices (constructions) that have a roof. The use of the volume of rainwater collected can be diverse: technical purposes, for watering (irrigation), sanitation, drinking, etc...
Potential for knowledge exchange and consolidation CAPACITY	It is enough to implement a pilot project, where the subsequent calculations of the volumes of water saved, in other words the profitability of the system, will be made, then to advertise and exchange experience, etc. This will increase the community's ability to cope with climate change.
Potential for enabling environment for technology diffusion	The use of rainwater as a consequence will reduce the use of water from other sources (rivers, underground water), thus creating premises for increasing water resources in the country.
Potential contribution to setting the regulatory and policy framework	It is necessary to develop normative acts, which would stimulate the collection of water from the roofs and reduce the volumes of water discharged into the rainwater collection networks.
Economic benefits	
employment workforce	When implementing technology, new jobs are created. Workers will be needed to install and service the systems. It is possible that companies will appear, which will also produce the components of the systems on site, in the Republic of Moldova.
investment	Investments are required to install the system. It will also be possible to invest in the creation of companies that will produce systems or its components.
Expenses publicly and private	Public expenses will be less - only for the fitting out of the respective buildings. The largest expenses will be borne by the private sector.
Social benefits	
Income	In the future, water consumption from water supply networks will be reduced. Households in the medium and long term will save money based on the use of collected water.
Learning	Understanding that technology can be an individual tool for climate change adaptation.
Health	Neutral.
Developmental impacts, indirect benefits	
Environmental benefits	The environment will gain from two aspects:

	- Indirectly it will increase the volume of surface and underground water resources (by reducing their consumption at the expense of polluted water); - Surface runoff from localities will decrease, so the volume of polluted water transported to the river will decrease. This will improve the quality of the water in the river.

General information	
Section	**WATER RESOURCES**
Category	**REDUCING LOSSES FROM DECLINED WATER QUALITY AND RESTORATION OF ECOSYSTEMS**
The name technology	**REHABILITATION OF NATURAL COURSES OF SMALL RIVERS**
Description summary of the technology option	The technology provides for the restoration of water flow through the natural beds of small rivers. Many segments of natural beds were canalized, barred and dammed in the 50-70s of the century. 20th Now (on the segments where possible) their rehabilitation is proposed. The extensive agriculture applied on the territory of the country starting from the period of collectivization and until the 70s of the last century resulted in the intensive exploitation of the lands in the meadows of the small rivers. Obviously, this capitalization resulted in certain hydromorphological transformations of the small riverbeds, of which the most aggressive for the environment were the damming of the beds, their damming and the canalization of the small rivers. The impact of these environmental changes may not be felt immediately, but now, especially in the conditions of climate change resulting in the drying of the climate and the reduction of water resources, their contribution to the degradation of small watercourses is obvious. Their role in the aridification of wetlands is indisputable. One of the most eloquent examples can be the degradation of the Camenca river in its lower course in the Prut meadow, on the territory of the Pădurea Domnească reserve. The river, in its middle course, from Căzăneşti to Orhei is completely channelized and dammed. Cula, Ichel , Bâc, Botna , Cogâlnic, have not preserved anything from its natural bed, respectively, and the flow regime is totally distorted. The proposed technology represents a complex of measures aimed at the naturalization of rivers, on the segments where in principle it is possible. Here can be attributed the demolition of dykes and dams, the clogging of canals, etc. Flowing water alone will continue to do its work by forming new natural beds or finding its way through old sloughs and beds where they have been preserved. The proposed technology will have an effect not immediately but in the medium and long term, which will result in increasing the humidity of the land (in the given case of the river meadow), which in itself represents a measure, a process of adaptation to climate change. But the biggest advantage in their application is the restoration of meadow ecosystems.
Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030

Priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood and drought risk management (Environmental Strategy for the years 2014-2023 and Action Plan for its implementation).
Priority climate of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring flood and drought risk management by implementing appropriate measures. Development of an integrated action plan to prevent and reduce the consequences of floods and droughts, mentioned in the National Determined Contribution, 2020.
Adaptation needs . How does it contribute? adaptation technology	If we were to absolutize then we can say that there are no small rivers in the Republic of Moldova. With some exceptions there are only the worst quality water drains, degraded. In the conditions of climate change, one of the urgent measures to adapt to them would be the rehabilitation of their natural flow. In line with compliance with the legal framework related to riparian protection strips, this would greatly influence the improvement of the ecological condition of the lands related to the river, and the increase of natural drainage. Anthropogenic impact currently reduces runoff by up to 15%. The application of rehabilitation technologies, naturalization of small watercourses is a stringent adaptation measure, which must be implemented immediately.
Implementation assumptions and scale of applicability	catchment basin or sub-basin will be launched . In principle, all sectors where the technology can be applied will be identified. Ideally, all canalized bed sectors should be rehabilitated.
Technology features	
Capital costs	EUR 10 million (three pilot projects)
Operating costs and management (O&M)	The investment costs are very high, enormous, because in most cases hydrotechnical works, excavation, for example, will be carried out. Operation and maintenance will not require large expenses, as the main goal is to reduce human impact on the river.
Safety , reliability	Any activity of rehabilitation of natural objects is safe and reliable, only the result will not be felt immediately.
Availability and Maturity	The technology is mature, widely applied in the countries of the world, especially in the states of Western Europe.
Country specific applicability	
Institutional capacity	The Republic of Moldova has sufficient institutional capacity to implement the technology, especially the "Waters of Moldova" Agency responsible for the management of the water bed.
Scale of applicability	Obviously you cannot rehabilitate from scratch what was destroyed decades in a row. For these reasons, initially the technology will be implemented on pilot projects in priority areas. The same basin of the Camenca river in the lower course. It is preferable for the rehabilitated sectors to be located in the north, center and south of the country. Following the lessons learned, the technology can be extended to all sectors with hydromorphologically regularized discharge .
Time horizon - On term short / medium / long	Medium and long. There will be no immediate result from the application of technology.
Status of technology in the country	It does not require any technology transfer, just to take into account the similar experience in the European states. Of the success stories (or failures).
Acceptability for NATIVE	Debatable subject. Rehabilitation of the natural flow of small rivers will affect privately owned lands. It will take multiple discussions, persuasions, compensations, etc. Some changes in the legal framework will also need to be made. Traditionally the native population resists any changes that affect their property.
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps;

	- In implementing the technology, gender equality policies in the country and sector will be taken into account; - In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	It will gain environmental quality in the medium and long term, but immediately the interests of landowners in the area of technology implementation will be affected.
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	As mentioned, after the implementation of the pilot projects, studies will be carried out for which regions the technology can be replicated.
Potential for knowledge exchange and consolidation CAPACITY	Following the successful implementation of the pilot projects, a well-argued publicity campaign will be carried out in which the beneficial impact of rehabilitating small river beds will be demonstrated. Lessons and knowledge learned will be applied to other areas of technology application.
Potential for enabling environment for technology diffusion	The potential is enormous, because anything renaturalized has a beneficial effect on the environment, on the quality of ecosystems.
Potential contribution to setting the regulatory and policy framework	Here it will not be a contribution, but the opposite – a request to change the legal framework, in order to apply the technology. Instead, policies will change to implement the technology on a large scale, throughout the country.
Economic benefits	
employment workforce	Jobs will be created only for the period of hydrotechnical works.
investment	The initial investments will be considerable, difficult to estimate, depending on the volume of hydrotechnical works needed to be carried out, for which work projects must be carried out, which in turn are still not cheap .
Expenses publicly and private	The expenses of the public sector will also be high, because all the riverbeds are located on the ground of the water bed, which is managed either by APL or by APC (Apele Moldovei Agency). Practically unachievable without the support of external donors, taking into account the budget of these structures.
Social benefits	
Income	The income is difficult to estimate, only indirectly, on account of the improvement of the state of the environment or on account of the increase of local water resources.
Learning	The population's understanding and awareness of the process of adapting to climate change manifested by improving the quality of the environment.
Health	Surely the improvement of the indirect environment will also lead to the improvement of the indicators that influence human health.
Developmental impacts, indirect benefits	
Environmental benefits	Huge. As already mentioned, the rehabilitation of natural riverbeds and riparian ecosystems has a beneficial impact on the quality of the environment.

General information	
Section	**WATER RESOURCES**
Category	**REDUCING LOSSES FROM DECLINED WATER QUALITY AND RESTORATION OF ECOSYSTEMS**
The name technology	**RESTORATION OF FORESTS, MEADOWS AND WATERCOURSE WETLANDS**
Description summary of the technology option	The technology provides for the application of afforestation and reforestation practices in the sectors related to rivers. In the places where it is possible, it is planned to restore the groves and meadows. The proposed technology, in part, represents a continuation or merger with the technology of rehabilitating the beds of small rivers, but that it focuses more on the naturalization, rehabilitation of the lands related to the rivers and the reception basin. The technology is classic. In the case of afforestation or restoration of forests on the slopes, the activity is oriented more towards deforested areas, or areas with less favorable land to be used in agriculture. The forested massifs will favor the overall increase of moisture in the catchment basin, the natural regularization of the runoff on the slope, reducing floods and high waters on the one hand, and the increase of surface runoff in periods of low water (with low water). Weeding and afforestation of the meadows has the same effect, but will clash with the resistance of the local people, who take land in the meadow of the small rivers. Both developments will favor the restoration of wetlands. It should be noted that special attention must be drawn both to the agrotechnical measures carried out and to the species of trees, shrubs and herbs that will be planted, because in the conditions of climate change they must be resistant to droughts and reach the mature phase of development as quickly as possible.
Priority developing country sociable	According to the Moldova 2030 National Development Strategy, the social development objectives in the Republic of Moldova are in accordance with the SDG-Agenda 2030, namely: eliminating poverty in all its forms by increasing incomes, reducing unemployment by providing jobs for 60% of the population, ensuring a literacy level for at least 95% of the population
Priority developing country economic	The national development strategy "Moldova 2030" foresees an annual economic growth of at least 5%, with a GDP growth level of 7% by 2030
Priority the country 's environmental development	In the National Development Strategy "Moldova 2030" it is indicated: Healthy environment: ensuring the fundamental right to a healthy and safe environment. Ensuring flood and drought risk management (Environmental Strategy for the years 2014-2023 and Action Plan for its implementation).
Priority climate of the country	The reduction of greenhouse gas emissions and the implementation of measures to adapt to climate change are established as a national priority. Ensuring flood risk management by implementing appropriate measures. Development of an integrated action plan to prevent and reduce the consequences of floods and droughts, mentioned in the National Determined Contribution, 2020.
Adaptation needs . How does it contribute? adaptation technology	The territory of the Republic of Moldova is under the increased pressure of desertification. One of the technologies that will allow adaptation to climate change, aimed at reducing the intensification of the desertification process, is the "greening" of the territory, focused on the application of natural processes to increase the humidity of the territory.
Implementation assumptions and scale of applicability	There is no need to implement pilot projects, because the technology is well known and already applied in the Republic of Moldova. A massive "greening" campaign will be launched throughout the country. Will work closely with APL and APC.

Technology features	
Capital costs	EUR 3 million for the whole country
Operating costs and management (O&M)	Maintenance costs, especially in the first phase of tree development, can reach EUR 500 thousand and are focused more on the protection of "green" lands. In the future, maintenance expenses will be reduced, but still focused on land protection.
Safety , reliability	The proposed technology is safe and reliable.
Availability and Maturity	The technology is mature and tested in many regions of the country, Most recently within the SDC-ADA project " Strengthening the Institutional Framework in the Water and Sanitation Sector Project" NGOs in the country have afforested land sectors related to small rivers.
Country specific applicability	
Institutional capacity	Moldsilva agency has the experience and tools to implement the project through its territorial subdivisions
Scale of applicability	About 1500 km^2 or 4.4% of the country's territory. This includes areas in the river meadows (without urban areas) and sectors on the slopes, which could potentially be forested.
Time horizon - On term short / medium / long	Medium and long term.
Status of technology in the country	Technology is a priority for the country. Its import is not necessary, because the afforestation and forestation procedures are already applied and known in the Republic of Moldova.
Acceptability for NATIVE	Debatable subject. There may be resistance from natives for objective and subjective reasons.
The impact on the gender .	- In the implementation of the technology, both gender equity will be respected, ensuring equal access to water resources (technology) of women and men, as well as gender equality, addressing the identified gender deficiencies and gaps; - In implementing the technology, gender equality policies in the country and sector will be taken into account; - In order to promote gender equality, the actions, activities, projects through which the technology will be implemented will have an Action Plan regarding gender equality, thus ensuring the gender-sensitive implementation of the given technology;
He has this one technology the potential to approach gender inequalities ? How can contribute to the achievement gender equality ? Which is EXTENT expect A the impact ?	- If necessary, the assessment of the needs of the potential beneficiaries of the technology from a gender perspective will be carried out with data analysis; - During the implementation of the technology attention will be drawn to the balanced participation of women and men in the associated activities; - The gender balance of technology beneficiaries will be respected, especially in the case of rural communities, and the benefits of the project/activities will be monitored based on indicators disaggregated by gender; - In the implementation of actions, activities, technology implementation projects, the empowerment of women, young people, especially in rural communities, will be pursued. Dedicated modules will be developed for the empowerment of women, young people, vulnerable groups in the implementation of activities related to the assimilation of technology.
Other features specific country related to technology (such as POTENTIAL market)	Multiple, from increasing runoff and protecting riverbeds and lake basins, from increasing biomass and wood production, to creating jobs, recreation and ecological services.
The potential for a paradigm shift	
Extensibility , replicability and APPLICATION	It will be carried out throughout the country.
Potential for knowledge exchange and consolidation CAPACITY	The involvement of LPAs will foster knowledge sharing and community capacity building.

Potential for enabling environment for technology diffusion	New agrotechnical planting technologies will be applied.
Potential contribution to setting the regulatory and policy framework	The major contribution consists in the support for the establishment and updating of the legal framework in the use of land in the river meadows, on the land of the water bed. It will favor the modification of the legal framework in the field of insurance.
Economic benefits	
employment workforce	New jobs will be created necessary to carry out the planting activities.
investment	Safe areas will be identified from the point of view of the possibility of applying the technology where economic investments can be made and ensure their security.
Expenses publicly and private	In the medium and long term, the costs of flood risk reduction will be reduced. Minimal expenditures will be required from the APL budgets, but the investments of external donors will be heavily relied upon.
Social benefits	
Income	The income can be indirect – from reducing the risk of flooding to enhancing the quality of ecosystem services.
Learning	The population's understanding and awareness of the process of adapting to climate change manifested by "greening the land" and rehabilitating natural ecosystems.
Health	Surely the improvement of the indirect environment will also lead to the improvement of the indicators that influence human health.
Developmental impacts, indirect benefits	
Environmental benefits	The impact will be felt by increasing the areas covered with vegetation (especially trees), which will reduce surface runoff, increase soil infiltration and contribute to increased humidity in wetlands. The major benefit consists in increasing the humidity during the summer period, increasing the moisture resources in the soil. It will increase the quality of the state of meadow ecosystems, maintain and increase biodiversity. The expanded areas will be a supplement to the expansion of the recreation areas.

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BARRIER ANALYSIS and ENABLING ENVIRONMENT REPORT/ BAEF(2)

REPORT II BAEF of Water Resources

Executive Summary

This report is a logical continuation of report I from the project NAP-2: Advancing Moldova's National Climate Change Adaptation Planning Project, dedicated to the identification of barriers and measures to overcome them. In Report I, the following priority technologies were identified:

1. Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions.

2. Improving the sustainable management of water resources by applying the water management balance sheet.

3. Optimization of number of reservoirs based on hydrological indicators..

For the identified technologies, the barriers and measures to overcome them are to be identified, presented below.

Improving monitoring and forecasting of runoff, water quality, and effective information sharing between various institutions. The technology provides for the optimization of the hydrological observation network, the adaptation of the methodologies to EU requirements and the implementation of new technologies for making forecasts, bulletins and hydrological alerts of different duration. The focus will be on the automation of hydrological monitoring stations and the application of digital models in the development of hydrological forecasts. Contemporary flashflood forecasting systems will be applied by applying contemporary techniques (especially radar data), something that has not been done in the Republic of Moldova until now.

The operational exchange mechanism with the data collected between the branch institutions will be developed. Even if the State Water Cadastre Automated Information System is already implemented, it does not provide for the operative updating of the information. He relies more on average data and indicators. It is proposed to develop and implement an operational data exchange mechanism between institutions related to the monitoring and management of water resources. The development and dissemination of forecasts, bulletins and hydrological alerts, water quality is considered.

The hydrological observation stations will be modernized by equipping them with constructions and contemporary monitoring equipment. Currently, only the stations on the Dniester and Prut rivers, as well as a few internal rivers, are equipped with contemporary equipment. Along with the total automation of the hydrological observation network, the classic equipment, necessary for calibrating the automatic stations, will also be modernized.

Automated hydrochemical stations are extremely expensive to operate and will be replaced by mobile sampling laboratories.
Improving the sustainable management of water resources by applying the water balance sheet. The water management balance, in general, represents the ratio between the intake and

consumption of water resources on some part of the earth's surface, with the evidence of human management activity. By intake of water resources, we mean the runoff of surface and underground waters, consisting of atmospheric precipitation, wastewater from sewage systems, filtered water from irrigated lands, as well as water transported from other reception basins. By consumption of water resources, we mean evaporation from the surface of the catchment basin, capture of water for different uses, transport of water to other catchment basins. The water management balance sheet creates a clear picture of the provision of water resources of a territory, allows the highlighting of the water deficit and the adoption of decisions on the implementation of measures to compensate for the formed deficit.

All the methods and procedures for calculating the water management balance for basins, reception basins and water management sectors must be stipulated in the legal framework of the branch. In accordance with the respective normative acts, the water balance materials will contain data and information about the water resources available for use for different purposes.

Optimization of number of reservoirs based on hydrological indicators.. The technology is completely new for the Republic of Moldova. The methodology for identifying the reservoirs intended for liquidation has already been developed. In its essence, multi-criteria analysis identifies the lake that no longer fulfills the function for which it was built. For example, it has become clogged, or is completely covered with swamp vegetation, etc. It is approved by the "Apele Moldovei" Agency and MADRM. The legal basis and procedural mechanisms are to be prepared.

Damping off a small (or even ephemeral) stream of water fed by shallow surface runoff or the few underground sources and being clogged, this pond represents an additional surface for water evaporation. It is known that in arid climate conditions with a shortage of water resources, reservoirs and ponds considerably reduce the flow of rivers. In other words, they directly favor the destruction of rivers both as a water course and as an ecosystem. From the surface of the small, clogged ponds, the collected water is only lost to intensive evaporation, in the conditions of climate change, in the conditions of increasing temperatures in the summer months.

Chapter 1. Water resources sector

1.1 Preliminary targets for technology transfer and diffusion

Improving monitoring and forecasting of runoff, water quality, and effective information sharing between various institutions. The main purpose of the technology is to improve the provision of hydrological information (which includes quantitative and qualitative components) to state structures, academia and civil society. The term "improvement" here must be viewed radically, because the goal is to fully automate the hydrological monitoring network and the flow of collected data, implement digital forecasting systems and facilitate access to data and information necessary for decision-making. Obviously, these activities are carried out at SHS and, therefore, their implementation will even result in the restructuring of the institution's activities or its reorganization. The direct beneficiaries of the implementation of the technology will be the state institutions and the private sector. Indirect beneficiaries, the academic environment, educational institutions and civil society.

Refinement of leakage monitoring. The main activities and needs in the development of the technology will focus on the following:

1. Detailed design of the new network: While the network has already been reviewed, a more detailed assessment needs to be undertaken considering the following:

    a. The history of selected stations to be moved or not upgraded to automatic stations should be reviewed in detail. As mentioned, the selection of these stations was made in geographical terms only and could, therefore, be selected immediately upstream of the downstream station (in some cases).

    b. The access, relevance, reliability and infrastructure of these stations should also be analysed.

    c. Selection of new stations should also be carefully considered based on existing discharge, flood history and water management history.

These activities should be undertaken by a qualified international expert (or team of experts) in close collaboration with national experts and SHS collaborators:

2. Detailed site selection: Once a more detailed design of the new network has been carried out, the detailed selection of new sites should be carried out by a national or international expert in close cooperation with SHS experts. The WMO site selection recommendations should be considered in this regard.

3. New stations: The new stations (about 30 in number) should be purchased after the procurement specifications have been detailed by an international expert in close collaboration with SHS staff.

4. Installation: Installation of new stations should be carried out by the station supplier in close cooperation with SHS staff.

5. Operation and maintenance training: It would be recommended that the station supplier conduct a training of at least 20 days in the operation and maintenance of the stations.

Improving hydrological forecasting:

1. Design: The first activity required in implementation would be detailed system design, including all necessary assessments of data inputs, platform and software identification, and detailed system design.

2. Data Collection: Extensive data collection should be undertaken to ensure that sufficient data are available to implement the event mode hydrologic model. Other data should be collected for other implementation purposes.

3. Implementation of hydrologic modeling: The hydrologic model should be implemented in event mode for calibration and validation purposes. This model should be calibrated to different events, considering different types of disasters. The calibrated model will be the basis for the implementation of hydrological forecasts, but this model can also be used for risk purposes.

4. Implementation of the forecasting platform: The forecasting platform should be implemented in this activity. The implementation of the platform should be done in a dedicated server, where all software inputs and associated data should be collected. It should be noted that here are also included the modeling of water resources according to the projections of regional climate change scenarios.

5. Implementation of hydrological forecasts: the hydrological model previously implemented in phase three should be adjusted for forecasting purposes. It should be noted that an event-based model and an operational hydrological model differ in approach for some of the modules, and therefore the model should be adjusted to be in operational mode. The model should be tested in feedforward mode to increase confidence in the results of the forecasting platform.

6. Data inputs and data flow procedures: To ensure that all required data inputs and data flow procedures are implemented, a detailed document should be developed with all procedures and data inputs should be tested and data flows in detail to ensure that all data required for the forecasting platform is routinely available.

7. Platform Testing: The entire forecasting platform should be thoroughly tested to ensure its proper functioning. At the beginning of the implementation, the platform will be in test mode, and the results will be carefully analyzed to improve the efficiency and accuracy of the forecast.

8. Implementation of the forecasting and warning platform: as mentioned, the results of the forecasting platform will have many uses within the water sector, including water management, hydroelectric purposes and flood warning. In this activity, procedures for using outputs data from the platform will be designed, including warning thresholds and warning procedures, for example the color code system currently used at SHS (fig. 1.1).

Improving effective information sharing:

1. The content and presentation method for beneficiaries of the structure and content of hydrological bulletins and alerts will be reviewed.

2. The presentation of operative and forecast information on the SHS web page will be revised.

3. The list of publications of regime materials and summary of indicators monitored by SHS will be reviewed and updated.

Figure 1.1. Coding of dangerous hydrological phenomena

The approximate steps for carrying out the activities are presented in Table 1.1.

Table 1.1. Stages of activities (estimate)

Activity	Duration of achievement
Improving leakage monitoring	
The design of the new monitoring network	0.5 year
Selecting the location of the automatic station	1 year
Purchase of automatic stations	1 year
Installation and calibration of stations	1 year
Staff training	1 month
Improving hydrological forecasting	
Forecasting and warning system design	1 month

Data collection	1 month
Implementation of hydrological modeling	0.5 year
Implementation of the forecasting platform	0.5 year
Implementation of hydrological forecasts	0.5 year
Data Entry and Data Flow Procedures	0.5 year
Platform testing	3 months
Implementation of the platform	0.5 year
Improving effective information sharing	
Reviewing and approving the content of forecasts, bulletins and warnings	0.5 year
Review and approval of presentation	0.5 year
Reviewing and updating and approving the list of summary publications	0.5 year

Improving the sustainable management of water resources by applying the water balance sheet. The basic objective of the technology is **the creation and implementation of the water management balance sheet** as a support, as a tool, in the sustainable management of water resources in the Republic of Moldova. Obviously, the coverage area is for the whole country. The main beneficiaries are the central public administration bodies, institutions skilled in design (hydrotechnical, transport, communications, agricultural, regional development and of course water supply and sewage, etc.), and enterprises that use water resources. The major benefit of implementing the water balance sheet is the assessment of available water resources.

The water management balance is a support in planning the sustainable use of water resources and has the following goals:

- Planning the sustainable, scientifically justified use of water resources, in the conditions of climate change.

- Operational management of water resources.

- Identification of water management measures to meet the water supply needs of the population and businesses.

It should be noted that the water management balance should not be confused with the water balance, which serves as a tool for analyzing the natural and anthropogenic water cycle in order to:

- Evaluate available water resources.

- Evaluate the anthropogenic impact on available water resources.

- Disclose surface water formation legalities.

- Evaluate the ratio between moisture supply and consumption for a certain territory.

Thus, the water balance allows the determination of the volume of available water resources and their flow regime, and the water management balance uses these data as water intake.

The water management balance can be divided into:
GA **reporting balance.** Calculated from the data of the previous year and serving to analyze household activity, record direct water losses, and to provide options for saving water resources.

Operative GA balance. Intended for the operative management of hydrotechnical constructions and is calculated in the nearest time interval – year, semester, month, decade.

GA **planning balance.** Represents an intermediate link between the reporting and perspective period, one that allows the phased planning of the implementation of the goals of the perspective water management balance.

Perspective GA balance. Intended for the development of water resource use plans that will ensure the development of the national economy (considering climate change scenarios). It is calculated in time intervals of 5-20 years.

The approximate steps for carrying out the activities are presented in Table 1.2.

Table 1. 2. Stages of activities (estimate)

ACTIVITY	Duration of achievement
Development and implementation of WBS calculation software	0.5 year
Optimizing the legal framework for WBS calculation	1 year
Identification of the institution responsible for WBS	0.5 year
Identification of the subdivision responsible for WBS calculation	0.5 year
Training of personnel responsible for WBS calculation	2 months
Review and approval of the water use reporting mechanism (forms)	1 year
Creation of the integrated database (water intake and consumption)	2 years
Organization of the flow of data required for WBS calculation	1 year

Revision of the mechanism for issuing authorizations for special water use	0.5 year

Optimization of number of reservoirs based on hydrological indicators.. The main objective is **to reduce the runoff losses of small rivers** in the Republic of Moldova. In hydrology the notion is the reduction of surface runoff losses.

For a more successful example, in Figure 1.2 an assessment of the trends in the increase of evaporation from the surface of the country during the last 50 years is presented.

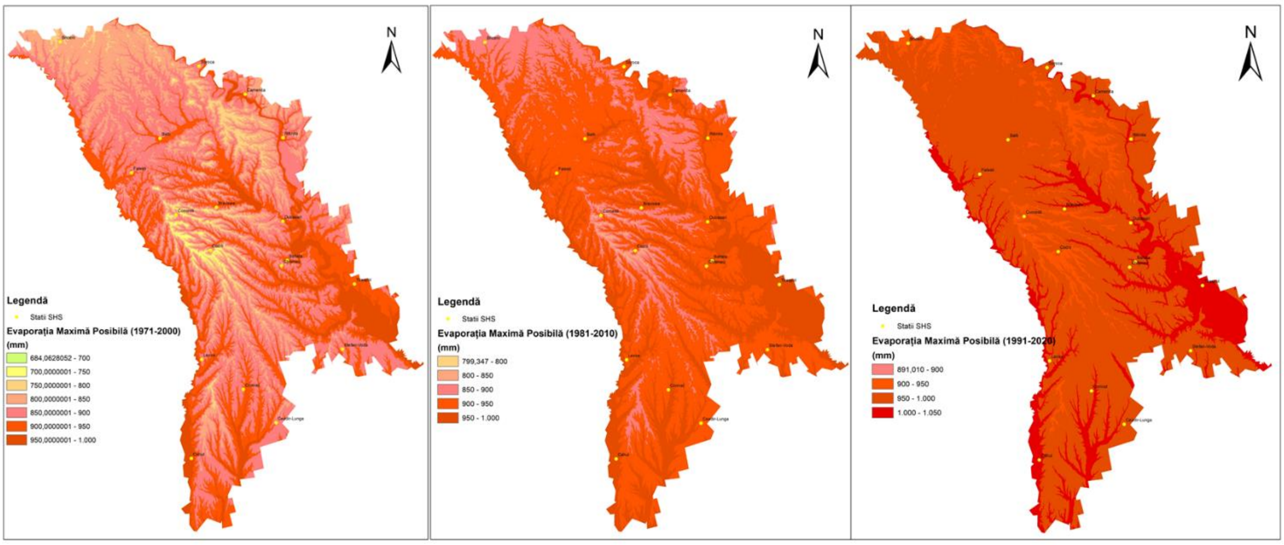

Figure 1.2. The trend of the change of evaporation in the Republic of Moldova presented for three time intervals – 1971-2000; 1981-2010 and 1991-2020

In the case of evaporation of 1000 mm, which has already become a reality, it is considered that from each square meter approx. 1m^3 of water can evaporate annually. The figure is enormous. To simplify – from the water surface of a small pond, with a surface of 100 m^2, 100m^3,of water can evaporate annually.

As a result of the increase in evaporation (due to the increase in temperatures), the surface runoff is also dramatically reduced, because enormous volumes of water evaporate from the surface of the water in reservoirs, fig. 1.3.

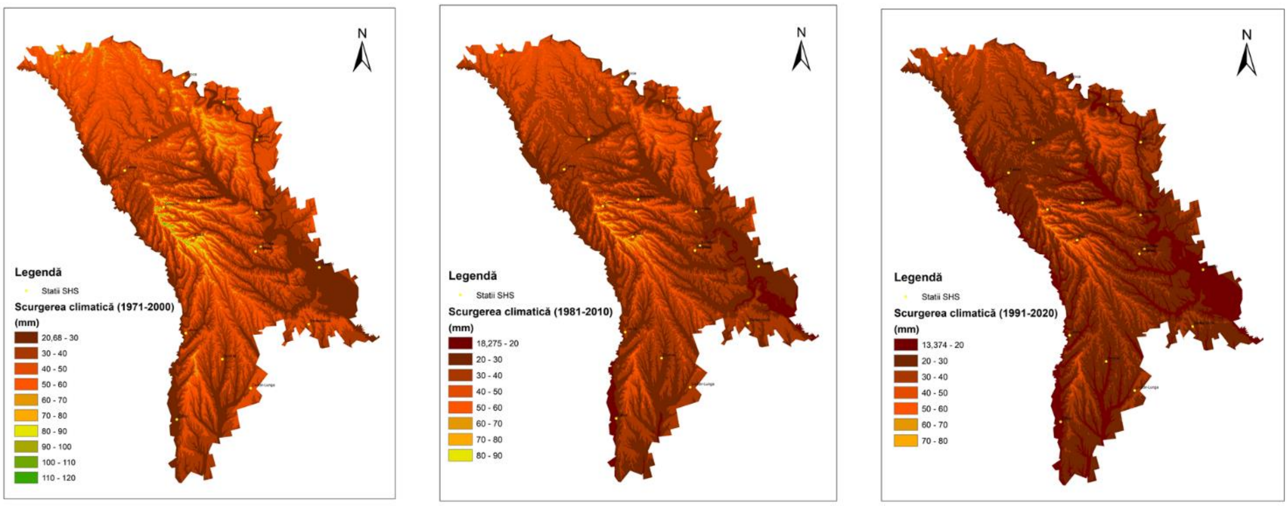

Figure 1.3. The trend of climate runoff change in the Republic of Moldova presented for three time intervals – 1971-2000; 1981-2010 and 1991-2020

It should be noted that on most of the small watercourses in the Republic of Moldova ponds are arranged. Many of them are built in river meadows. Many of them do not even have proper documents. Many do not fulfill the function for which they were built (Figure 1.4). However, all of them cause the evaporation of large volumes of water into the atmosphere.

Figure 1.4. Examples of small ponds that need to be liquidated

The proposed technology provides for the identification of reservoirs (ponds, ponds) that do not fulfill their function and serve only as a source of additional evaporation, and their liquidation.

Under the conditions of climate change, the frequency and severity of droughts in the Republic of Moldova is increasing. The proposed technology is an adaptation tool, which will increase the volume of water resources in the basins of small rivers by increasing (more correctly, restoring) the volume of the natural flow of small rivers.

A pilot project will be launched focusing on a catchment basin or sub-basin from an administrative district or development region. Then the activities will expand throughout the country. Normative acts will be developed for the possibility of application throughout the country.

The approximate steps for carrying out the activities are presented in Table 1.3.

Table 1.3. Stages of activities (estimate)

ACTIVITY	Duration of achievement
Adjusting the legal framework	1 year
Identification of the responsible institution	0.5 year
Development and implementation of verification and control procedures	1 year
Testing and implementation of lake identification methodology	1 year
Liquidation of identified lakes	2 years
Elaboration of recommendations regarding the use of land after the liquidation of the lakes	1 year
Land utilization after liquidation of the lakes	5 years
Evaluation of the change in runoff after liquidation of the lakes	0.5 year

1.2 Barrier analysis and possible enabling measures for technology *Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions*

1.2.1 General description of technology

Improving leakage monitoring

Currently there are 53 hydrological stations in Moldova, of which:

- 33 are classic stations.
- 14 have classic and automatic functions.
- 16 are automatic.

From the total number of hydrometric stations listed, 41 are managed by the SHS of the Republic of Moldova, and 12 are subordinated to the Tiraspol Hydrometeorological Center.

However, there is cooperation between the hydrometeorological services on both banks of the Dniester, based on partnership relations.

It should be noted that, based on these agreements, the data observed by the hydrometric stations on the west bank of the Dniester are included in the information circuit of the SHS of the Republic of Moldova. The reverse flow of data (or what happens to it) on the east bank is not known with certainty.

It should be noted that a total of 30 stations have automatic data communication capabilities. It should also be added that automatic stations should be favored and that classic stations are not particularly useful for modern hydrological services, especially regarding flood forecasting.

From the sensor point of view, of the 53 stations:

- 16 stations are Radar Level Sensor (OTT) stations.
- 12 stations are compact bubble sensor (OTT).
- 14 stations have both bubble sensors and radar level sensors (OTT).
- 5 stations have old sensors.

It can be concluded that both the measurement approach, the site location and the age of the sensors are within sensible limits and are suitable for the operation of a hydrological monitoring network.

One of the main problems with the hydrological monitoring network, however, is the maintenance, management and processing of the data.

The main gaps and needs in terms of hydrological monitoring are [1]:

- There are still several manual stations in Moldova, without telemetry procedures. Automation of all stations is recommended for hydrological forecasting and data management purposes.
- The density of stations in some areas is not adequate, while in other areas it is believed that so many stations are not needed. At SHS there are already preliminary investigations with the identification of these gaps.
- Network maintenance issues have been identified, leading to periods of no data from some stations. An O&M program should be developed.

The analysis of the location density of the hydrometric observation stations indicates a less positive situation from an operational point of view. However, from several stations considering the area of the country, the density of stations seems acceptable. The number of hydrological stations in Moldova is 53, which means that one station covers approximately 638km^2 (considering that the surface of the country is 33,846km^2).

This number is significantly higher than the value recommended by the WMO for hydrometeorological monitoring (1,875 km^2), but the water resources of the small rivers in the country require a higher density of observation stations.

However, the location of hydrological stations should be carefully considered. The basic criterion here is representativeness, i.e. the place chosen must be typical for the given region. It should be noted that the criteria for selecting the locations of the stations are described in specialized methodical instructions. Of the 53 stations, 38 are in the two main rivers (Dniester and Prut), while only 15 are in other watercourses. Some of them close to the mouths of rivers draining into these two watercourses. The Dniester and Prut rivers are highly regulated, there are numerous dams in their course, and there is also hydrological information (monitoring and forecasting) from the upstream countries of Moldova (Ukraine and Romania, respectively). Therefore, at this stage, it is not believed that many stations, 38, need to be in these two rivers and it would be advisable to move these stations to other watercourses in other areas of Moldova.

To further evaluate the upstream area per station, information was collected from the SHS. This information refers to the total area of the watershed served by a station, including the watershed served by other stations. While the station in the Danube River covers a significant area and there is no possibility for other stations to be in this river on the territory of Moldova, the hydrographic basin per station varies greatly in Moldova, obviously depending on the impact on this assessment that they have the two main rivers.

Therefore, a more detailed analysis was performed for all stations regarding the catchment area covered by that station. In this case, the catchment area between any particular station and the station immediately upstream was considered in the assessment. That is, the results of this exercise only show the area served by that station.

This will provide good information related to the proximity of some stations. It should be noted that this exercise was undertaken using GIS resources and that the watersheds defined by the GIS may differ from the real ones (depending on the accuracy of the DEM) (Figure 1.5, 1.6).

It should also be noted that structures such as dams were not considered in this assessment. In this evaluation, the hydrographic basin located outside the territory of Moldova was also considered, as is the case for many stations located in the Dniester and Prut rivers.

As can be seen, while there are some stations that serve a significant catchment area (such as Ungheni, Jeloboc, Leușeni or Tudora), other stations are very close to each other and, therefore, the downstream station does not record additional discharges from a significant hydrographic basin (such as Camenca, Sanatauca, Costesti or Braniste).

The case of the Tudora station, for example, seems to be inevitable, since there is a significant tributary coming between the Nezavertailovca-Rascaieti and the Tudora stations.

The Ungheni and Leuseni stations are in the Prut River, and even if the increase in catchment area in these stations is significant, since this is a larger river, the discharge changes are not expected to be very drastic.

The case of Jeloboc should be noted, since the station is in the middle of the country and serves a significant area.

At this stage, more stations in this area would be recommended.

An analysis of the discharges between some of these stations and the station immediately upstream will be undertaken in future activities of this consultation.

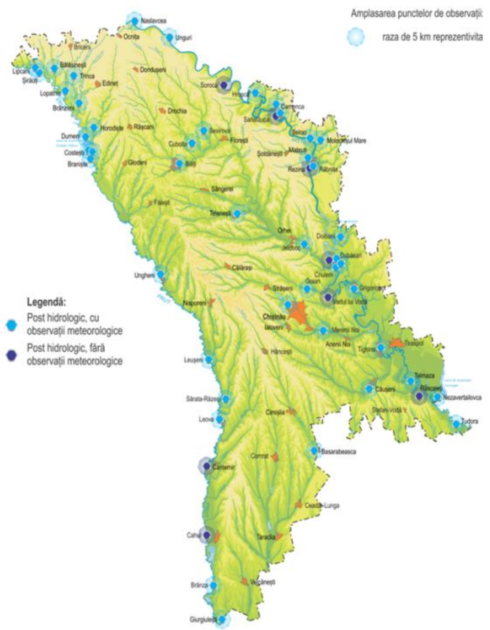

Figure 1.5. Distribution of hydrological stations and stations (current situation)

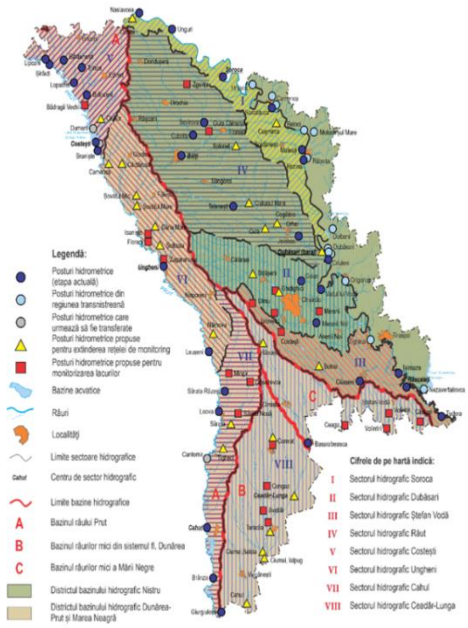

Figure 1.6. Distribution of proposed stations and stations for optimal ROH density coverage

Another important feature to analyze, to determine if all climatic and geophysical conditions are covered by the hydrological network, is the assessment of the distribution of hydrological stations/stations according to altitude. To address this, an assessment was made of the altitude distribution in Moldova and the number of stations on each of these altitude ranges.

As would be expected, especially considering that the altitude in Moldova varies from 0 to 450m, most of the stations are in the low area. Only 2 stations are located at 105m, most stations are below 50m.

While it is understandable (and recommended) that stations are in the lower part of catchments where more significant runoff occurs, it would also be advisable to monitor runoff from small catchments as well. The data for which is very useful in the assessment of flash floods.

Therefore, in summary and considering all the previously mentioned information, the density of the existing network is not sufficient to cover all the requested information and/or to provide observations in key areas for hydrological or climate service purposes. It is recommended to include 30 additional stations in the country within the hydrological monitoring network.

It should also be added that in the last 30 years, several observation posts have been closed for various reasons, including lack of funding, the opening of automated posts or lack of qualified personnel, or the unilateral decision of some bosses.

An example is studies conducted in the last 30 years, which were not considered.

It should also be noted that in the scientific hydrological research carried out in the country, the need to open new stations or the lack of data in one region or another is often emphasized. The importance of measuring high water and flash floods should be emphasized.

Improving hydrological forecasting
It is essential to implement hydrological models in SHS, especially for forecasting purposes, but also for risk and disaster management purposes. The implementation of hydrological forecasting models will increase the reliability of forecasting results, limit the time spent on daily forecasting and increase the possibility of automatic publication of hydrological forecasts. The system to be implemented should meet the following requirements:

- It should consider all hydrological monitoring data in real time and automatically.
- It should also consider additional data resources, both from remote sensing and from hydrological and hydraulic models.
- It will be based on open-source software.
- It should be easy to operate and analyze.
- It will be based on the implementation of previously calibrated models.
- It will provide daily hydrological forecasts and support the development of climate services.
- The system will be multifunctional. In addition to providing daily hydrological forecasts at predefined locations in Moldova, which can be used for water management purposes, the hydrological forecasts will be coupled with a climate database to also provide warnings associated with potential floods. It should be noted that the development of the SHS integrated database will also include the climate change segment. An IT platform focused on climate services will even be developed.

Although it is not intended to provide a detailed description of the requirements of a hydrological forecasting system and/or the design of the system itself, a brief description of the required components and the suggested approach will be presented within this document. It should be noted that more thorough documentation will be required during implementation to outline the design and conceptualization of the model.

It should also be noted that the forecasting system will be based on the following components, including the various data sources, hydrological modeling forecasting and output analysis. The hydrological forecasting system will be implemented at the national level, covering the entire territory of Moldova and considering local peculiarities during the calibration procedures. It should also be noted that, in the implementation phase, locations will be defined for modeling/forecasting the results, but that this could be adjusted, and the results could be produced anywhere in the country.

As for the various processes and input data, they are described below. However, to provide a better understanding, it should be noted that the meteorological input will be used by the hydrological forecast model to produce water discharge information at the previously mentioned predefined locations. The hydrological modeling approach and meteorological data variables to be considered in implementing the hydrological modeling will be defined during the calibration process, but at this stage it is expected that precipitation and temperature will be the main inputs.

Improving effective information sharing

Currently SHS provides hydrological forecasts, bulletins and alerts, which are sent to beneficiaries by e-mail or placed on the SHS web page. Regime data and information are not published in hydrological yearbooks or summary guides. The reason is simple: Lack of human and financial resources.

There is a limited exchange of operational and regime information with branch institutions. The practice of "Apele Moldovei" Agency, the Ministry of the Environment, the Civil Protection and Exceptional Situations Service, etc. indicates that, in addition to forecasts, warnings (which are issued according to the regulation to the indicated institutions by e-mail) and predetermined information bulletins, there is also the need for access to hydrological information for branch institutions depending on the need and on each case. The subject is resolved through official steps at SHS to provide or give access to the information in question.

Suggestions are in the form of:

1. Reviewing the structure and content of forecasts, alerts and bulletins developed and disseminated by SHS.

2. Elaboration of models of hydrological yearbooks and multi-year synthesis data, as well as their publication (on the website of the SHS and on paper – in limited edition, for internal use).

3. Modernization of the sections of the SHS web page by improving the presentation methods. Information presentation procedures will be used interactively, spatially and dynamically.

1.2.2. Identification of barriers for technology

Most of the existing barriers for three technologies (1. Improving the monitoring and forecasting of runoff, water quality and the effective exchange of information between various institutions; 2. Improving the sustainable management of water resources by applying the water management balance; 3. Liquidating the reservoirs that do not perform their functions and optimizing their number based on hydrological indicators) are common. Common barriers can be divided into the following categories:

- Economic and financial.

- Legislative and regulatory.

- Technical.

- Institutional.

Barriers were analyzed by building problem trees and defining the effects and links between them (Appendix 1).

Economic and financial barriers are common, as the implementation of new technologies requires significant investments. In our case, the problem is not so much economic, because the technology will not bring direct profit, rather financial, because it requires substantial investment. It should be noted that the state budget does not foresee investments for the given technology.

The legislative barrier includes the fact that legislation and normative acts are in constant reform, are not optimized and have large gaps.

There are a wide range of technical issues, both hardware and software related. The equipment is outdated, it no longer meets contemporary quality requirements, and the use of contemporary software is limited or even absent.

The institutional barrier consists in the chronic lack of qualified personnel, especially in the last decade.

Understanding common barriers can help address them to promote faster implementation of selected technologies.

1.2.2.1 Economic and financial barriers

Improving leakage monitoring

The instruments, machines and constructions for carrying out hydrological observations are expensive, and the state budget does not provide for their procurement. Respectively, from the 90s until now, practically all the equipment is procured from financial sources provided by external donors. Therefore, the main financial barrier is the high cost of the equipment for making the measurements. This includes high maintenance costs.

Improving hydrological forecasting

Lack of digital forecasting models. They represent software in themselves, which can be open-source, but more often - commercial. Their cost is quite high.

It should be noted that in the country there is currently no centralized early warning system against hydrological risk phenomena (floods due to overflowing rivers and rain floods). The implementation of these systems is mostly done through the transfer of technologies and requires both capital investment and high maintenance costs.

Improving effective information sharing

There are no major financial barriers. The necessary expenses will only be related to the maintenance of the SHS web page, filling it with operational and regime information, as well as the publication of summary data.

1.2.2.2. Non-financial barriers

Improving leakage monitoring

The main barrier is the lack of cadres in the territory. Namely, the lack of trained personnel in the localities in the vicinity of which monitoring stations are set up. As a rule, the workers working at the stations are of advanced age, without specialized studies, and their training is carried out directly by the SHS collaborators. Indirectly, of course, it is the financial motivation (very low salaries). However, the main barrier is the worsening demographic situation in the country.

Improving hydrological forecasting

Lack of contemporary (numerical) models for making long-term and short-term hydrological forecasts. Lack of special training of SHS collaborators in the use of information systems (GIS, for example). Lack of specialized training (studies) in developing forecasts of engineers from SHS. Lack of knowledge of modern languages. The lack of initiative can also be attributed here, as a subjective barrier.

Improving effective information sharing

Here, a lack of will to "open the archive" can be attributed; to provide access to the collected information for other institutions, beneficiaries and civil society. Awareness of the development of a mechanism for access to information and data exchange is an important barrier, the removal of which will further favor the efficient management of water resources in the country.

In the not-so-distant past, "hydrological yearbooks" were published annually, which were integrated into a summary guide once every five years. Paper publications were sent to state libraries and branch institution libraries. Nowadays, this practice is lost, and many branch institutions do not even have libraries anymore. The respective information cannot even be found online on the SHS website.

Again, SHS had previously produced publications in the form of summaries and regionalizations and specialized guides of hydrological information, which served as a good support in understanding the situation in the field and were useful for the development of policy documents, for decision-making, etc. This practice has also been forgotten.

It should be noted that this opening implies integration (to the extent of needs and possibilities) with regional/international profile networks and the exchange of data, as well as cooperation with them.

1.2.3. Identified measures

The identified measures were analyzed through the lens of the objectives/solutions tree, with the functional links between them. (Appendix 2).

1.2.3.1. Economic and financial measures

Improving leakage monitoring
In order of priority: Revision of the spatial location of the hydrological stations; identification of the set of modern equipment, machines and constructions, as well as the necessary software; continuous training of station workers in making measurements.

Improving hydrological forecasting

Continuous training of forecasting engineers at SHS in the use of contemporary techniques and methodologies for making short-, medium- and long-term forecasts. Organization of permanent recycling courses to adapt the methods and techniques used at the European Hydrometeorological Services. Procurement of specialized software for making digital spatial forecasts of hydrological phenomena (including those of increased risk).

Improving effective information sharing

Creation of a mechanism (software, IT platform), which will integrate all the data set collected from automatic and classic hydrological observation stations. The given software must be connected to the unique meteorological and hydrological database of the SHS and the Environment Agency. The software must be connected with long-, medium- and short-term numerical forecasting systems. The development of early alerts of hydrological phenomena with a risk character (overflow floods and flash floods) will be automated. Operational information must be automatically disseminated to beneficiaries. Regime information – in accordance with the provided regulatory-legal framework.

1.2.3.2. Non-financial measures

Improving leakage monitoring

Improving the legal framework by introducing into development strategies, state programs and development plans the equipment needs for SHS, as well as the maintenance costs of the functional observation network. Implementation of contemporary methodologies and technologies of hydrological observations, quality management of collected data.

Improving hydrological forecasting

Implementation of contemporary forecasting methods. Approval of instructions for making these forecasts. Participation in free online training courses and free recycling workshops.

Improving effective information sharing

Organization of cycles and workshops to raise awareness of the implementation of digital technologies in water resources management for employees of branch institutions. Obviously, the development within the web page of SHS – the main source of informatization of a dedicated platform, will serve as a channel of informatization of the entire society on the issues of the water sector, and its completion with data and information retrieved automatically and semi-automatically and from other institutions will be of enormous benefit.

1.3 Barrier analysis and possible enabling measures for technology, *Improving the sustainable management of water resources by applying the water management balance sheet (Water Balance Sheet/WBS)*

1.3.1 General description of technology

The technology is based on the development and/or implementation of a software application for the analysis and calculation of the balance of water management by water resources management sectors. The given tool will allow you to give a quick answer regarding the available water resources both on water resource management sectors and for a specific water body.

The essence of the water balance lies in knowing the difference between intake and consumption of water, that is, in evaluating the available water resources. The forecasting component allows the assessment of available water resources in the future as well. In other words, depending on the regional scenarios of climate change, the available water resources will be evaluated for different time intervals, for example from 10 to ten years (until the end of the XXI century) and according to the intensity of global warming. This moment is important, because some beneficiaries currently obtain long-term special water use authorization, even up to 30 years, without considering the impact of climate change on water resources. That is, without arguing whether the requested volumes of water will generally be available. So, applying the indicated technology (WBS) depending on the presence, insufficiency or lack of water resources, special water use permits will be issued and management activities in the water resources sector will be planned for the near- and medium-term.

Two main input data sets are used to calculate the water management balance: Water resources (based on the water balance) and water use. The water management balance can be calculated at the point or for some area (water management sector, reception basin, river basin).

For planning the use of water resources, the water management balance is calculated for the water resources management sectors (approved by the "Apele Moldovei" Agency). Water resource management sectors are identified at two levels, broad sectors and more detailed sectors. In both cases, the basin principle is respected.

In the calculation of the water balance, one operates not with the measured runoff, but with the available runoff ensured, with a different exceedance probability. As a rule, P=50% (average runoff year), P=75% (dry year) and P=85, 90 or 95% very dry years.

The results of the evaluation will be placed in the Automated Information System of the State Cadastre of Waters. For this, the calculation must be done using specialized software, which can be free, commercial or specially developed in the Republic of Moldova. The calculation algorithm is well known, applied all over the world and approved by the "Apele Moldovei" Agency.

To calculate the water balance for a given sector (as a rule water management sector) the following equation is applied (in water volume units for the calculation period):

$$\mathbf{WB} = W_{int} + W_{loc} + W_{sb} + W_{rt} \pm W_{n} \pm \Delta V - W_{ev} - W_{inf} - W_{y} - W_{capt} - W_{ec}$$

WB – water balance result;

W_{int} – the volume of water reaching the calculation sector from the upstream sectors (input volume in the sector);

w_{place} – the volume of local runoff, formed within the limits of the given sector (lateral intake);

W_{sb} – volume of water extraction from underground aquifers within the given sector;

W_{rt} – volume of water returned from the given sector;

$\pm W_{n} = W_{dot} - W_{tr}$ – the volume of water received from other sectors ($+W_{dot}$) or transmitted ($-W_{tr}$) to other sectors, due to the redirection of the runoff within the sector or to other sectors;

$\pm\Delta V$ – emptying (+) or filling (-) reservoirs and ponds in the sector;

W_{ev} – additional evaporation losses from the surface of reservoirs and ponds in the given sector;

W_{inf} – losses due to water infiltration from reservoirs and ponds;

W_{y} - reducing the flow of rivers by capturing underground waters that have a hydraulic connection with surface waters;

W_{capt} – capturing water from surface water bodies within the given sector;

W_{ec} – the sanitary or ecological discharge in the terminus section of the given sector;

Here a more detailed analysis deserves the flow of input data, which according to the presented formula are owned by different institutions:

- The State Hydrometeorological Service measures runoff volumes at hydrological stations but does not assess water resources per country and/or at a defined point other than at the hydrological station. The Moldavian Water Agency is the institution responsible for the assessment of water resources, but it does not have the capacity for this. The Geological and Mineral Resources Agency monitors and assesses groundwater resources, but it also lacks the capacity to carry out its mission. Returned waters are not controlled by anyone. The volume of water received from other sectors or transmitted to other sectors due to the redirection of the runoff within the sector or to other sectors is not monitored and evaluated by any state structure.

- The second part of the formula, only on the compartment "capture of water from surface water bodies within the limits of the given sector" has a record from the companies with special water use authorization. The given enterprises report the capture and use of water to the Basin Directorates, which then report them to the Moldavian Water Agency, which then generalizes them for the National Bureau of Statistics. It should be noted that the legal framework (forms for reporting) are outdated and require a cardinal revision [2]. The rest of the indicators in the formula are calculated on a case-by-case basis, sporadically, in most cases or in scientific publications, or within dedicated projects.

The capital costs of implementing the technology are not high, approx. 100 thousand EUR.

Operation and maintenance costs are very modest and can only be reduced to data collection and water balance reassessment. They can be reduced to the salary of employees and IT specialists who will service the computing system. About 5 thousand EUR, annually.

1.3.2. Identification of barriers for technology

Most of the existing barriers for three technologies (1. Improving the monitoring and forecasting of runoff, water quality and the effective exchange of information between various institutions; 2. Improving the sustainable management of water resources by applying the water management balance; 3. Liquidating the reservoirs that do not perform their functions and optimizing their number based on hydrological indicators) are common. Common barriers can be divided into the following categories:

- Economic and financial.
- Legislative and regulatory.
- Technical.
- Institutional.

The barriers were analyzed by building problem trees and defining the effects and links between them (Appendix 3).

Against the background of the aridification of the climate in the region, due to the acceleration of climate change, the subject of the availability of water resources at the point, reception basin, river basin, water resources management sector (in other words, on different spatial units) is neither clearly described nor well analyzed in the perspective of adaptation to climate change. Even if the phrase "there is not enough water" is circulated for different sectors of the national economy; water use authorizations are issued without considering the available water resources and without considering their possible changes due to climate change. What is more, on the environmental authorization’s portal (https://autorizatiimediu.gov.md/), in the benefits section for the Republic of Moldova, it is clearly stipulated: "the identification and inventory of the use of water resources in order to assess the balance of water resources" (Figure 1.7).

Figure 1.7. Extract from the Portal of medical authorizations

1.3.2.1 Economic and financial barriers

Economic and financial barriers are common, as the implementation of new technologies requires significant investments. In our case, the problem is not so much economic, because the technology will not bring direct profit, but financial, because it requires investment. Of course, any technology implementation activity requires financial investments (often indirect or camouflaged), but in the case of the proposed technology (WBS), the major expenses will be limited to the procurement of the computer software. It should be noted that the problem is intertwined with that of the institutional category, more precisely through the lens of the financing of the functions intended to implement the technology.

The implementation of the technology will require financial investment in the function of the approach to the subject.

- If free calculation software is to be used, the costs will be minimal and the adaptation of the software for the conditions of the Republic of Moldova will be reduced (e.g. WEAP - https://www.weap21.org/).

- If commercial software is to be used, investments will be required in the procurement and maintenance of these software, as well as their calibration for the conditions of the Republic of Moldova (e.g. AKWA-m - https://www.hydro-consult.de/wasserhaushaltsmodell-na -modell, or Water Balance Model Desktop - https://waterbalance.ca/tool/water-balance-desktop/).

- In case of developing the domestic software for calculating the water management balance (incidentally, the preferable option), the costs will be comparable to the commercial one. However, here the specifics of the national database and longer-term maintenance will be included from the start.

The maintenance costs depend on the way of organization of the unit that will deal with the water balance calculation, but again they cannot exceed the amount previously indicated.

The calculation software itself is simply a tool. It will also be necessary to develop and implement an independent database or with the possibility of access to the databases of the institutions that will provide data for the calculation.

1.3.2.2. Non-financial barriers

The legislative barrier includes the fact that legislation and normative acts are in constant reform, are not optimized and have large gaps. The old, even ex-Soviet, methodologies and instructions that are in force today have led to the use of reporting forms that no longer correspond to the structures of the national economy, which uses water for various uses. The lack of an approved procedure for evaluating the available water resources is reflected in the issuance of unjustified special water use permits, which means their ineffective management.

There is a wide range of **technical issues** related to data flow and software. The data flow must be organized from scratch, because the necessary data collection procedures do not exist at the moment. It should be noted here that there is no integrated database, which must contain data collected from different institutions focused on water intake, water losses and water use. There is no approved software (commercial or free) with which the calculations will be made. There are also no plans in the use of water resources, especially considering the impact of climate change on water resources and the overdevelopment of the national economy.

The institutional barrier consists in the fact that the operational process must be organized from scratch. From the identification of the institution, the approval of the procedures, etc., to the elaboration of the reporting forms and, finally, the issuance of justified authorizations. The chronic lack of qualified personnel, especially in the last decade, is a serious problem. It should be noted that, in principle, a sustainable management of water resources is also achieved by planning their use. In the Republic of Moldova, unfortunately, this activity was not carried out and only their dramatic reduction, especially due to climate change, requires the application of WBS.

Understanding common barriers can help address them to promote faster implementation of selected technologies. Next, a description is presented.

Hence, the main barrier is institutional and consists of the fact that these calculations are not carried out and there is no subdivision within the Ministry of the Environment that is responsible for carrying out the Water Management Balance Sheet. It should also be mentioned here that, in the water law, neither the phrase "climate change" (https://www.legis.md/cautare/getResults?doc_id=121479&lang=ro#) nor "water balance" is applied.

Starting from the fact that a new activity will be organized (WBS calculation), several institutional barriers will be outlined, the most important of which will be the informational ones. From the conceptual calculation model of the WBS, it is obvious that data will be needed regarding water intake and consumption. It will be necessary to organize the information flow of data to the institution responsible for the calculation of the WBS.

Another problem, already of a technical nature, concerns the quality of the data and its insufficiency, or lack thereof. Authorizations for the special use of water are issued based on the documents presented by the user, and there is no control mechanism for this data. In other words, it is not checked exactly how much water is extracted from the river (at a pumping station) or from an artesian well. The data provided are of a high degree of generalization (approximation). On the other hand, small-scale agriculture must not be forgotten, which generally does not declare the volume of water pumped from the river or lake.

The issue of gender today is neither clear nor explicit. Traditionally, the share of men and women in the field of water resources management is about equal and, in some institutions (SHS, AGRM), the share of women is higher than that of men. In any case, however, it will be indicated by internal regulations that the share of specialists, who will take care of the WBS calculation, should be proportional.

Finally, a problem arises out of a lack of competent personnel. This problem begins with a lack of university-trained specialists with respective studies entering state institutions under the Ministry of the Environment.

1.3.3. Identified measures

The identified measures were analyzed through the lens of the objectives/solutions tree, with the functional links between them. (Appendix 4).

1.3.3.1. Economic and financial measures

Soft. The financial expenses will be predominantly focused on the development or adaptation of the WBS calculation software. This includes investments in the development, testing, validation and maintenance of the developed software. In case of using free software, the expenses will be minimized. However, practice indicates that there will be multiple problems of adapting the software to the specifics of water resources management in the Republic of Moldova, so that the changes introduced in it will be comparable to the expenses of developing new software. In any case, software development represents the most expensive component of the budget. The estimated amount needed is estimated at around 100 thousand EUR.

Institutionalization. Certain financial sources will be necessary (but very difficult to estimate) for the optimization of the legal framework. Here, it will be necessary to introduce changes to the water law (LAW No. 272 of 23-12-2011), where the necessity of the WBS calculation, the responsible institution and the way of organizing the data flow will be indicated.

The last financial component is the maintenance of the unit that will handle the WBS calculation. Taking into account the fact that the structural unit will manage not only the WBS calculation, the overall maintenance costs are estimated to be no more than 5 thousand EUR annually.

In total, two main financial measures are proposed:

1. Development/adaptation of WBS calculation software.

2. Maintenance (salary) of the unit responsible for WBS calculation.

1.3.3.2. Non-financial measures

The subject is very difficult to evaluate, because any activity has some financial investment behind it, even if it is declared that it does not require monetary expenditure. These activities can conventionally be divided into activities related to data flow organization and institutionalization activities. However, both require interventions to improve the legal framework.

Activities focused on organizing **data flow:**

Creation of the integrated database. Here, on the water intake component, it is relatively simple – SHS and AGRM are the institutions that monitor surface and underground runoff. The use of water is controlled by the Ecological Inspectorate. A special place belongs to commercial organizations, especially Apa-Canal, which are the main users of water. On the given segment, the reporting mechanism (and reporting frequency) of water captured from surface and underground water sources must be identified.

Organization of the flow of data required for WBS calculation. The exchange of data between the institutions that collect the data is a necessary step, which must be fully automated by uploading the data to the integrated database.

Calibration and validation of approved software. The procedure is strictly necessary to understand if the chosen software provides truthful results.

Activities to strengthen **institutional capacities:**

1. **Identification of the institution responsible** for the calculation of the WBS, and within the institution – the respective subdivision with the organization of the respective job sheets. Currently, it is logical that this institution is the "Apele Moldovei" Agency, which deals with the implementation of policies in the field of water resources. At least here the WBS calculation methodology was developed and approved, and the water resources management sectors were identified. However, the institutional capacity of the agency is currently very low. From here the next measure is taking shape.

2. **Approval of procedural instructions.** Data flow can be organized by strengthening the legal framework, namely by approving procedural instructions. Here the main role rests with the designated institution, i.e. with whom it will be reported and in what terms. From which results:

3. **Revision of reporting forms.** Current water user reporting forms are outdated and need updating. So simple forms must be developed, but which contain the whole spectrum of water resource use from different sources of supply.

4. **Training of personnel responsible** for WBS calculation. The measure is complex, because the engineers who will perform the calculations must have special studies: hydrology, water management, or similar. For this reason, it is desirable that at the faculties that train specialists in the field of geography, hydrology, water improvement, water management, maybe even ecology, the hydrological calculations related to the water management balance should be included in the study plans.

The actions described will result in the creation of a subdivision within the identified institution, in which they will activate qualified personnel. Normative acts, instructions and methods will be developed and approved, which will ensure efficient data exchange between institutions and favor the calculation of the water management balance. As a result, the Ecological Inspectorate will issue special water use permits only in accordance with the WBS calculation, which will also consider the water resources available in the near future against the background of climate change.

1.4 Barrier analysis and possible enabling measures for technology *Optimization of number of reservoirs based on hydrological indicators.*

1.4.1 General description of technology

Most ponds/lakes were built between the 1960s and 1980s. Correspondingly, their useful volume of water is considerably reduced.

In 1995, an inventory was carried out regarding the state of 1253 ponds/lakes (ACVAPROIECT data). As a result, their degree of danger was determined for the localities located downstream of the dams in the case of high risk (dam break). Within the project EPTATF 2013-2016, Management and support for Technical Assistance regarding the protection of the territory of the Republic of Moldova against floods, financed by the EIB - Service contract No TA2011038 MD EST (TA-MDFRM 2013-2016), also an assessment was carried out for cases of breaking dams for several lakes.

It was found that a good part of the ponds/lakes were built with deviations from the norms in force (СНИП), respectively about 40% of them present a real danger for the population in case of dam break (visual inspection). The prevailing height of the dams varies from 5 to 7 m.

All ponds/reservoirs in the Republic of Moldova are designed and built for seasonal water regulation. The technical parameters of the hydrotechnical edifices must ensure the drainage of rainwater with the probability of occurrence of the flow of 5% and 1% depending on the degree of reliability of the construction.

At the same time, it is found that the density of ponds and reservoirs on the territory of the Republic of Moldova is higher than the optimal one, depending on the intrinsic (essential) characteristic of the hydrographic basin, also, the density of the location of ponds/lakes is uneven on the hydrographic basins. The high density of the location of ponds/lakes within a watershed, in many cases leads to the disappearance of water flow in small rivers. The disappearance of the water flow in the river means not ensuring the ecological flow, which in turn does not ensure the stable development of the biodiversity of the respective river.

In 2017, about 3,900 reservoirs/ponds were inventoried (except UAT: Cantemir, Briceni, Ocnița, Soroca, Bălti municipality) (source Apele Moldovei). Thus, the following can be established:

- Dry ponds – 166 units.
- Ponds with passports and technical sheets – 160 units.
- Ponds with exploitation regulations – 58 units.
- Ponds with damaged dams – 537 units.
- Ponds with damaged large water spillway – 289 units.
- Ponds with damaged bottom evacuator – 169 units.

In the spring of 2017, by issuing the order of the district presidents, mixed commissions were created for the evaluation of reservoirs/ponds, which included representatives of the APL (Local Public Administration), the Civil Protection and Emergency Service, the Territorial Ecological Inspections and enterprises subordinate to the Moldavian Water Agency.

The joint commissions examined the current state of the hydrotechnical constructions of the reservoirs/ponds (dam, high water spillway, bottom drain), as well as the passporting of the reservoirs/ponds. The analysis of existing materials finds the following:

- Many hydrotechnical constructions of ponds/lakes are in a damaged condition.
- The designed exploitation period of the lakes is 40-50 years. Considering that most of them were built in the years 1960-1980, it follows that many of them have expired exploitation period, and the others are at the limit of the exploitation term. Estimates show that, due to the high level of clogging, the volume of reservoirs has decreased by an average of 0.50% annually [source: World Bank].

Thus, optimizing the number of lakes/ponds appropriate to the situation in the Republic of Moldova becomes a priority. A fact that can be a good contribution to risk assessment, the development of measures to protect and improve aquatic resources, increase surface runoff, also to rural development.

1.4.2. Identification of barriers for technology

Most of the existing barriers for three technologies (1. Improving the monitoring and forecasting of runoff, water quality and the effective exchange of information between various institutions; 2. Improving the sustainable management of water resources by applying the water management balance; 3. Liquidating the reservoirs that do not perform their functions and optimizing their number based on hydrological indicators) are common. Common barriers can be divided into the following categories:

- Economic and financial.
- Legislative and regulatory.
- Technical.
- Institutional.

The barriers were analyzed by building problem trees and defining the effects and links between them (Appendix 5).

Against a background of the aridification of the climate in the region, due to the acceleration of climate change, the topic of reducing the number of reservoirs is neither clearly described nor well analyzed in the perspective of adaptation to climate change. Even if the phrase "there is not enough water" is circulated for different sectors of the national economy, local and central authorities support the initiative to create reservoirs, ponds and ponds. This support is based on additional access to water for various uses. The subject is ambiguous, because it is not analyzed in depth. Each newly created reservoir has a period of operation and a regime of operation described in the technical sheet of the hydrotechnical construction.

After the intended period of operation, a lake clogs, becomes muddy and no longer fulfills its functions. It must then be either liquidated or cleaned. The sediment excavation procedure is very expensive and there are no economic premises to be applied in the Republic of Moldova.

One of the optimal ways is to liquidate these lakes and capitalize on the freed land (i.e. land from the lake beds).

1.4.2.1 Economic and financial barriers

Economic and financial barriers are common, as the implementation of new technologies requires significant investments. In our case, the problem is not so much economic, because the technology will not bring direct profit, but financial, because it requires large investments.

Even if in the country there are procedures described in the legal framework for the liquidation of constructions [3], indicated in the "Law on the principles of urbanism and territorial development", it is not clearly stipulated from which financial sources the respective works will be carried out. In the case of small lakes, often abandoned or built illegally, without permits, the financing of these activities can be a very serious impediment to carrying out the works.

1.4.2.2. Non-financial barriers

The legislative barrier includes the fact that legislation and normative acts are in constant reform, are not optimized and have large gaps. The old, even ex-Soviet methods and instructions, which are in force today, have led to only formal compliance with the legislation due to the creation of a new lake and the same in compliance with the rules for its exploitation. The lack of an approved procedure for assessing the available water resources is reflected in the issuance of documents for the creation of new lakes. On the other hand, there is no elaborate mechanism for regulating the number of lakes in a catchment basin, on a water course, and even more so for their liquidation and optimization.

There are a wide range of **technical problems**, the most important of which is the calculation of the anthropogenic pressure exerted by regulating surface runoff from a catchment. In other words, there are no general or individual studies for each catchment area of small rivers, in which the number of lakes that can, in principle, be built and what volume of water they can regularize. Or what is the maximum surface of the water mirror that can be formed on them.

The liquidation of a lake (at least, the hydrotechnical construction that forms it) is quite difficult from a technical point of view. It can be achieved by breaking the dam and completely draining the water alone. The topic is apparently outdated. However, the environmental impact is still neglected. The dam must be demolished, and the accumulated alluvium and the land occupied by these alluviums must be naturalized or exploited. Here again, there is a lack of technical documentation regulating these measures.

The institutional barrier consists in the fact that the country is currently not ready for the application of the technology given by the awareness of the problem. It is difficult to explain that some abandoned 'puddle' essentially represents a 'boiling kettle' during the summer. The collaboration mechanisms between the institutions (there is not even an institution specifically responsible) – The Moldavian Water Agency, SHS, the Ecological Inspectorate and the Ministry of the Environment – are not developed. In other words, the competences of the institutions for the implementation of the proposed technology are not institutionalized.

For these reasons, it is necessary to implement the technology on a pilot reception basin, to later liquidate all the deficiencies for a large-scale application, for the entire territory of the country.

The final problem arises from the lack of competent personnel. This problem begins with a lack of university-trained specialists with respective studies entering state institutions under the Ministry of the Environment.

1.4.3. Identified measures

The identified measures were analyzed through the lens of the objectives/solutions tree, with the functional links between them (Annex 6).

1.4.3.1. Economic and financial measures

Research. The financial expenses will be focused on assessing the impact of regulating the flow through reservoirs and determining their optimal number (surface area, retention capacity, functionality) for a small water course in the Republic of Moldova. In other words, an important measure will be the development of the calculation methodology for each small river, depending on the length, the area of the reception basin, the surface runoff and other environmental conditions, which will allow the determination of the anthropogenic pressure on this river through the reservoirs. In other words, it will be known how many reservoirs can in principle operate on this water course. Accordingly, the rest will be recommended for liquidation.

Techniques. As mentioned, demolishing a dam, excavating the accumulated sediments and transporting them to another place is technically quite difficult and expensive. Certainly, in the budgets of the LPAs these expenses cannot be included. The owners of lakes or dams (as a rule leased for a certain term) will not plan these works. Many small dams are generally abandoned. The approval of two current methods to identify the lakes that need to be liquidated and to naturalize or capitalize on the freed surfaces is, of course, required. Here, it will also be necessary to consider the change in the cadastral status of these lands, because they will certainly pass from the water fund land to the agricultural fund or others.

Institutionalization. Certain financial sources will be necessary (but very difficult to estimate) for the optimization of the legal framework. Here it will be necessary to introduce changes to the water law (LAW No. 272 of 23-12-2011), where the need to evaluate the human pressure by regularizing the drain will be indicated. The development of the set of instructions and normative acts will also require financial expenses.

Another financial component consists in the maintenance of the unit that will deal with the identification of the lakes that need to be liquidated and the training of the staff.

Identifying the responsible institution, adjusting and delimiting the responsibilities between different institutions, in some cases even training the staff requires financial investment. The given activities can be done with little financial effort.

1.4.3.2. Non-financial measures

The subject is very difficult to evaluate because any activity has some financial investment behind it, even if it is declared that it does not require monetary expenditure. Conventionally, these activities can be divided into technical and institutionalization activities, and both require interventions to improve the legal framework. In other words, several solutions even if they require a financial contribution, but their realization in a big way can be achieved from the own resources of APL, owners, state enterprises, etc.

As previously mentioned, the development of the proposed methodologies is backed by financial investment, but their discussion and approval do not require additional expenses. It is only necessary to follow procedures, which take time.

1.5 Linkages of the identified barriers

Improving leakage monitoring

Starting from the phrase that primary information (systematized and / or generalized) is the key to success in the development of a sustainable management of water resources, we can say that the implementation of the presented technology will be found successfully in all activities related to the management of water resources.

Improving hydrological forecasting

Quality hydrological forecasts will certainly be useful in all activities and measures related to the water resources sector, especially those in the agricultural, transport and public health sectors.

Improving effective information sharing

Operative access to qualitative hydrological information will favor the successful implementation of projects related to the management of water resources. On the other hand, the data can be integrated into various specialized information systems. For example, the hydrographic network in the State Water Cadastre Information System is practically useful for all environmental information systems.

Improving the sustainable management of water resources by applying the water balance sheet

The synergy of overcoming the barriers described by the proposed measures lies in the fact that they cannot be achieved separately. They represent in themselves a sequence of intertwined activities. Neglecting a problem or failing to fulfill a measure will result in a large gap in technology implementation, or even failure to implement WBS calculation in the Republic of Moldova. In other words, the proposed measures are in series, not in parallel. So, if a proposed measure is not carried out, for example "approved and calibrated software", or "trained staff", or "approved instructions", in the end, the calculation of the water management balance will not be carried out either. If the calculation of a parameter from the indicated formula is not performed, the WBS will not be performed correctly, etc.

Optimization of number of reservoirs based on hydrological indicators.

The synergy of overcoming the barriers described by the proposed measures lies in the fact that they cannot be achieved separately. They represent in themselves a sequence of intertwined activities, which will make up the Technology Action Plan. Neglecting a problem, or not fulfilling a measure, will result in a big gap in the implementation of the technology, or even the failure of its implementation in the Republic of Moldova. In other words, the proposed measures are in series, not in parallel. So, if a proposed measure is not carried out, for example "assessment of the number of lakes...", or "trained personnel", or "approved instructions", in the end, the reduction of pressure on small water courses will not be carried out either. If only the dam is broken, without the revalorization of the upstream lands, the effect will be only partial. If the cadastral title of the back land is not changed, the effect will be partial again. If the institution with control functions is not identified, the redundant lakes will not disappear, rather they will multiply.

1.6 Enabling framework for overcoming the barriers in Water sector

Improving leakage monitoring

The hydrological monitoring network must be approved by a normative act at the state level, and the methodology for making observations, by internal normative acts of the SHS and the Environment Agency.

Improving hydrological forecasting

The legal framework already clearly stipulates that the only institution responsible for making hydrological forecasts in the country is SHS. However, it is necessary to develop sets of instructions, which will be approved internally after consultations with the WMO.

Improving effective information sharing

The current legal framework expressly indicates how to access environmental information. But the procedures for quick access to data and information must be formalized and legalized.

Improving the sustainable management of water resources by applying the water balance sheet

The current permissive framework is best mirrored in Figure 1 (Extract from the Environmental Authorizations Portal), but it can also be found in the normative acts of the State Cadastre Automated Information System (SIA CSA) - DECISION No. 491 of 23-10-2019 regarding the approval of the Automated Information System Concept "State Cadastre of Waters". The results of the water balance calculation will be found in this Information System. However, only the final data calculated for the water resource management sectors will be presented here.

It should be noted that short- and medium-term water resource management decisions will be taken considering the results of the water balance calculation. We also mention here that the data from the SIA CSA do not take climate change scenarios into account. This would mean that apart from the CSA SIA, the WBS calculation data must also be found in other public and internal documents related to water resource management.

ORDER No. 98 of 20-12-2014 regarding the approval of the Guide for the preparation of the Feasibility Study for water and wastewater projects describes in sufficient detail how to calculate the water balance, only for very narrow purposes and which do not exactly correspond to the objectives proposed in the framework of data technology for adaptation to climate change.

DECISION No. 931 of 20-11-2013 for the approval of the Regulation on groundwater quality requirements in only one paragraph refers to the water balance in Section 2 Threshold values for pollutants and groundwater pollution indicators.

It should be mentioned that within the common Dniester projects (Moldova and Ukraine), the implementation of the proposed technology has already been attempted only within the fl. Dniester: (https://dniester-commission.com/bassejn-reki-dnestr/).

Totaling up. The normative framework of the Republic of Moldova must be updated through a calculation regulation and MRV of the water balance with the record of the calculation methodology and climate change scenarios.

Optimization of number of reservoirs based on hydrological indicators.

The current permissive framework is reflected in:

- Water Law no. 272 of 23.12.2011.
- The law regarding the areas and sheets for the protection of the waters of rivers and water basins no. 440 of 27.04.95.
- The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013.
- Government Decision no. 932 of 20.11.2013 for the approval of the Regulation on the systematic monitoring and record of the state of surface waters and underground waters.
- Common to all these normative acts, as a red line is the phrase of the protection of water resources. Hence, the proposed technology is precisely oriented towards the protection of water resources of small rivers. Protection against their degradation, against their disappearance in general.

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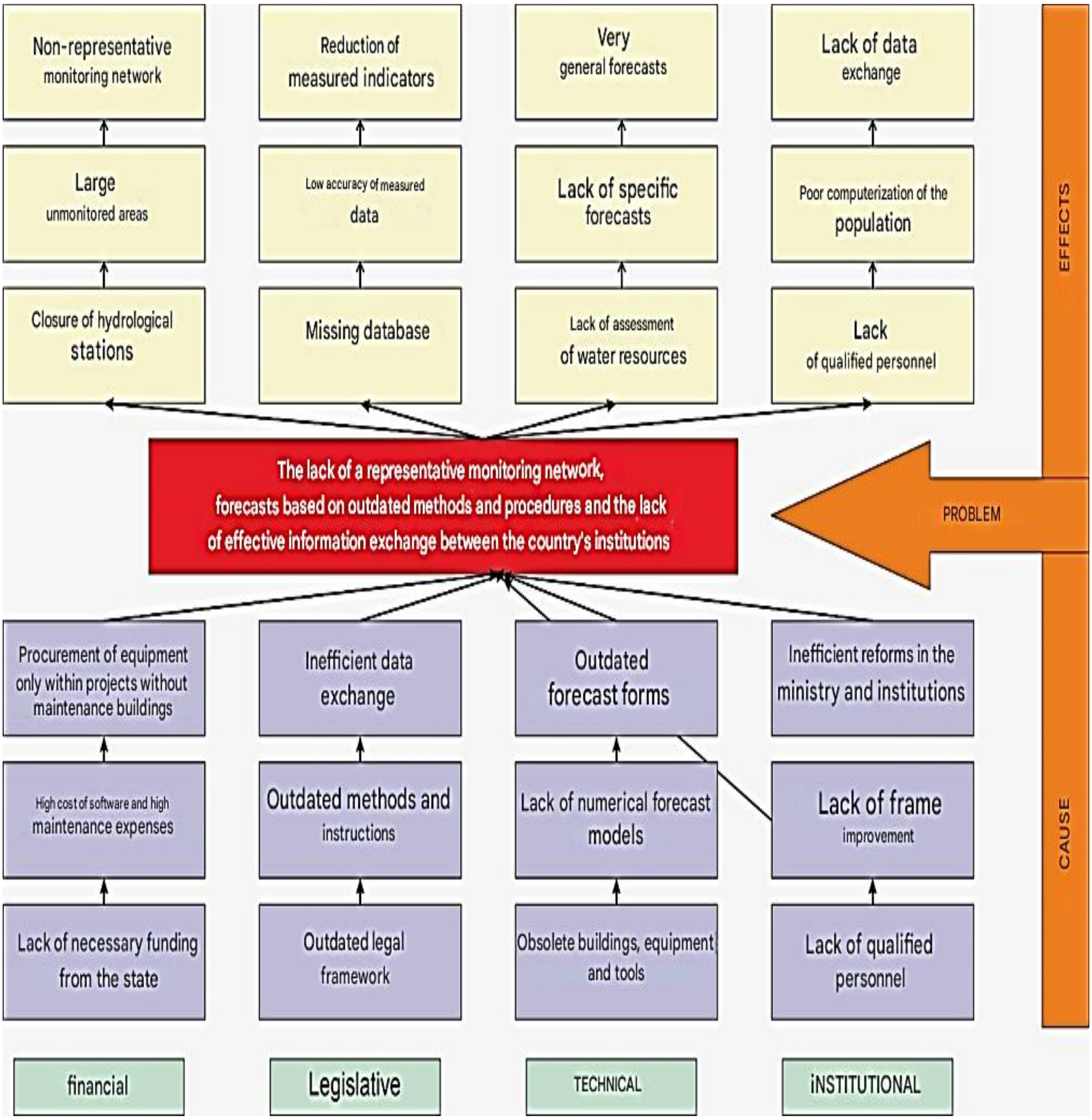
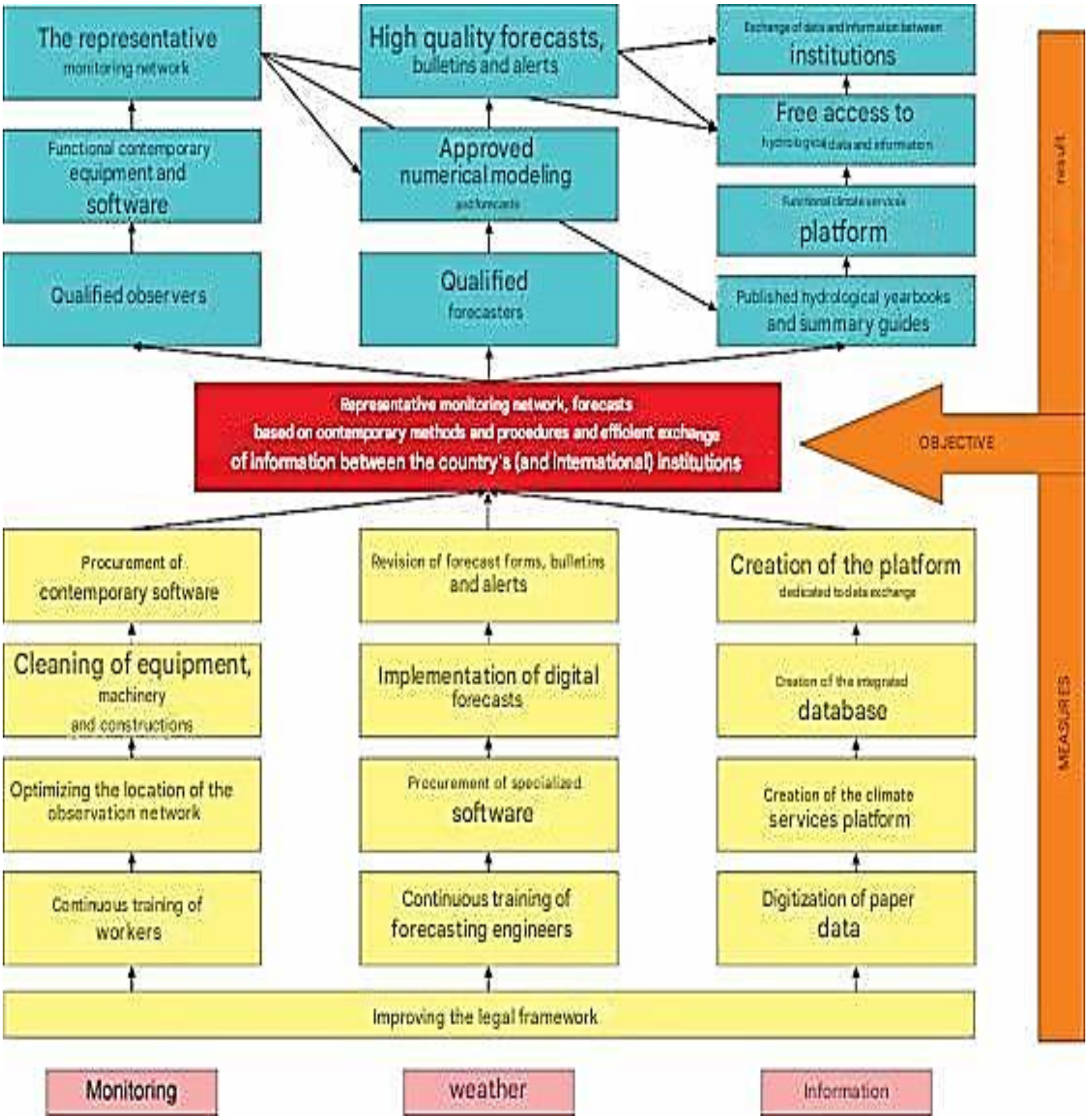
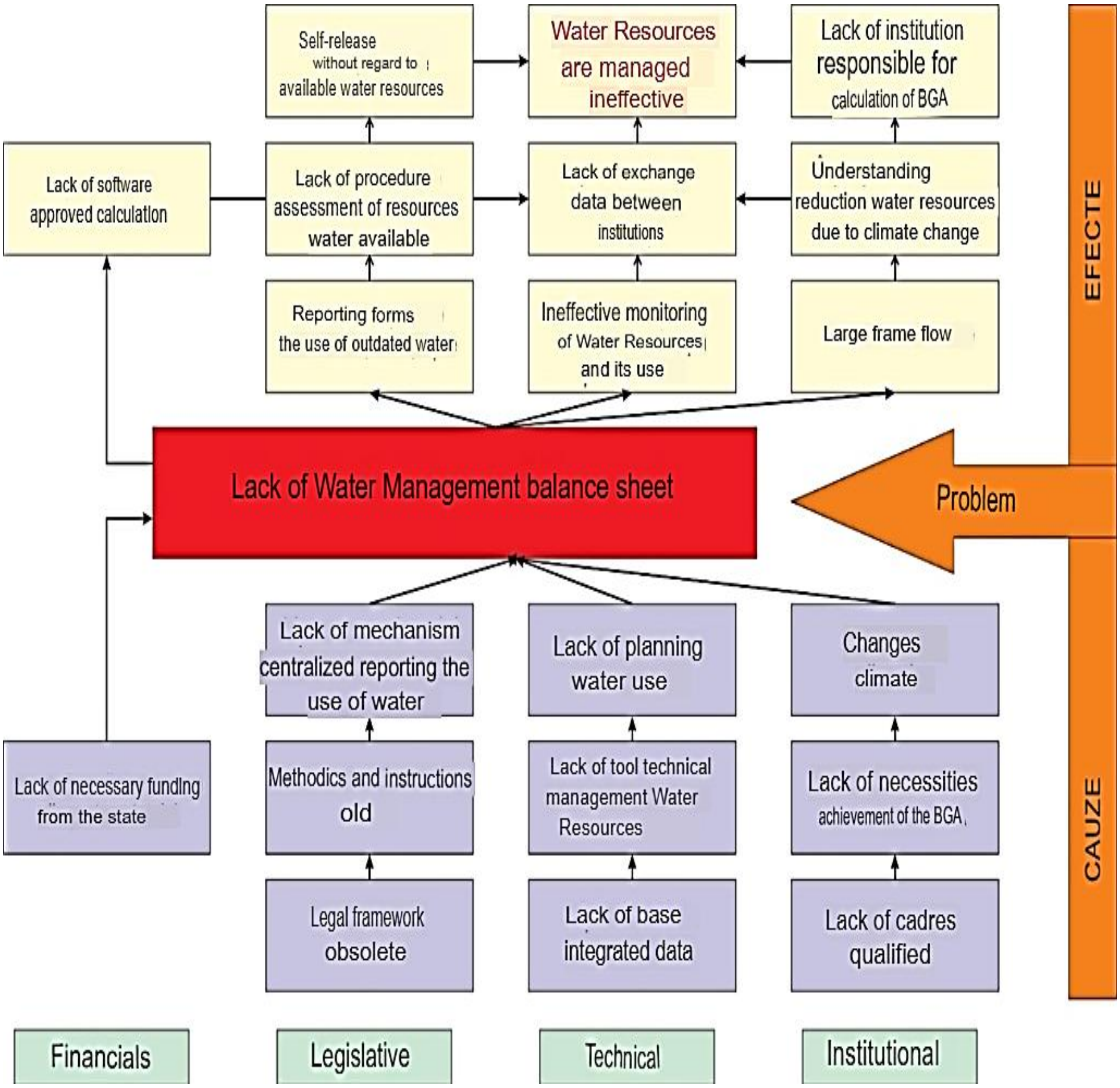
Annex 1. Technology Problem Tree "Improving leakage monitoring and forecasting, water quality and efficient exchange of information between various institutions."



Annex 2. The Measures Tree of and results in the technology "Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions"

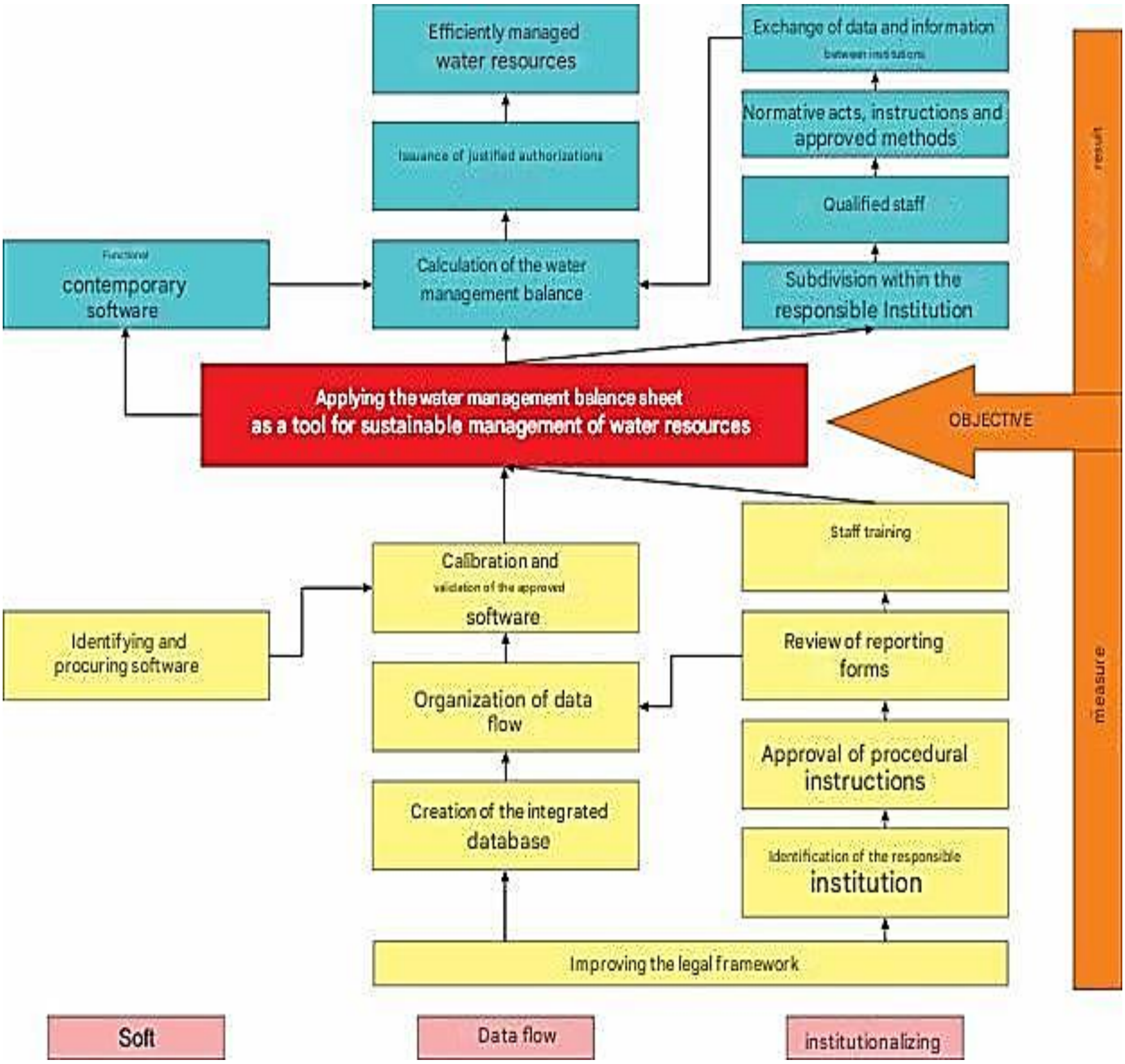


Appendix 3. Problem tree in the technology "Improving the sustainable management of water resources by applying the water management balance sheet.

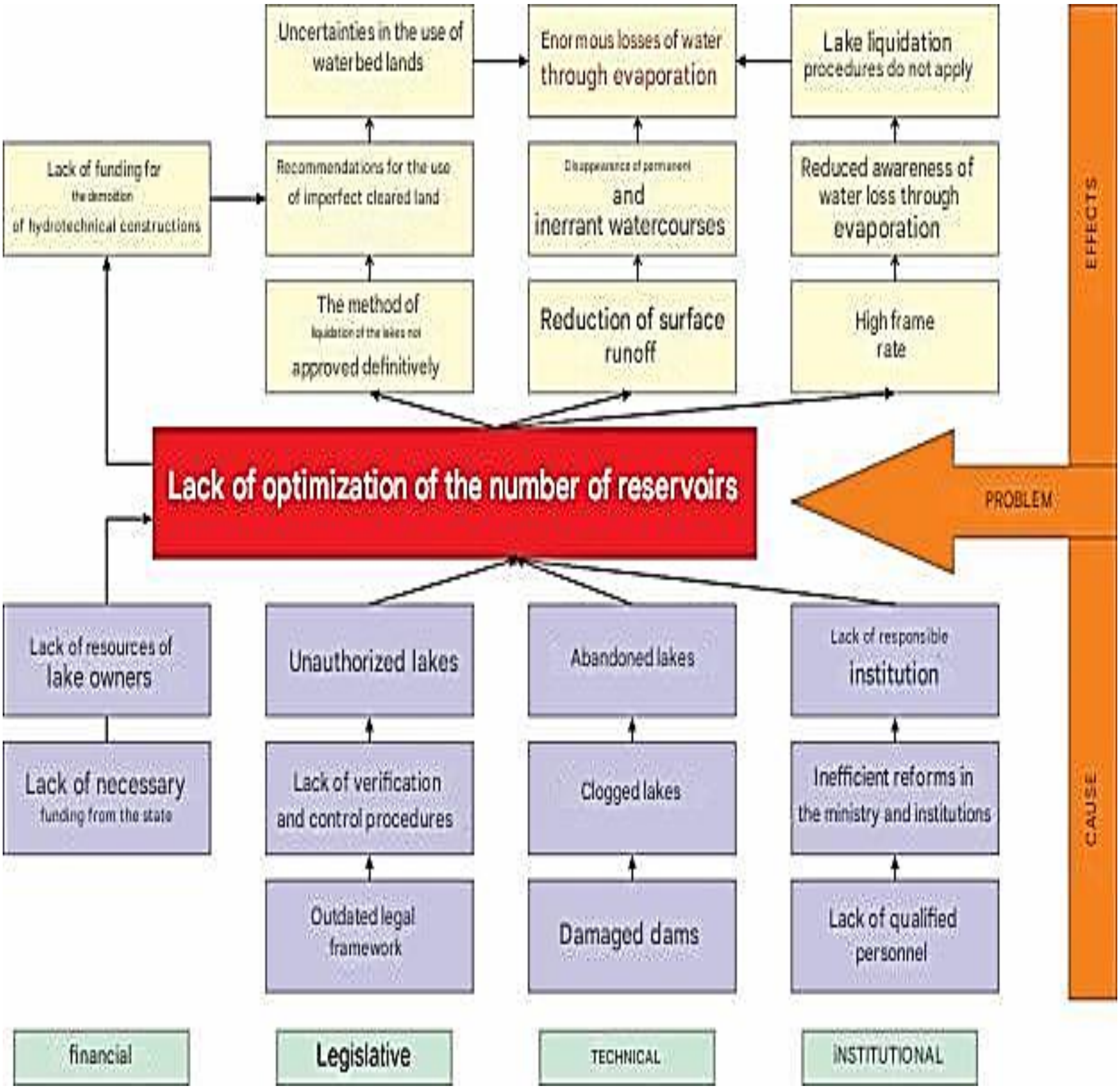


BGA- Water Balance Sheet

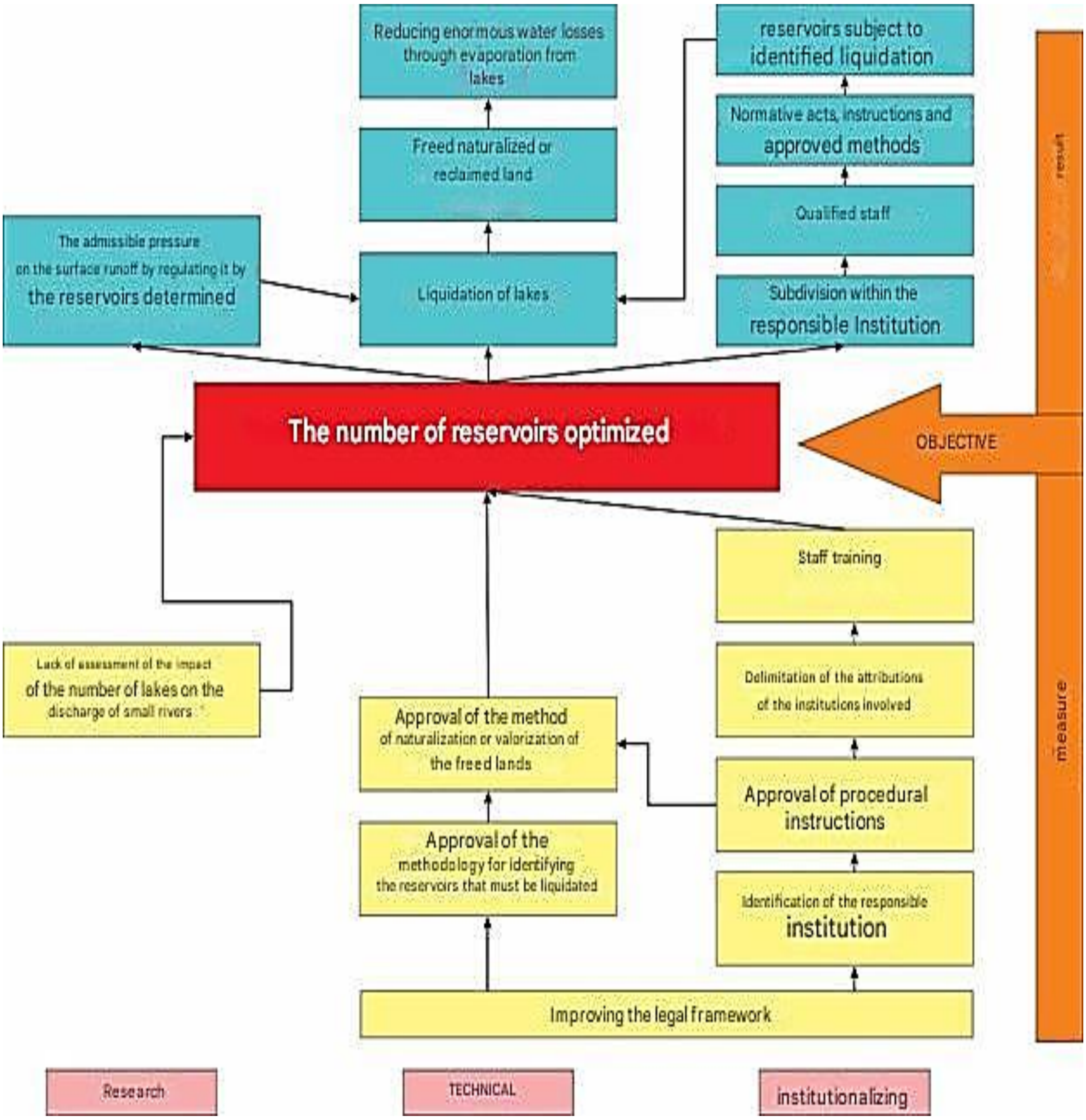
Annex 4. The tree of measures and results in the technology "Improving the sustainable management of water resources by applying the water management balance"



Appendix 5. Problem tree in the technology "Optimization of number of reservoirs based on hydrological indicators."



Annex 6. The tree of measures and results in the technology "Optimisation of number of reservoirs based on hydrological indicators."



TECHNOLOGY ACTION PLANS and PROJECT IDEAS REPORT/TAP (3)

REPORT III WATER RESOURCES TAP

Executive Summary

The action plan for the selected technologies is the third and final report of the Technology Needs Assessment (TNA) project – a series of activities carried out in the country through the broad participation of society and aimed at determining and identifying ecologically clean technologies in reducing CO2 emissions and/or reducing vulnerability to climate change. Technology Action Plans (TAPs) were developed for the technologies that were selected in the first stage of the TNA project and presented in detail in the Adaptation Technology Needs Assessment Report. The technology selection and prioritization processes were carried out by the national team of experts in the energy, transport, water resources, forestry, health sectors and included representatives of government, academic, public and business organizations. In the second stage, the analysis of barriers and measures for the development of technologies and the evaluation of the favorable environment for their further dissemination was carried out.

The development of the TNA project coincided with increased national interest in sectoral adaptation to climate change and the desire to increase resilience to climate change. In the past decade, adaptation actions have been recognized as a key pillar of ecological sectoral growth for the Republic of Moldova. Moreover, adaptation policy has been recognized as a matter of national environmental security through its implementation in most state environmental policies.

In this sense, the TNA project lays the groundwork for the next steps and the practical implementation of adaptation policy in the water resources sector.

Consequently, TAPs of adaptation technologies for the water resources sector are presented in the chapters of this paper. Each chapter consists of sectoral introductions, including analysis of the enabling legislative and policy environment for further implementation of TAPs; a brief description of each technology; summary analysis of barriers to technology implementation; and the full description of the identified measures, actions, results, means of verification, indicators and possible risks are presented as an action plan for each technology. In addition, the reader will find the most important next steps that should be taken to implement TAPs, as well as project ideas developed to implement these selected steps/ideas, represented for each sector.

The following priority technologies for the Water Resources sector have been identified in previous reports:

1. Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions.

2. Improving the sustainable management of water resources by applying the water management balance sheet.

3. Optimization of number of reservoirs based on hydrological indicators..

A project idea for technology **Improving the monitoring and forecasting of runoff, water quality and the effective exchange of information between various institutions** requires the total reform and modernization of the SHS and the Environment Agency and the services they provide.

The expected effect of the implemented technology will result in the availability of water resources data measured at the SHS observation network, which will be of appropriate quality both due to the contemporary measurement equipment installed and due to the spatial optimization of the observation network. The data collected automatically, in real time, will allow the use of numerical models in forecasting the runoff (especially the maximum runoff; floods and floods, as well as the minimum runoff, or low water level, which describes the frequent hydrological droughts in the country). The collected data and information will be available both to the decision-making structures and to all interested structures, including civil society and academia and the private sector.

The implementation of this technology will be the basis of all actions, activities and initiatives to adapt to climate change, which have a direct and indirect tangent to the correct and sustainable management of water resources in the conditions of environmental transformations.

The technology will be applied at the spatial level of the entire territory of the country and the estimated costs are around 2.2 million EUR.

For the successful implementation of the technology **improving the sustainable management of water resources through the application of the water balance sheet,** legislative changes are needed to create a favorable climate for overcoming financial and bureaucratic obstacles to implement the appropriate technology and to oblige stakeholders in the water sector. State and private institutions must use technology to properly manage water resources in the face of climate change.

The expected effect of the implemented technology will be found in the protection and rational use of the volumes of water resources, because it is currently not known precisely how much water is available in the country. Nor are even estimates made of how much water there will be in the near future. The impact of climate change is felt here by the reduction of available water volumes and by the intensification of floods (especially rainwater). The mechanism for issuing authorizations for special water use generally does not consider those indicated above. Any applicant can obtain a permit, regardless of whether it is water or not, and how much water there will be available in the near future.

The technology will be applied at the country level, and the costs of its implementation are modest - 100 thousand EUR.

The success of the implementation of the technology of the **Optimization of number of reservoirs based on hydrological indicators.** depends primarily on the removal of legal barriers through the development of effective legislation in the use of water fund land and the management of hydrotechnical constructions.

The great tragedy in the management of water resources in the Republic of Moldova consists in the abusive humanization of small water courses. After the construction of numerous small reservoirs (ponds), often without permissive acts, it turned out that many of them do not fulfill their functions according to the project, and as a result of rapid silting, they turned into an additional anthropogenic evaporator through the created water mirror. The expected effect of the application of the technology consists in the liquidation of these ‘evaporation mirrors’, a fact that will increase the flow of the river and intensify the naturalization process of the water course.

The technology requires implementation for the entire country but, being a new tool for adapting to climate change, it requires testing on a pilot area (small catchment area). After identifying and solving possible implementation problems, it will be expanded throughout the country. The estimated cost of implementing the technology on a pilot basin is about 150 thousand EUR.

Chapter 1 Technology Action Plan and project ideas for sector water resources

1.1 TAP for sector water resources

1.1.1 Sector overview

For the Republic of Moldova, climate change represents one of the biggest threats to sustainable development and constitutes one of the biggest environmental problems, with negative consequences on various daily activities. The accelerated pace of climate changes and society's inability to quickly adapt to them, the lack of sectoral strategies for adapting to current and expected climate changes, the agrarian orientation of the national economy, which largely depends on the weather and climate, determine the development of a set of practical guidelines for the rational use of natural resources, especially water resources.

The water resources of the Republic of Moldova are represented by surface water runoff (permanent and intermittent watercourses), in other words by water transported by rivers, and by underground water resources. These resources are often not enough to meet different requirements (most often agricultural) in case of removal from the source of water supply, i.e. from river, reservoir or water intake. They can most conveniently be presented through different insurances (Table 1). 50% insurance corresponds roughly to an average runoff year, 75% to a dry year, and 95% to an extremely dry year.

Table 1. Water resources of the Republic of Moldova of different assurance (data up to 2015 are analyzed), km3

Reception pools	P=50%	P=75%	P=95%
PRUT River Basin	2.39	1.59	1.10
Basin fl. Dniester	8.42	6.33	4.57
Small river basins of the BLACK SEA	0.03	0.02	0.01
Basin fl. DANUBE	0.07	0.06	0.01
Total country	10.9	8.0	5.7

Exploitable groundwater reserves (or exploitable, RE) represent the maximum amount of water that can be extracted from an aquifer without changing the hydrogeodynamic balance. In the Republic of Moldova, exploitable reserves were calculated only for interstratal aquifers (without groundwater) that contain large amounts of water (Table 2).

Table 2. Determination of exploitable reserves of potable underground water in the territory of the Republic of Moldova, within its geographical borders, year 2018

Method (author) and year	Potential underground water reserves (RP), m^3/day	Exploitable reserves (RE), m^3 /day
Stasiev et al. (1962)	1,199,105.00	760,320.00
Zelenin et al. (1973)	1,500,003.00	540,004.00

Saraevskii et al. (1982)	2,542,800.00	733,700.00
Moraru et al. (2001)	4,331,874.54	1,819,387.00
Moraru (2013)	3,729,888.00	1,566,553.00

The evaluation of the water resources of the Republic of Moldova (surface and underground) requires the improvement of the monitoring network, equipped with contemporary equipment and machines for the realization of complex measurements. Climate change has a specific impact on water resources, the adaptation to which is a vital necessity for different sectors of the country's economy, primarily the agricultural sector. The impact of climate change on water resources, currently, on the territory of the Republic of Moldova, is manifested in the reduction of their quantity and the decrease of water quality. Contemporary surface water resources with 50%, 75% and 95% assurance, constitute 10.9, 78.0 and 5.7 km^3 of water respectively. The ecological runoff represents 30% of the average runoff. The rest of the water is available for various uses.

The contemporary exploitable underground water resources constitute 1,566,553.00 m^3/day or 0.57 km^3/year, and the potential ones 3,729,888.00 m^3 /day or 1.4 km^3/year.

Improving monitoring and forecasting of runoff, water quality, and effective information sharing between various institutions. The technology provides for the optimization of the hydrological observation network, the adaptation of the methodologies to EU requirements and the implementation of new technologies for making forecasts, bulletins and hydrological alerts of different duration. The focus will be on the automation of hydrological monitoring stations and the application of digital models in the development of hydrological forecasts. Contemporary flashflood forecasting systems will be applied by applying contemporary techniques (especially radar data), something that has not been done in the Republic of Moldova until now.

The operational exchange mechanism with the data collected between the branch institutions will be developed. Even if the State Water Cadastre Automated Information System is already implemented, it does not provide for the operative updating of the information. It relies more on average data and indicators. It is proposed to develop and implement an operational data exchange mechanism between institutions related to the monitoring and management of water resources. The development and dissemination of forecasts, bulletins and hydrological alerts, water quality is considered.

The hydrological observation stations will be modernized by equipping them with constructions and contemporary monitoring equipment. Currently, only the stations on the Dniester and Prut rivers, as well as a few internal rivers, are equipped with contemporary equipment. Along with the total automation of the hydrological observation network, the classic equipment, necessary for calibrating the automatic stations, will also be modernized.

Automated hydrochemical stations are extremely expensive to operate and will be replaced by mobile sampling laboratories.

The technology aims to strengthen the operational capacities of SHS, AGRM and the Environment Agency. Training existing staff and familiarizing them with the new procedures for making observations and forecasts will increase the quality of the products developed. The technology is in constant development and the obtained results will facilitate the whole range of decisions taken in the field of adapting water resources to climate change. Currently, all normative acts developed and applied in the Republic of Moldova are based on the data and information provided by SHS, AGRM and the Environment Agency. The improvement of the quality of the collected data will certainly be reflected in the necessary normative acts to be developed and implemented for the purpose of the sustainable management of water resources.

The main economic benefits are: The opening of new jobs, the creation of mobile sampling groups, the provision of climate services involves the creation of new jobs for highly qualified personnel. Investments in high-performance equipment and highly qualified personnel will also ensure a high quality of the products obtained. The expenses from the state budget (as well as from other sources) will be compensated by the products obtained, which are free, and the climate services provided will partially compensate the investments made.

The main social benefits are: The computerization of all state structures involved in decision-making on the one hand. On the other hand, in the computerization of the population with high-quality hydrological and hydrochemical information. Climate services rendered can also produce an income. The data and information collected and analyzed will be the basis of the computerization and awareness of the population regarding the adaptation of the water resources sector to climate change. The health of the population largely depends on access to water resources in sufficient volumes and of high quality. State institutions in the field of public health having quality data and information will be able to organize their prevention activities and not only for the purpose of increasing the health of the population, in accordance with the priorities described in the National Development Strategy "Moldova 2030".

Environmental benefits will be reflected in decision-making based on qualitative and current environmental information.

Improving the sustainable management of water resources by applying the water balance sheet. The water management balance, in general, represents the ratio between the intake and consumption of water resources on some part of the earth's surface, with the evidence of human management activity. By intake of water resources, we mean the runoff of surface and underground waters, consisting of atmospheric precipitation, wastewater from sewage systems, filtered water from irrigated lands, as well as water transported from other reception basins. By consumption of water resources, we mean evaporation from the surface of the catchment basin, capture of water for different uses, transport of water to other catchment basins. The water management balance sheet creates a clear picture of the provision of water resources of a territory, allows the highlighting of the water deficit and the adoption of decisions on the implementation of measures to compensate for the formed deficit.

All the methods and procedures for calculating the water management balance for basins, reception basins and water management sectors must be stipulated in the legal framework of the branch. In accordance with the respective normative acts, the water balance materials will contain data and information about the water resources available for use for different purposes.

The technology will be developed and applied from the start for the whole country. The technology aims to strengthen the capacities of local communities to adapt to hydrometeorological risk phenomena (droughts) under climate change conditions, as well as the involvement of state institutions, responsible for data collection and water resource management. Protection of water resources will be ensured, especially during dry periods. Water management balance calculations will regulate the sustainable use of water resources according to climate change.

The main economic benefits are: The technology does not provide for the creation of new jobs. Investments will be reduced only to the development of the calculation software. There will not be additional expenses.

The main social benefits are: An understanding and awareness by the population, the employees of the institutions responsible for the management of water resources, of the process of adaptation to climate change manifested by reducing the risk of water scarcity and the sustainable management of water resources. An improvement in the quality of the environment and, especially, water. However, there will be no direct benefits.

Main benefits for the environment and, indirectly, the protection of water resources, will be favored during periods of moisture deficit.

Optimization of number of reservoirs based on hydrological indicators.. The technology is completely new for the Republic of Moldova. The methodology for identifying the reservoirs intended for liquidation has already been developed. In its essence, multi-criteria analysis identifies the lake that no longer fulfills the function for which it was built. For example, it has become clogged, or is completely covered with swamp vegetation, etc. It is approved by the "Apele Moldovei" Agency and MADRM. The legal basis and procedural mechanisms are to be prepared.

Damping off a small (or even ephemeral) stream of water fed by shallow surface runoff or the few underground sources and being clogged, this pond represents an additional surface for water evaporation. It is known that, in the conditions of arid climate with a shortage of water resources, reservoirs and ponds considerably reduce the flow of rivers. In other words, they directly favor the destruction of rivers both as a water course and as an ecosystem. From the surface of small, clogged ponds, the collected water is lost only to intensive evaporation, in the conditions of climate change, with increasing temperatures in the summer months.
Overall, no fewer than 3,000 reservoirs and ponds in the country will be liquidated. The technology can be applied and transposed in neighboring countries (Romania and Ukraine), in regions with similar relief and climate. The technology aims to strengthen the capacities of local communities to adapt to hydrological risk phenomena (floods and droughts) under climate change conditions, as well as to improve the ecological status of small rivers. Improving the ecological status of small rivers and increasing their water resources represents a high potential to increase the quality of the environment. The very involvement of technology will favor the improvement of the legal framework and environmental policies.

The main economic benefits are: The liquidation of lakes and the reduction of their number in a catchment basin will allow investments to be made in unclogging, repair and effective maintenance of an optimal number of lakes on a river.

The expenses for the liquidation of dams and unclogging of lakes depend largely on the owner of the hydrotechnical construction (dam). The expenses will be borne by APL or the owners.

The main social benefits are: The volumes of water saved from additional evaporation can be used for different purposes (irrigation, for example). The population's understanding and awareness of the process of adapting to climate change manifested by increasing the volume of water in rivers. It will increase the volume of water resources, their quality and the overall quality of the environment.

Obviously, the quality of the environment will be improved by increasing the wetting of the territory, by reducing additional evaporation and restoring (in some sectors) the natural flow of water through the riverbeds.

The main normative acts in the field of water resources, which represent a result of the implementation of village policies, the list of important reports made on the given sector, as well as the important scientific monographs are presented as follows:

NO.	Normative act	Highlights
1.	The water supply and sanitation strategy (2014 – 2030), approved by Government Decision no. 199 of 20.03.2014	The purpose of the Strategy is to develop the water supply and sanitation sector, to create the necessary framework for the gradual assurance until 2030 of access to safe water and adequate sanitation for all localities and the population of the Republic of Moldova, thus contributing to the improvement of health, dignity and quality of life and to the economic development of the country.
2.	Water Law no. 272 of 23.12.2011	The purpose of the law is to create a normative framework for the monitoring, evaluation, management, protection and efficient use of surface water and underground water.
3.	The law regarding the areas and sheets for the protection of the waters of rivers and water basins no. 440 of 27.04.95	The purpose of the law is to protect rivers and water basins against pollution, impurity, depletion and siltation, as well as the use of related lands, as well as regulates the way of creating water protection zones and riparian water protection sheets for rivers and basins of water, the regime of use and the activity of their protection
4.	Law on associations of water users for irrigation no. 171 of 09.07.2010	The purpose of the law is to create the legal framework for the establishment and operation of irrigation water user associations and the creation of an effective mechanism for managing the state-owned irrigation and/or drainage infrastructure.
5.	Regulation regarding flood risk management, approved by Government	The regulation establishes the regulatory framework for flood risk management.

	Decision no. 887 of 11.11.2013.	
6.	Government Decision no. 433 of 18.06.2012 for the approval of the Regulation on flood protection dikes	The regulation establishes the requirements for the design, construction and operation of flood protection dikes; and extends to flood protection dikes located in the Republic of Moldova.
7.	Government Decision no. 977 of 16.08.2016 regarding the approval of the standard Regulation for the exploitation of reservoirs/ponds	The model regulation for the exploitation of reservoirs/ponds regulates how the regulation of reservoirs/ponds is drawn up and establishes the general criteria for the exploitation of water reservoirs, regardless of the form of ownership, built according to the requirements of the normative and legislative acts in force, to maintain their correct and sustainable exploitation, and applies to any natural or legal person who owns and manages reservoirs/ponds.
8.	Government Decision no. 775 of 04.10.2013 regarding the boundaries of the districts of river basins and sub-basins and the special maps where they are determined	The decision approves the boundaries of the watershed districts and subbasins.
9.	Government Decision no. 867 of 01.11.2013 for the approval of the Model Regulation on the method of constitution and operation of the River Basin District Committee	The regulation establishes the way of constitution and operation, structure and attributions of the River Basin District Committee
10.	Government Decision no. 835 of 29.10.2013 on the approval of the Regulation on the record and reporting of water used	The regulation establishes the method of recording and reporting the water used by water users, who operate based on the environmental authorization for the special use of water, regardless of the form of ownership and the source of water used.
11.	Government Decision no. 881 of 07.11.2013 for the approval of the Methodology regarding the identification, delimitation and classification of water bodies	The methodology establishes the methods for the identification and delimitation of surface and underground water bodies and the principles of their classification.
11.	Government Decision no. 949 of 25.11.2013 for the	The regulation establishes rules for the delimitation, creation and operation of sanitary protection zones

	approval of the Regulation on sanitary protection zones of water intakes	for water intakes from surface and underground waters.
13.	Government Decision no. 894 of 12.11.2013 for the approval of the Regulation on the organization and operation of the one-stop shop in the field of environmental authorization of the special use of water.	The purpose of the regulation is to streamline and rationalize the coordination and approval procedure of the necessary documents for the environmental authorization for the special use of water.
14.	Government Decision no. 506 of 01.11.2019 regarding the approval of the framework procedure regarding the organization, development and awarding of contracts for delegating the management of the public water supply and sewerage service	The procedure regulates the unitary legal framework related to the organization and carrying out of the procedures for awarding the contract for delegating the management of public water supply and sewerage services, as well as the concession of the assets that make up the water supply and sewerage systems.
15.	Government Decision no. 1466 of 30.12.2016 for the approval of the Sanitary Regulation on small drinking water supply systems	The purpose of the Regulation is to regulate the provision of safe drinking water supply to the population in small communities, the prevention and liquidation of possible pollution of small drinking water supply systems.
16.	DECISION No. 1466 of 12-30-2016 for the approval of the Sanitary Regulation on small drinking water supply systems	This Regulation establishes public health requirements for water quality, the choice of location, arrangement and operation of water capture, accumulation and distribution facilities, as well as the related territory. The purpose of the Regulation is to regulate the provision of safe drinking water supply to the population in small communities, the prevention and liquidation of possible pollution of small drinking water supply systems. The Regulation applies to small drinking water supply systems, operational or designed, that supply less than 200 m^3 on average/day or that serve communities of less than 2000 people and serve to satisfy the population's drinking and household water requirements.
17.	The national development strategy "Moldova 2030"	The national development strategy "Moldova 2030" is a strategic vision document, which indicates the development direction of the country and society to be followed in the next decade, based on the principle

		of the human life cycle, rights and quality of life, and includes four pillars of sustainable development, with 10 corresponding long-term objectives.
18.	The Sustainable Development Goals (SDGs) formulated by the 2030 Sustainable Development Agenda	The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. These 17 goals build on the successes of the Millennium Development Goals and now cover new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among other priorities. Objectives are interconnected. Often, the key to success in one area will involve addressing issues more commonly associated with another area.
19.	INDC-1 of the Republic of Moldova	The Republic of Moldova intends to achieve an economy-wide unconditional target of reducing its greenhouse gas emissions by 64-67 percent below its 1990 level in 2030 and to make best efforts to reduce its emissions by 67 percent. The reduction commitment expressed above could be increased up to 78 per cent below 1990 level conditional to, a global agreement addressing important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale commensurate to the challenge of global climate change. The adaptation component is present in this document.
20.	INDC-2 of the Republic of Moldova	The Republic of Moldova has included in its updated NDC the adaptation component in line with Articles 2.1 and 7.1 of the Paris Agreement and Katowice Rulebook (COP 24), as an opportunity to communicate the country's strategic vision on climate change adaptation. The adaptation component, as a forward-looking document, incorporates country's adaptation priorities that derive from the in-force policy documents, such as the Climate Change Adaptation Strategy and the Action Plan for its implementation (2014), as well as from the Fourth National Communication to the UNFCCC (2018), and from a number of national level policy documents covering cross-sectoral socioeconomic areas and sector-specific development documents of the national priority

		sectors: agriculture, water resources, human health, forestry, energy and transport.

Reports		
1	Moldova's Second National Communication under the United Nations Framework Convention on Climate Change (UNFCCC)21 (SNC, 2009).	The document includes climate projections for Moldova to 2100 and undertakes a preliminary vulnerability assessment of sectors including agriculture, water resources and forestry. This assessment includes an analysis of climate change impacts using three separate GCM's and time periods, as well as broad recommendations and potential adaptation and mitigation options for each sector. To assess the economics of mitigation and adaptation actions, the report also includes cost benefit analysis; however, no evaluation or prioritization of the adaptation options was performed.
2	The Third National Communication of Moldova under the United Nations Framework Convention on Climate Change (UNFCCC) 2013.	To evaluate Moldova's environmental performance we have utilized the data referring to Environmental Sustainable index (ESI) and Environmental Performance index (EPI) annually produced by Yale University's and Center for International Earth Science.
3	The Fourth National Communication of the Republic of Moldova Prepared to be reported to the United Nations Framework Convention on Climate Change	The Fourth National Communication of the Republic of Moldova to the United Nations Framework Convention on Climate Change was developed within the Project "Ensuring the support of the Republic of Moldova in order to prepare the first updated biennial report and the fourth national communication in accordance with its obligations towards the Convention- United Nations framework on climate change", implemented by the Ministry of Agriculture, Regional Development and Environment and the United Nations Environment Programme, with the financial support of the Global Environment Facility.
4	Vulnerability Assessment and Climate Change Impacts in the Republic of Moldova. Research, Studies, Solutions. Chisinau, 2018, "Bons Offices" - 352 p.	The Research Study Complementing Chapter 5 "Vulnerability Assessment and Climate Change Impacts" of the Fourth National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change.

Monographs		
1	Maria Nedealcov. Regional climate changes. Inst. of Ecology and Geography - Ch.: Sn, 2020. "Impressum" – 367 p.	The paper provides a deep analysis of climate change at a regional level. Changes in climate components – temperatures, precipitation, evaporation and its derivatives – are analyzed. Droughts and heatwaves and their impact on environmental components are described in detail.
2	Bejenaru Gh., Melniciuc O., Water resources of the Republic of Moldova (formation theory and regional synthesis), Chisinau, "Protipar Service", 2020, 338 p.	The monograph is dedicated to the development of methodological principles regarding the evaluation and research of water resources in the Republic of Moldova in the context of their change under the influence of human economic activity and in relation to the possible climate changes of this century. A complex system of calculations regarding the genetic components of the formation of water resources of rivers and intermittent streams is proposed based on the genetic-statistical theory of river flow, using elements of systemic and factorial analysis.

1.1.2. Action Plan for Technology "Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions"

1.1.2.1 Introduction

The members of the sectoral working group participated in the exercise of multi-criteria analysis and prioritization of technologies for adapting the water resources sector to climate change:

1. The Ministry of the Environment, Directorate of integrated water resources management policies.

2. South Regional Development Agency.

3. Agency for Geology and Mineral Resources, Geological Directorate.

4. State Hydrometeorological Service, Hydrology Center.

5. EcoContact Public Association.

6. "Apele Moldovei" Agency, Water Resources Management Directorate.

7. Institute of Ecology and Geography, Landscape Geography Laboratory.

8. Institute of Geology, Hydrogeology Laboratory.

As a result of the analysis, 3 technologies were identified as priorities, which accumulated maximum points:

1. Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions.

2. Improving the sustainable management of water resources by applying the water management balance sheet.

3. Optimization of number of reservoirs based on hydrological indicators..

Although the technologies prioritized by applying the MCA tool correspond to major risks and vulnerabilities caused by climate impacts, to test their robustness, the awareness exercise was applied.

The sensitivity exercise carried out focused on the fact that the climatic impacts identified as major have a relative character, which could change depending on the dynamics and amplitude of external climatic factors, as well as different economic and social aspects within the sector/country. Respectively, the predefined weights of climate impacts (Surplus of water – 40; Deficit of water – 40; Protection of aquatic ecosystems – 20) could change.

It is obvious that the most important in the case of water resources are the floods, with their extremely negative consequences for the human frame and the water deficit, mainly due to droughts.

Based on the sensitization exercise, we can conclude that the technologies selected in the process of the prioritization exercise are in the Top 3 positions, with the given technology in first place.

Improving leakage monitoring. The technology provides for the optimization of the hydrological observation network, the adaptation of the methodologies to EU requirements and the implementation of new technologies for making hydrological forecasts of different durations. The focus will be on the automation of hydrological monitoring stations and the application of digital models in the development of hydrological forecasts. Contemporary flashflood forecasting systems will be applied by applying contemporary techniques (especially radar data), something that has not been done in the Republic of Moldova until now.

The operational exchange mechanism with the data collected between the branch institutions will be developed. Even if the State Water Cadastre Automated Information System is already implemented, it does not provide for the operative updating of the information. He relies more on average data and indicators. It is proposed to develop and implement an operational data exchange mechanism between institutions related to the monitoring and management of water resources. The development and dissemination of forecasts, bulletins and hydrological alerts, water quality is considered.

The hydrometric observation stations will be modernized by equipping them with construction and contemporary monitoring equipment. Currently, only the stations on the Dniester and Prut rivers and a few internal rivers are equipped with contemporary equipment. Along with the total automation of the hydrological observation network, the classic equipment, necessary for calibrating the automatic stations, will also be modernized.

It is essential to implement hydrological models in SHS, especially for forecasting purposes, but also for risk and disaster management purposes. The implementation of hydrological forecasting models will increase the reliability of forecasting results, limit the time spent on daily forecasting and increase the possibility of automatic publication of hydrological forecasts. The system to be implemented should meet the following requirements:

Although it is not intended to provide a detailed description of the requirements of a hydrological forecasting system and/or the design of the system itself, a brief description of the required components and the suggested approach will be presented within this document. It should be noted that more thorough documentation will be required during implementation to outline the design and conceptualization of the model.

It should also be noted that the forecasting system will be based on the following components, including the various data sources, hydrological modeling forecasting and output analysis. The hydrological forecasting system will be implemented at the national level, covering the entire territory of Moldova and considering local peculiarities during the calibration procedures. It should be noted that also in the implementation phase, locations will be defined for modeling/forecasting the results, but that this could be adjusted, and the results could be produced anywhere in the country.

As for the various processes and input data, they are described below. However, to provide a better understanding, it should be noted that the meteorological input will be used by the hydrological forecast model to produce water discharge information at the previously mentioned predefined locations. The hydrological modeling approach and meteorological data variables to be considered in implementing the hydrological modeling will be defined during the calibration process, but at this stage it is expected that precipitation and temperature will be the main inputs.

Improving effective information sharing

Currently SHS provides hydrological forecasts, bulletins and alerts, which are sent to beneficiaries by e-mail or placed on the SHS web page. Regime data and information are not published in hydrological yearbooks or summary guides. The reason is simple – lack of human and financial resources.

There is a limited exchange of operational and regime information with branch institutions. The "Apele Moldovei" Agency, the Ministry of the Environment, the Civil Protection and Exceptional Situations Service, etc., practice indicates that, in addition to forecasts, warnings (which are issued according to the regulation to the indicated institutions by e-mail) and predetermined information bulletins, there is also the need for access to hydrological information for branch institutions depending on the need and case. The subject is resolved through official steps at SHS to provide or give access to the information in question.

Thus, the technology implies:

1. Reviewing the structure and content of forecasts, alerts and bulletins developed and disseminated by SHS.

2. Elaboration of models of hydrological yearbooks and multi-year synthesis data, as well as their publication (on the website of the SHS and on paper – in limited edition, for internal use).

3. Modernization of the sections of the SHS web page by improving the presentation methods. Information presentation procedures will be used interactively, spatially and dynamically.

The technology will contribute both conceptually and technically to the reduction of sectoral vulnerability to climate impact through fast, qualitative, spatially more precise computerization. All forecasts and spatial alerts will be reduced, that is, not on the entire territory of the country or the river basin, but on the identified sectors where the phenomenon will be triggered. The presentation of the regime data collected, and their open publication will serve in the computerization of the structures that deal with the analysis of climate change, the assessment of vulnerability and the development of concrete measures to adapt to climate change. The modernization of information dissemination and distribution systems will favor access to information for all interested structures, as well as they will be the basis for the creation of the long-awaited early warning system of risk phenomena.

1.1.2.2 Ambition for the TAP

Currently, there are 53 hydrological stations in the Republic of Moldova, among which:

- 33 are classic stations.
- 14 have classic and automatic functions.
- 16 are automatic.

From the total number of hydrometric stations listed, 41 are managed by the SHS of the Republic of Moldova, and 12 are subordinated to the Tiraspol Hydrometeorological Center. However, there is cooperation between the hydrometeorological services on both banks of the Dniester, based on partnership relations.

The analysis of the location density of the hydrometric observation stations indicates a less positive situation from an operational point of view. However, from several stations considering the area of the country, the density of stations seems acceptable. The number of hydrological stations in Moldova is 53, which means that one station covers approximately 638km^2 (considering that the surface of the country is 33,846km^2).

This number is significantly higher than the value recommended by the WMO for hydrometeorological monitoring (1,875 km^2 for one station), but the water resources of the small rivers in the country require a higher density of observation stations.

However, the location of hydrological stations should be carefully considered. The basic criterion here is representativeness, i.e. the place chosen must be typical for the given region. Of the 53 stations, 38 are in the two main rivers (Dniester and Prut), while only 15 are located in other watercourses, some of them close to the mouths of rivers draining into these two watercourses or close to of the mouth. The Dniester and Prut rivers are highly regulated, there are numerous dams in their course, and there is also hydrological (monitoring and forecasting) information from the upstream countries of Moldova (respectively Ukraine and Romania). Therefore, the number of stations on these rivers must be reduced, and the number of stations on internal watercourses must be increased.

Contemporary hydrological forecasts are based on the methods developed in the former USSR with a very limited informative content and are carried out without the application of contemporary technologies but on graph paper.

The exchange of information at the international level is carried out with Romania and Ukraine based on emails. There are no effective data exchange platforms. Data exchange between state institutions is carried out by e-mails, or (upon request) even in the context of warnings and alerts. It should be noted that there is no early warning system in the country.

So, the ambition for the technology "Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions" consists in the **creation of a representative monitoring network, supported by an effective platform for data collection and processing, the development of forecasts based on methodologies and contemporary procedures based on WMO and EU standards/procedures and efficient exchange of information between the country's and international institutions** .

It should also be noted that in the scientific hydrological research carried out in the country, the need to open new stations or the lack of data in one region or another is often emphasized. The importance of measuring high water and flash floods should be emphasized.

Currently, only the stations on the Dniester and Prut rivers and a few internal rivers are equipped with contemporary equipment. Along with the total automation of the hydrological observation network, the classic equipment, necessary for calibrating the automatic stations, will also be modernized.

Automated hydrochemical stations are extremely expensive to operate and will be replaced by mobile sampling laboratories.

1.1.2.3 Actions and Activities selected for inclusion in the TAP

Most of the existing barriers are common to all technologies. They can be divided into the following categories:

- Economic and financial.
- Legislative and regulatory.
- Technical.
- Institutional.

Given that the selected technology consists of three components, the barriers will be broken down into these components:

Economic and financial barriers

Improving leakage monitoring: The instruments, machines and constructions for carrying out hydrological observations are expensive, and the state budget does not provide for their procurement. Respectively, from the 90s until now, practically all the equipment is procured from financial sources provided by external donors. So, the main financial barrier is the high cost of the equipment for making the measurements. This includes high maintenance costs.

Improving hydrological forecasting: Lack of digital forecasting models. They represent software in themselves, which can be open-source, but more often, commercial. Their cost is quite high.

It should be noted that in the country there is currently no centralized early warning system against hydrological risk phenomena (floods due to overflowing rivers and rain floods). The implementation of these systems is mostly done through the transfer of technologies and requires both capital investment and high maintenance costs.

Improving effective information sharing: There are no major financial barriers. The necessary expenses will only be related to the maintenance of the SHS web page, filling it with operational and regime information, as well as the publication of summary data.

<u>Non-financial barriers</u>

Improving leakage monitoring: The main barrier is the lack of cadres in the territory. Namely, the lack of trained personnel in the localities in the vicinity of which monitoring stations are set up. As a rule, the workers working at the stations are of advanced age, without specialized studies, and their training is carried out directly by the SHS collaborators. Indirectly, of course, it is the financial motivation (very low salaries), but the main barrier is the worsening demographic situation in the country.

Improving hydrological forecasting: Lack of contemporary (numerical) models for making long-term and short-term hydrological forecasts. Lack of special training of SHS collaborators in the use of information systems (GIS, for example). Lack of specialized training (studies) in developing forecasts of engineers from SHS. Lack of knowledge of modern languages. The lack of initiative can also be attributed here, as a subjective barrier.

Improving effective information sharing: The lack of will to "open the archive" can be attributed here, to provide access to the collected information for other institutions, beneficiaries and civil society. Awareness of the development of a mechanism for access to information and data exchange is an important barrier, the removal of which will further favor the efficient management of water resources in the country.

In the not-so-distant past, "hydrological yearbooks" were published annually, which were integrated into a summary guide once every five years. Paper publications were sent to state libraries and branch institution libraries. Nowadays, this practice is lost, and many branch institutions no longer even have libraries. The respective information cannot even be found online on the SHS website.

Again, SHS previously produced publications in the form of summaries and regionalizations and specialized guides of hydrological information, which served as a good support in understanding the situation in the field and were useful for the development of policy documents, for decision-making, etc. This practice has also been forgotten.

It should be noted that this opening implies integration (to the extent of needs and possibilities) with regional/international profile networks and the exchange of data, as well as cooperation with them.

Actions selected for inclusion in the TAP

The measures selected as actions for inclusion in the TAP related to the technology "Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions" are the following:
Refinement of leakage monitoring: The main activities and needs in the development of the technology will focus on the following:

1. Detailed design of the new network: While the network has already been reviewed, a more detailed assessment is required to be undertaken considering the following:

    a. The history of selected stations to be moved or not upgraded to automatic stations should be reviewed in detail. As mentioned, the selection of these stations was made in geographical terms only and could therefore be selected immediately upstream of the downstream station (in some cases).

    b. The access, relevance, reliability and infrastructure of these stations should also be analysed.

    c. Selection of new stations should also be carefully considered based on existing discharge, flood history and water management history.

These activities should be undertaken by a qualified international expert (or team of experts) in close collaboration with national experts and SHS collaborators.

2. Detailed selection of station locations: once a more detailed design of the new network has been carried out, the detailed selection of new sites should be carried out by a national or international expert in close cooperation with SHS experts. The WMO recommendations for site selection should be considered in this regard.

3. New stations: The new stations (about 30 in number) should be purchased after the procurement specifications have been detailed by an international expert in close collaboration with SHS staff.

4. Installation: Installation of new stations should be carried out by the station supplier in close cooperation with SHS staff.

5. Operation and maintenance training: It would be recommended that the station supplier conduct a training of at least 20 days in the operation and maintenance of the stations.

Improving hydrological forecasting:

1. Design: The first activity required in implementation would be detailed system design, including all necessary assessments of data inputs, identification of presentation and visualization platform, and software, and detailed system design.

2. Data Collection: Extensive data collection should be undertaken to ensure that sufficient data are available to implement the event mode hydrologic model. Other data should be collected for other implementation purposes.

3. Implementation of hydrologic modeling: The hydrologic model should be implemented in event mode for calibration and validation purposes. This model should be calibrated to different events, considering different types of disasters. The calibrated model will be the basis for the implementation of hydrological forecasts, but this model can also be used for risk purposes.

4. Implementation of the forecasting platform: The forecasting platform should be implemented in this activity. The implementation of the platform should be done in a dedicated server, where all software inputs and associated data should be collected. It should be noted that here are also included the modeling of water resources according to the projections of regional climate change scenarios.

5. Implementation of hydrological forecasts: The hydrological model previously implemented in phase three should be adjusted for forecasting purposes. It should be noted that an event-based model and an operational hydrological model differ in approach for some of the modules, and therefore the model should be adjusted to be in operational mode. The model should be tested in feedforward mode to increase confidence in the results of the forecasting platform.

6. Data inputs and data flow procedures: To ensure that all required data inputs and data flow procedures are implemented, a detailed document should be developed with all procedures and data inputs should be tested and data flows in detail to ensure that all data required for the forecasting platform is routinely available.

7. Platform Testing: The entire forecasting platform should be thoroughly tested to ensure its proper functioning. At the beginning of the implementation, the platform will be in test mode, and the results will be carefully analyzed to improve the efficiency and accuracy of the forecast.

8. Implementation of the forecasting and warning platform: As mentioned, the results of the forecasting platform will have many uses within the water sector, including water management, hydroelectric purposes and flood warning. In this activity, procedures for using outputs data from the platform will be designed, including warning thresholds and warning procedures, for example the color code system currently used at SHS.

- It should consider all hydrological monitoring data in real time and automatically.

- It should also consider additional data resources, both from remote sensing and from hydrological and hydraulic models.

- It will be based on open-source software.

- It should be easy to operate and analyze.

- It will be based on the implementation of previously calibrated models.

- It will provide daily hydrological forecasts and support the development of climate services.

- The system will be multifunctional. In addition to providing daily hydrological forecasts at predefined locations in Moldova, which can be used for water management purposes, the hydrological forecasts will be coupled with a climate database to also provide warnings associated with potential floods. It should be noted that the development of the SHS integrated database will also include the climate change segment. An IT platform focused on climate services will even be developed. The nominated platform will include the good practices used in this segment by the countries of the European Community, respecting the community standards. It is developed with maximum data import and export compatibility with similar European systems. The climate services developed by SHS and placed in the database of this platform will facilitate the decision-making of dedicated state structures, the informatization of researchers and analysts in the sector, farmers, water users and other state or private commercial structures, as well as civil society.

Improving effective information sharing

1. The content and presentation method for beneficiaries of the structure and content of hydrological bulletins and alerts will be revised and standardized templates will be developed.

2. The presentation of operative and forecast information on the SHS web page will be revised.

3. The list of publications of regime materials and summary of indicators monitored by SHS will be reviewed and updated.

Activities identified for the implementation of selected actions

The activities identified for the implementation of the selected actions:

1. The Improving Leakage Monitoring Action will include the following activities:

i. Revision of the spatial location of the hydrological stations. The design of the new monitoring network.

ii. Identification of the set of modern equipment, machines and constructions, as well as the necessary software, their procurement and installation.

iii. Training of station workers.

2. The action Improving hydrological forecasting will include the following activities:

i. Procurement of specialized forecasting software.

ii. Implementation of contemporary forecasting methodologies and instructions.

iii. Training forecasting engineers.

3. The action Enhancing the effective exchange of information will include the following activities:

i. Creation of a mechanism (software, IT platform), which will integrate all the data set collected from automatic and classic hydrological observation stations.

ii. Automation of issuing warnings and early alerts.

Actions to be implemented as project ideas

The project idea provides for the optimization of the hydrological observation network, the adaptation of the methodologies to EU requirements and the implementation of new technologies for making hydrological forecasts of different durations. The focus will be on the automation of hydrological monitoring stations and the application of digital models in the development of hydrological forecasts. Contemporary flashflood forecasting systems will be applied by applying contemporary techniques (especially radar data), something that has not been done in the Republic of Moldova until now.

The operational exchange mechanism with the data collected between the branch institutions will be developed. Even if the State Water Cadastre Automated Information System is already implemented, it does not provide for the operative updating of the information. He relies more on average data and indicators. It is proposed to develop and implement an operational data exchange mechanism between institutions related to the monitoring and management of water resources. The development and dissemination of forecasts, bulletins and hydrological alerts, water quality is considered.

The hydrometric observation stations will be modernized by equipping them with constructions and contemporary monitoring equipment. Currently, only the stations on the Dniester and Prut rivers and a few internal rivers are equipped with contemporary equipment. Along with the total automation of the hydrological observation network, the classic equipment, necessary for calibrating the automatic stations, will also be modernized.

All actions are gender neutral and envisage equal opportunities for men and women of all ages for their implementation.

1.1.2.4 Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The main actors in the field of the selected technology were divided into several groups. The highlighting of these groups was done according to its role in relation to water resources. Without the involvement of these actors, it is impossible to implement the identified measures.

2. The "Integrated water resources management policies" department of MADRM, which directly deals with the development of policies in the given sector.

3. The "Bilateral Treaties" section of the Ministry of Foreign Affairs and European Integration. The management of transboundary water resources of the Dniester and Prut rivers requires support at the ministry level.

4. The Meteorological Center and the Hydrological Center of the State Hydrometeorological Service. It should be noted that monitoring and developing forecasts and warnings becomes difficult without the use of contemporary technologies. This institution is crucial in the implementation of new technologies for monitoring and evaluating water resources.

5. The "Environmental Quality Monitoring" Department of the Environmental Agency. This direction has an extremely high mandate in the management of the quality of water resources, but the potential (both of the direction and of the Agency as a whole) is currently very limited. This can be explained a period of painful reforms of organization and administration that has been undertaken.

6. The "Water Resources Management" Directorate of the "Moldova Waters" Agency. In this unit the situation is similar to that in the Environment Agency. The assessment and management of water resources is within the competence of this unit. However, the insufficiency of the staff limits the efforts made.

7. The "Geological" Directorate of the Agency for Geology and Mineral Resources. Groundwater is monitored and assessed through this facility. Unfortunately, the institutional potential of the entity is minimal.

8. The "Geography of landscapes" laboratory from the Institute of Ecology and Geography. The representatives of the academic environment are the main generators of ideas in the application of new technologies for managing water resources in the conditions of environmental transformations. This laboratory is concerned with solving problems related to hydrological problems.

9. The "Hydrogeology" Laboratory of the Institute of Geology and Seismology. Groundwater is scientifically researched by that unit. Currently, only the human resources who are familiar with the new technologies for adapting to climate change in the underground water segment are concentrated here.

10. Representatives from environmental NGOs (Ecocontact, Oikumena, Ecotiras). These environmental NGOs have manifested themselves through the implementation (or participation in the implementation) of a series of projects oriented towards climate change adaptations in the field of water resources. We believe that the accumulated experience can be useful in achieving the intended objectives.

Scheduling and sequencing of specific activities

The approximate stages of carrying out the activities are presented in tabular form:

Activity	Duration of achievement
Improving leakage monitoring	
The design of the new monitoring network	0.5 year
Selecting the location of the automatic station	1 year
Purchase of automatic stations	1 year
Installation and calibration of stations	1 year
Staff training	1 month
Improving hydrological forecasting	
Forecasting and warning system design	1 month
Data collection	1 month
Implementation of hydrological modeling	0.5 year
Implementation of the forecasting platform	0.5 year
Implementation of hydrological forecasts	0.5 year
Data Entry and Data Flow Procedures	0.5 year
Platform testing	3 months
Implementation of the platform	0.5 year
Improving effective information sharing	
Reviewing and approving the content of forecasts, bulletins and warnings	0.5 year
Review and approval of presentation	0.5 year
Reviewing and updating and approving the list of summary publications	0.5 year

1.1.2.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

The State Hydrometeorological Service, the Geology and Mineral Resources Agency and the Environment Agency are the institutions responsible for monitoring water resources. All of them have the institutional capacity to organize effective monitoring, but they are in acute crisis of qualified personnel to carry out the works.

It should be noted that for some specialties in the Republic of Moldova, respective cadres are not prepared, for example hydrological engineers or hydrological forecasters. For these reasons, unfortunately, self-training or on-the-job training has become one of the main tools for staff training. In other words - the young staff working in the field do not have fundamental university training.

Very roughly, no less than 20 specialists working in shifts should be trained, and the estimated cost of the courses can be 10 thousand EUR.

Estimates of costs of actions and activities

The technology provides for the optimization of the hydrological observation network, the adaptation of the methodologies to EU requirements and the implementation of new technologies for making forecasts, bulletins and hydrological alerts of different duration. The focus will be on the automation of hydrological monitoring stations and the application of digital models in the development of hydrological forecasts. Contemporary flashflood forecasting systems will be applied by applying contemporary techniques (especially radar data), something that has not been done in the Republic of Moldova until now.

The operational exchange mechanism with the data collected between the branch institutions will be developed. Even if the State Water Cadastre Automated Information System is already implemented, it does not provide for the operative updating of the information. He relies more on average data and indicators. It is proposed to develop and implement an operational data exchange mechanism between institutions related to the monitoring and management of water resources. The development and dissemination of forecasts, bulletins and hydrological alerts, water quality is considered.

The hydrological observation stations will be modernized by equipping them with constructions and contemporary monitoring equipment. Currently, only the stations on the Dniester and Prut rivers, as well as a few internal rivers, are equipped with contemporary equipment. Along with the total automation of the hydrological observation network, the classic equipment, necessary for calibrating the automatic stations, will also be modernized.

The investment costs are very roughly estimated at about 2 million euros. There will be big problems in the given segment because the budget of the Republic of Moldova has never provided sources for the procurement of equipment or software for the successful realization of hydrological monitoring. The contemporary economic situation does not create premises that the paradigm will change. So, the investments will be made by external donors, who need to be identified further.

Operational expenses will be borne by the institutions responsible for monitoring: SHS – hydrological monitoring, Environment Agency – hydrochemical and hydrobiological monitoring. Respectively, they will be covered by the budget of the respective institutions.

Maintenance expenses include repair of equipment, buildings, machinery and tools. In the case of hydrochemical monitoring, the reagents are expensive. The maintenance assessment is very approximate and can amount to around 300 thousand EUR annually. Of course, in the first years of operation of the new machine, the maintenance expenses will be minimal.

Estimated cost calculations are presented in Table 1.1.2.7.

1.1.2.6 Management Planning

Risks and Contingency Planning

Potential risks can be of several types – the cost of insufficient equipment and software investments, lack of adherence to the implementation schedule, insufficient training and high fluidity of trained personnel.

Identification and procurement of equipment may take time despite the uncertainty of the economic and political situation in the region and in the country. There may be unpredictable risks of equipment delivery, travel of professional technicians from abroad, who will install the equipment, etc.

One of the major risks may be the vandalism of equipment already installed at the SHS observation network.

Compliance with the schedule of works is partly subject to the same risk, and partly in the solution of bureaucratic problems between the institutions of the country. In particular, we are referring to the identification of the lands, where new stations will be set up (including the necessary constructions and the approval of the respective exploitation documents) and the solution of all the problems related to the use of the respective lands. Also here can be attributed the risks of delivery of the necessary equipment.

No less important is the training of specialists, which is not currently possible to identify in which way it will be carried out – whether live or online, in-country or abroad – and the planned budget depends on these circumstances. The biggest risk lies, however, in the fact that, following significant investment in the professional training of the collaborator (e.g. forecasting engineer, or GIS-analyst and modeler), there are neither incentives nor levers to keep them in the SHS team.

Next Steps

One of the pressing needs is the approval of the Law on meteorological and hydrological activity, which will regulate practically all the proposed measures and activities. The law is already being drafted and will be put up for public discussion.

The critical needs require political will and prioritization by the Ministry of the Environment of the quality monitoring of water resources, which will be the main support in the development of effective forecasts and alerts, and ultimately will stimulate the creation of an early warning system. Political support will be crucial in achieving the proposed objectives, as they are themselves highly technical.

1.1.2.7 TAP overview table

TAP overview table								
Section	Water resources							
subsector								
Technology	Improving monitoring and forecasting of runoff, water quality, and effective information sharing between various institutions.							
pique	The creation of a representative monitoring network, supported by an efficient data collection and processing platform, the development of forecasts based on contemporary methodologies and procedures based on WMO and EU standards/procedures and efficient exchange of information between the country's and international institutions.							
Benefits	**The main benefits are:** Improving the monitoring of water resources, qualitative and timely forecasts, warnings and alerts, efficient exchange of data between the actors involved in the management of water resources to make correct and quick decisions. **Economic benefits:** The opening of new positions, the creation of mobile sampling groups, the provision of climate services requires the creation of new jobs for highly qualified personnel. Investments in high-performance equipment and highly qualified personnel will also ensure a high quality of the products obtained. The expenses from the state budget (as well as from other sources) will be compensated by the products obtained, which are free, and the climate services provided will partially compensate the investments made. **Social benefits:** The major benefit consists in the computerization of all state structures involved in decision-making on the one hand, on the other hand in the computerization of the population with high-quality hydrological and hydrochemical information. Climate services rendered can also produce an income. The data and information collected and analyzed will be the basis of the computerization and awareness of the population regarding the adaptation of the water resources sector to climate change. **Environmental benefits:** Environmental benefits will be reflected in decision-making based on qualitative and current environmental information. **Adaptation/resilience benefits:** Information with qualitative data, forecasts and qualitative warnings about water resources of all structures involved in the field of water management will be the major support in the development of climate change adaptation actions both at the country level and at the local. Knowing the real situation is the first step in correct management of the problem that has arisen.							
Act	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame, (month)**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity, Mil. than EUR**
Improving leakage monitoring	Activity 1.1. Review of the spatial location of hydrological stations. The design of the new monitoring network	State budget	**SHS,** Environmental Agency, Moldavian Waters Agency, AGRM	6	Political will	Share of stations per body of water	Representative monitoring network	0.05

	Activity 1.2. Identifying the set of modern equipment, machinery and construction, as well as the necessary software, their procurement and installation	External donors	**SHS,** Environmental Agency, Moldavian Waters Agency, AGRM	18	Unpredictability in implementation	Contemporary equipment installed and operational	Functional automatic stations	1.0
	Activity 1.3. Training of station workers	External donors	**SHS**	1	Migration of trained personnel	The existence of professional engineers	No trained specialists	0.1
Improving hydrological forecasting	Activity 2.1. Procurement of specialized forecasting software	External donors	**SHS**	6	Unpredictability in implementation	Specialized software installed	Functional specialized software	0.5
	Activity 2.2. Implementation of contemporary forecasting methodologies and instructions.	State budget	**SHS**	12	Lack of trained personnel	The existence and availability of contemporary methods and technologies	Applied contemporary methods and technologies	0.1
	Activity 2.3. Training forecasting engineers	External donors	**SHS,** Environmental Agency, Moldavian Waters Agency, AGRM	3	Migration of trained personnel	Professional engineers	No trained specialists	0.1
Improving effective	Activity 3.1. Creation of a mechanism	External donors	**SHS**	12	Unpredictability in	Software developed	Functional data exchange platform	0.3

information sharing	(software, IT platform), which will integrate all the data set collected from automatic and classic hydrological observation stations				implement ation	(or adapted) and implemente d		
	Activity 3.2. Automating early warnings and alerts	State budget	**SHS**	3	Lack of trained personnel	Bulletins, warnings and alerts issued automaticall y	Automatic issuing system	0.05
							Total	2.2

1.1.3 Action Plan for Technology Improving the sustainable management of water resources by applying the water management balance sheet

1.1.3.1 Introduction

The members of the sectoral working group participated in the exercise of multi-criteria analysis and prioritization of technologies for adapting the water resources sector to climate change:

1. The Ministry of the Environment, Directorate of integrated water resources management policies.

2. South Regional Development Agency.

3. Agency for Geology and Mineral Resources, Geological Directorate.

4. State Hydrometeorological Service, Hydrology Center.

5. EcoContact Public Association.

6. "Apele Moldovei" Agency, Water Resources Management Directorate.

7. Institute of Ecology and Geography, Landscape Geography Laboratory.

8. Institute of Geology, Hydrogeology Laboratory.

As a result of the analysis, 3 technologies were identified as priorities, which accumulated maximum points:

1. Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions.

2. Improving the sustainable management of water resources by applying the water management balance sheet.

3. Optimization of number of reservoirs based on hydrological indicators..

Although the technologies prioritized by applying the MCA tool correspond to major risks and vulnerabilities caused by climate impacts, to test their robustness, the awareness exercise was applied.

The sensitivity exercise carried out focused on the fact that the climatic impacts identified as major have a relative character, which could change depending on the dynamics and amplitude of external climatic factors, as well as different economic and social aspects within the sector/country. Respectively, the predefined weights of climate impacts (Surplus of water – 40; Deficit of water – 40; Protection of aquatic ecosystems – 20) could change.

It is obvious that the most important in the case of water resources are the floods, with their extremely negative consequences for the human frame and the water deficit, mainly due to droughts.

Based on the sensitization exercise, we can conclude that the technologies selected in the prioritization exercise process are in the Top 3 positions, with the given technology in second place.

The technology is based on the development and/or implementation of a software application for the analysis and calculation of the balance of water management by water resources management sectors. The given tool will allow you to give a quick answer regarding the available water resources both on water resource management sectors and for a specific water body.

The essence of the water balance lies in knowing the difference between intake and consumption of water, that is, in evaluating the available water resources. The forecasting component allows the assessment of available water resources in the future as well. In other words, depending on the regional scenarios of climate change, the available water resources will be evaluated for different time intervals, for example every 10 to ten years, and ideally every 5 years because climate change has a high production speed (up to at the end of the XXI century) and depending on the intensity of global warming. This moment is very important, because currently some beneficiaries obtain long-term special water use authorization, even up to 30 years, without considering the impact of climate change on water resources. That is, without arguing whether the requested volumes of water will generally be available. So, applying the indicated technology (WBS) depending on the presence, insufficiency or lack of water resources, special water use permits will be issued and management activities in the water resources sector will be planned for the near and medium future.

Two main input data sets are used to calculate the water management balance: Water resources (based on the water balance) and water use. The water management balance can be calculated at the point or for some area (water management sector, reception basin, river basin).

For planning the use of water resources, the water management balance is calculated for the water resources management sectors (approved by the "Apele Moldovei" Agency). Water resource management sectors are identified at two levels, broad sectors and more detailed sectors. In both cases, the basin principle is respected.

In the calculation of the water balance, one operates not with the measured runoff, but with the available runoff ensured, with a different exceedance probability. As a rule, P=50% (average runoff year), P=75% (dry year) and P=85, 90 or 95% very dry years.

The results of the evaluation will be placed in the Automated Information System of the State Cadastre of Waters. For this, the calculation must be done using specialized software, which can be free, commercial or specially developed in the Republic of Moldova. The calculation algorithm is well known, applied all over the world and approved by the "Apele Moldovei" Agency.

1.1.3.2 Ambition for the TAP

The ambition of the technology is **the application of the water management balance sheet, as a tool, in the sustainable management of water resources in the Republic of Moldova.** Obviously, the coverage area is for the whole country. The main beneficiaries are the central public administration bodies, institutions skilled in design (hydrotechnical, transport, communications, agricultural, regional development and of course water supply and sewage, etc.), and enterprises that use water resources.

The major benefit of implementing the water management balance lies in the assessment and management of available water resources. The application of this technology will primarily favor the protection of water resources through their rational use, especially in the conditions of arid climate, during periods of drought, summer lows, when there is very little water available.

1.1.3.3 Actions and Activities selected for inclusion in the TAP

Summary of barriers and measures to overcome barriers

Economic and financial barriers

Economic and financial barriers are common, as the implementation of new technologies requires significant investments. In our case, the problem is not so much economic, because the technology will not bring direct profit, but financial, because it requires investment. Of course, any technology implementation activity requires financial investments (often indirect or camouflaged), but in the case of the proposed technology (WBS), the major expenses will be limited to the procurement of the computer software. It should be noted that the problem is intertwined with that of the institutional category, more precisely through the lens of the financing of the functions intended to implement the technology.

The implementation of the technology will require financial investment in the function of the approach to the subject.

- If free calculation software will be used, the costs will be minimal and the adaptation of the software for the conditions of the Republic of Moldova will be reduced (eg WEAP - https://www.weap21.org/).

- If commercial software is used, investments will be required in the procurement and maintenance of these software, as well as their calibration for the conditions of the Republic of Moldova (e.g. AKWA-m - https://www.hydro-consult.de/wasserhaushaltsmodell-na -modell, or Water Balance Model Desktop - https://waterbalance.ca/tool/water-balance-desktop/).

- In case of developing the domestic software for calculating the water management balance (preferable variant) – the costs will be comparable to the commercial one, but here the specifics of the national database and the longer-term maintenance will be included from the start.

The maintenance costs depend on the organization of the unit that will deal with the water balance calculation but cannot be compared to the primary investments.

The calculation software itself is simply a tool. It will also be necessary to develop and implement an independent database or with the possibility of access to the databases of the institutions that will provide data for the calculation.

<u>Non-financial barriers</u>

The legislative barrier includes the fact that legislation and normative acts are in constant reform, are not optimized and have large gaps. The old, even ex-Soviet, methodologies and instructions that are in force today have led to the use of reporting forms that no longer correspond to the structures of the national economy, which uses water for various uses. The lack of an approved procedure for evaluating the available water resources is reflected in the issuance of unjustified special water use permits, which means their ineffective management.

There is a wide range of **technical barriers** related to the flow of data and software. The data flow must be organized from scratch, because the necessary data collection procedures do not exist at the moment. It should be noted here that there is no integrated database, which must contain data collected from different institutions focused on water intake, water losses and water use. There is no approved software (commercial or free) with which the calculations will be made. There are also no plans in the use of water resources, especially considering the impact of climate change on water resources and the overdevelopment of the national economy.

The institutional barrier consists in the fact that the operational process must be organized from scratch. From the identification of the institution, the approval of the procedures, etc., to the elaboration of the reporting forms and, finally, the issuance of justified authorizations. The chronic lack of qualified personnel, especially in the last decade, is a serious problem. It should be noted that, in principle, a sustainable management of water resources is also achieved by planning their use. In the Republic of Moldova, unfortunately, this activity was not carried out and only their dramatic reduction, especially due to climate change, requires the application of WBS.

Understanding common barriers can help address them to promote faster implementation of selected technologies. Next, adescription is presented.

The main barrier, therefore, is institutional and consists of the fact that these calculations are not carried out and there is no subdivision within the Ministry of the Environment that is responsible for carrying out the Water Management Balance Sheet. It should also be mentioned here that, in the water law, neither the phrase "climate change" (https://www.legis.md/cautare/getResults?doc_id=121479&lang=ro#) nor "water balance" is applied.

Starting from the fact that a new activity will be organized (WBS calculation), several institutional barriers will be outlined, the most important of which will be the informational ones. From the conceptual calculation model of the WBS it is obvious that data will be needed regarding water intake and consumption. It will be necessary to organize the information flow of data to the institution responsible for the calculation of the WBS.

Another problem, already of a technical nature, concerns the quality of the data and its insufficiency, or lack thereof. Authorizations for the special use of water are issued based on the documents presented by the user, and there is no control mechanism for this data. In other words, it is not checked exactly how much water is extracted from the river (at a pumping station) or from an artesian well. The data provided are of a high degree of generalization (approximation). On the other hand, small-scale agriculture must not be forgotten, which generally does not declare the volume of water pumped from the river or lake.

The issue of gender today is neither clear nor explicit. Traditionally, in the given field, the share of men and women in the field of water resources management is about equal. Even more, in some institutions (SHS, AGRM the share of women is higher than that of men). However, in any case, it will be indicated by internal regulations that the share of specialists, who will take care of the WBS calculation, should be proportional. In the end even the final beneficiaries – the users of water resources will gain from the gender point of view, by applying the given technology.

The final problem arises from the lack of competent personnel. This problem begins with a lack of university-trained specialists with respective studies entering state institutions under the Ministry of the Environment.

Actions selected for inclusion in the TAP

The measures selected as actions for inclusion in TAP related to the technology "Improving the sustainable management of water resources by applying the water management balance" are the following:

The water management balance is a support in planning the sustainable use of water resources and has the following goals:

- Planning the sustainable, scientifically justified use of water resources, in the conditions of climate change.

- Operational management of water resources.

- Identification of water management measures to meet the water supply needs of the population and businesses.

It should be noted that the water management balance should not be confused with the water balance, which serves as a tool for analyzing the natural and anthropogenic water cycle to:

- Evaluate available water resources;
- Evaluate the anthropogenic impact on available water resources;
- Disclose surface water formation legalities;
- Evaluate the ratio between moisture intake and consumption for a certain territory.

Thus, the water balance allows the determination of the volume of available water resources and their flow regime, and the water management balance uses these data as water intake.

The water management balance can be divided into the following:

The GA **reporting balance** is calculated from the data of the previous year and serves for the analysis of household activity, the record of direct water losses, the options for saving water resources.

Operative GA balance is intended for the operative management of hydrotechnical constructions and is calculated for the nearest time interval – year, semester, month, decade.

The GA **planning balance** represents an intermediate link between the reporting and perspective period, the one that allows the phased planning of the implementation of the goals of the perspective water management balance.

Perspective GA balance is intended for the development of water resource use plans that will ensure the development of the national economy (taking into account climate change scenarios) and is calculated for time intervals of 5-20 years.

Activities identified for the implementation of selected actions

The activities identified for the implementation of the selected actions are the following:

Action 1. Implementation of the WBS calculation software will include the activities:

1. Identifying and procuring the software (or developing native software).
2. Creating the database, organizing the data flow and calibrating the software.

Action 2. The implementation of the normative acts necessary for the calculation of the WBS will include the activities:

1. Approval of procedural instructions.
2. Revision of reporting forms.

Action 3. Increasing institutional capacities:

1. Staff training and/or retraining.

2. Training in the field of computer software.

The subject is very difficult to evaluate, because any activity has some financial investment behind it, even if it is declared that it does not require monetary expenditure. These activities can conventionally be divided into activities related to data flow organization and institutionalization activities, but both require interventions to improve the legal framework.

Activities focused on organizing **data flow:**

1. **Creation of the integrated database.** Here, on the water intake component, it is relatively simple: SHS and AGRM are the institutions that monitor surface and underground runoff. The use of water is controlled by the Ecological Inspectorate. A special place belongs to commercial organizations, especially Apa-Canal, which are the main users of water. On the given segment, the reporting mechanism (and reporting frequency) of water captured from surface and underground water sources must be identified.

2. **Organization of the flow of data** required for WBS calculation. The exchange of data between the institutions that collect the data is a necessary step, which must be fully automated by uploading the data to the integrated database.

3. **Calibration and validation of approved software.** The procedure is strictly necessary to understand if the chosen software provides truthful results.

Activities to strengthen **institutional capacities:**

1. **Identification of the institution responsible** for the calculation of the WBS, and within the institution; the respective subdivision with the organization of the respective job sheets. Currently, it is logical that this institution is the "Apele Moldovei" Agency, which deals with the implementation of policies in the field of water resources. At least here the WBS calculation methodology was developed and approved, and the water resources management sectors were identified. However, the institutional capacity of the agency is currently very low. The next measure follows from this:

2. **Approval of procedural instructions.** Data flow can be organized by strengthening the legal framework, namely by approving procedural instructions. Here, the main role rests with the designated institution, i.e. with whom it will be reported and in what terms. From which results:

3. **Revision of reporting forms.** Current water user reporting forms are outdated and need updating. So simple forms must be developed, but which contain the whole spectrum of water resource use from different sources of supply.

4. **Training of personnel responsible** for WBS calculation. The measure is complex, because the engineers who will perform the calculations must have special studies:

hydrology, water management, or similar. For this reason, it is desirable that at the faculties that train specialists in the field of geography, hydrology, water improvement, water management, maybe even ecology, the hydrological calculations related to the water management balance should be included in the study plans. Following the training courses, at least 5 people from the "Apele Moldovei" Agency will be trained, and the highly estimated cost of the taught courses will be about 6 thousand EUR.

The actions described will result in the creation of a subdivision within the identified institution, in which they will activate qualified personnel. Normative acts, instructions and methods will be developed and approved, which will ensure efficient data exchange between institutions and favor the calculation of the water management balance. As a result, the Ecological Inspectorate will issue special water use permits only in accordance with the WBS calculation, which will also consider the water resources available in the near future against the background of climate change.

Actions to be implemented as Project Ideas

The project idea consists in the implementation of a complex of activities that will allow the implementation of the given technology. The technology is based on the development of a software for the analysis and calculation of the balance of water management by water resource management sectors. The given tool will allow you to give a quick answer regarding the available water resources both on water resource management sectors and for a specific water body.

The essence of the water balance lies in knowing the difference between intake and consumption of water, that is, in evaluating the available water resources. The forecasting component allows the assessment of available water resources in the future as well. Depending on the presence, insufficiency or lack of water resources, special water use permits will be issued and management activities in the water resources sector will be planned for the near future.

Two main input data sets are used to calculate the water balance – water resources and water use. The water balance can be calculated at the point or for some area.

For planning the use of water resources, the water balance is calculated for the water resources management sectors (approved by the "Apele Moldovei" Agency). Water resource management sectors are identified at two levels, broad sectors and more detailed sectors. In both cases, the basin principle is respected.

In the calculation of the water balance, one operates not with the measured discharge, but with the assured discharge, with a different probability of exceeding. As a rule, P=50% (average runoff year), P=75% (dry year) and P=85, 90 or 95% very dry years.

The results of the evaluation will be placed in the Automated Information System of the State Cadastre of Waters. For this, the calculation must be done using specialized software, which can be free, commercial or specially developed in the Republic of Moldova. The calculation algorithm is well known, applied all over the world.

In the conditions of our country, it is quite a difficult problem to identify the institution and units that will carry out these activities. Currently, the "Apele Moldovei" Agency is mandated to evaluate water resources, but civil servants do not have the specialized training to carry out these works.

All actions are gender neutral and envisage equal opportunities for men and women of all ages for their implementation.

1.1.3.4. Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The main actors in the field of the selected technology were divided into several groups. The highlighting of these groups was done according to its role in relation to water resources. Without the involvement of these actors, it is impossible to implement the identified measures.

1. The "Integrated water resources management policies" department of MADRM, which directly deals with the development of policies in the given sector.

2. The Meteorological Center and the Hydrological Center of the State Hydrometeorological Service. It should be noted that monitoring and developing forecasts and warnings becomes difficult without the use of contemporary technologies. This institution is crucial in the implementation of new technologies for monitoring and evaluating water resources.

3. The "Water Resources Management" Directorate of the "Moldova Waters" Agency. In this unit the situation is similar to that in the Environment Agency. The assessment and management of water resources is within the competence of this unit. However, staff insufficiency limits the efforts made.

4. The "Geological" Directorate of the Agency for Geology and Mineral Resources. Groundwater is monitored and assessed through this facility. Unfortunately, the institutional potential of the entity is minimal.

5. The "Hydrogeology" Laboratory of the Institute of Geology and Seismology. Groundwater is scientifically researched by that unit. At the moment, the only human resources who are familiar with the new technologies for adapting to climate change in the underground water segment are concentrated here.

6. Representatives from environmental NGOs (Ecocontact, Oikumena, Ecotiras). These environmental NGOs have manifested themselves through the implementation (or participation in the implementation) of a series of projects oriented towards climate

change adaptations in the field of water resources. We believe that the accumulated experience can be useful in achieving the intended objectives.

7. From the private sector, representatives of SA Apa-Canal (or similar regional enterprises), which are the main suppliers and users of water in the country.

Scheduling and sequencing of specific activities

The approximate stages of carrying out the activities are presented in tabular form:

ACTIVITY	Duration of achievement
Development and implementation of WBS calculation software	0.5 year
Optimizing the legal framework for WBS calculation	1 year
Identification of the institution responsible for WBS	0.5 year
Identification of the subdivision responsible for WBS calculation	0.5 year
Training of personnel responsible for WBS calculation	2 months
Review and approval of the water use reporting mechanism (forms).	1 year
Creation of the integrated database (water intake and consumption)	2 years
Organization of the flow of data required for WBS calculation	1 year
Revision of the mechanism for issuing authorizations for special water use	0.5 year

1.1.3.5. Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

The very fact that the technology is not developed and implemented in the country is a result of the weak institutional capacities of the institutions in the water resources sector.

The water management balance, in general, represents the ratio between the intake and consumption of water resources on some part of the earth's surface, with the evidence of human management activity. Intake of water resources is defined as the runoff of surface and underground waters, consisting of atmospheric precipitation, wastewater from sewage systems, filtered water from irrigated lands, as well as water transported from other reception basins. Consumption of water resources means, here, evaporation from the surface of the catchment basin, capture of water for different uses, transport of water to other catchment basins. The water management balance sheet creates a clear picture of the provision of water resources of a territory, allows the highlighting of the water deficit and the adoption of decisions on the implementation of measures to compensate for the formed deficit.

All the methods and procedures for calculating the water management balance for basins, reception basins and water management sectors must be stipulated in the legal framework of the branch. In accordance with the respective normative acts, the water balance materials will contain data and information about the water resources available for use for different purposes.

As a whole, the "Apelei Moldovei" Agency is the institution responsible for the WBS. However, it does not currently have a hydrologist on staff to evaluate water resources. Therefore, training of the personnel responsible for these activities is urgently required.

The data providers – SHS, the National Bureau of Statistics and SA Apa-Canal – collect and process the necessary data adequately enough. The situation in the field of underground water – managed by AGRM – is problematic. Therefore, this institution also needs to strengthen its institutional capacities.

Estimates of costs of actions and activities

The capital costs of implementing the technology are not high, approx. 100 thousand EUR.

Operation and maintenance costs are very modest and can only be reduced to data collection and the reassessment of the water management balance sheet (which must be done, if not annually, at least every 5 years). They can be reduced to the salary of employees and IT specialists who will service the computing system. About 5 thousand EUR annually. Estimated cost calculations are presented in Table 1.1.3.7.

1.1.3.6 Management Planning

Risks and Contingency Planning

The potential risks fall into two major categories – political will and institutional capacity.

The "Apele Moldovei" agency, by changing the legal framework, must be delegated to carry out the WBS. As long as the responsibility of the institution is not stipulated, this WBS activity will not be carried out. Neither at the level of enthusiasm and curiosity of some enthusiastic collaborators, nor within pilot projects.

As for institutional capacity, everything comes down to qualified personnel. Simplistically, WBS represents a formula that can be applied and the calculations can be done primitively – on paper or in excel (if we omit automation and spatial components). But for this, skilled personnel are needed, who know how to collect data from different sources, how to structure them and how to apply the calculation methodology.

Next Steps

The first urgent need is to change the legal framework in several stages:

- Assignment of WBS calculation responsibilities to the "Apele Moldovei" Agency.

- Approval by regulations or instructions of the WBS calculation methodology.

- Elaboration of a decision at the level of the Ministry of the Environment for the operative and free provision of the information necessary for the calculation of the WBS from the branch institutions.

The critical needs urgently require the identification of the personnel responsible for the WBS calculation within the indicated subdivisions, with the respective job descriptions. The personnel must be qualified, with university education, or a short-term retraining will be needed to acquire the WBS application methodology.

1.1.3.7 TAP overview table

<table>
<tr><th colspan="9">TAP overview table</th></tr>
<tr><td>Section</td><td colspan="8">Water resources</td></tr>
<tr><td>subsector</td><td colspan="8"></td></tr>
<tr><td>Technology</td><td colspan="8">Improving the sustainable management of water resources by applying the water management balance sheet</td></tr>
<tr><td>pique</td><td colspan="8">The application of the water management balance sheet as a record tool in the transparent and sustainable management of the water resources of the Republic of Moldova</td></tr>
<tr><td>Benefits</td><td colspan="8">Economic benefits: Technology does not provide for the creation of new jobs. Investments will be reduced only to the development of the calculation software. There will not be additional expenses.
Social benefits: There will be no direct benefits. The understanding and awareness by the population, the employees of the institutions responsible for the management of water resources, of the process of adaptation to climate change manifested by reducing the risk of water scarcity and the sustainable management of water resources. The quality of the environment and especially water will improve.
Benefits for the environment: The protection of water resources during periods of moisture deficit will be favored.
Adaptation/resilience benefits: Water resources, which in the conditions of climate change, especially in the direction of its aridification, will be less and less and through the implementation of the proposed technology will be better managed. Issuance of water use authorizations based on the assessment of the WBS is an extremely good measure for adapting to climate change by using them rationally not only now, but also during the term of the authorization.</td></tr>
<tr><td>Act</td><td>Activities to be implemented</td><td>Sources of funding</td><td>Responsible body and focal point</td><td>Time frame, month</td><td>Risks</td><td>Success criteria</td><td>Indicators for Monitoring of implementation</td><td>Budget per activity, thus. than EUR</td></tr>
<tr><td rowspan="2">Action 1. Implementation of WBS calculation software</td><td>Activity 1.1. Identifying and procuring software (or developing native software)</td><td>External donors</td><td>"Waters of Moldova" Agency</td><td>6</td><td>Unpredictability in implementation</td><td>Specialized software installed</td><td>Calibrated, validated and used software</td><td>50</td></tr>
<tr><td>Activity 1.2. Creating the database, organizing the data flow and calibrating the software</td><td>State budget, External donors</td><td>"Apele Moldovei" Agency, SHS, AGRM, NBS, Apa-Canal</td><td>24</td><td>Bureaucratic obstacles in granting normative acts</td><td>Completed database</td><td>Functional database</td><td>35</td></tr>
</table>

Action 2. Implementation of the necessary normative acts for WBS calculation	Activity 2.1. Approval of procedural instructions	State budget	**"Apele Moldovei" Agency,** Ministry of the Environment	12	Unpredictability in implementation	Promotion and approval of Instructions	Instructions approved and in effect	5
	Activity 2.2. Review of reporting forms	State budget	**"Apele Moldovei" Agency,** Ministry of the Environment, NBS	12	Unpredictability in implementation	Report forms produced and approved	Approved and used reporting forms	5
Action 3. Increasing institutional capacities	Activity 3.1. Staff training and/or retraining	State budget, External donors	**"Waters of Moldova" Agency**	2	Lack of trained personnel	Trained staff	No trained specialists	3
	Activity 3.2. Training in the field of computer software	State budget, External donors	**"Waters of Moldova" Agency**	2	Migration of trained personnel	Trained staff	No trained specialists	3
							Total	101

1.1.4 Action Plan for technology, Optimization of number of reservoirs based on hydrological indicators.

1.1.4.1 Introduction

The members of the sectoral working group participated in the exercise of multi-criteria analysis and prioritization of technologies for adapting the water resources sector to climate change:

1. The Ministry of the Environment, Directorate of integrated water resources management policies.

2. South Regional Development Agency.

3. Agency for Geology and Mineral Resources, Geological Directorate.

4. State Hydrometeorological Service, Hydrology Center.

5. EcoContact Public Association.

6. "Apele Moldovei" Agency, Water Resources Management Directorate.

7. Institute of Ecology and Geography, Landscape Geography Laboratory.

8. Institute of Geology, Hydrogeology Laboratory.

As a result of the analysis, 3 technologies were identified as priorities, which accumulated maximum points:

1. Improving the monitoring and forecasting of leakage, water quality and the efficient exchange of information between various institutions.

2. Improving the sustainable management of water resources by applying the water management balance sheet.

3. Optimization of number of reservoirs based on hydrological indicators..

Although the technologies prioritized by applying the MCA tool correspond to major risks and vulnerabilities caused by climate impacts, to test their robustness, the awareness exercise was applied.

The sensitivity exercise carried out focused on the fact that the climatic impacts identified as major have a relative character, which could change depending on the dynamics and amplitude of external climatic factors, as well as different economic and social aspects within the sector/country. Respectively, the predefined weights of climate impacts (Surplus of water – 40; Deficit of water – 40; Protection of aquatic ecosystems – 20) could change.

It is obvious that the most important in the case of water resources are the floods with their extremely negative consequences for the human frame and the water deficit, mainly due to droughts.

Based on the awareness exercise, we can conclude that the technologies selected in the process of the prioritization exercise are in the Top 3 positions, with the given technology in third place.

The vast majority of ponds/lakes were built between the 1960s and 1980s, respectively their useful volume of water is considerably reduced, and they no longer fulfill their function because they are silted up.

In 1995, an inventory was carried out regarding the state of 1253 ponds/lakes (ACVAPROIECT data). As a result, their degree of danger was determined for the localities located downstream of the dams in the case of high risk (dam break). Within the project EPTATF 2013-2016, Management and support for Technical Assistance regarding the protection of the territory of the Republic of Moldova against floods, financed by the EIB - Service contract No TA2011038 MD EST (TA-MDFRM 2013-2016). An assessment was also carried out for cases of breaking dams for several lakes.

It was found that a good part of the ponds/lakes were built with deviations from the norms in force (СНИП), respectively about 40% of them present a real danger for the population in case of dam break (visual inspection). The prevailing height of the dams varies from 5 to 7 m.

All ponds/reservoirs in the Republic of Moldova are designed and built for seasonal water regulation. The technical parameters of the hydrotechnical edifices must ensure the drainage of rainwater with the probability of occurrence of the flow of 5% and 1% depending on the degree of reliability of the construction.

At the same time, it is found that the density of ponds and reservoirs on the territory of the Republic of Moldova is higher than the optimal one, depending on the intrinsic (essential) characteristic of the hydrographic basin, also, the density of the location of ponds/lakes is uneven on the hydrographic basins. The high density of the location of ponds/lakes within a watershed, in many cases leads to the disappearance of water flow in small rivers. The disappearance of the water flow in the river means not ensuring the ecological flow, which in turn does not ensure the stable development of the biodiversity of the respective river.

Thus, optimizing the number of lakes/ponds appropriate to the situation in the Republic of Moldova, becomes a priority, a fact that can be a good contribution to risk assessment, the development of measures to protect and improve aquatic resources, increase surface runoff, also to rural development.

1.1.4.2 Ambition for the TAP

The technology is completely new for the Republic of Moldova. The methodology for identifying the reservoirs intended for liquidation has already been developed. In its essence, multi-criteria analysis identifies the lake that no longer fulfills the function for which it was built. For example, it has become clogged, or is completely covered with swamp vegetation, etc. It is approved by the "Apele Moldovei" Agency and MADRM. The legal basis and procedural mechanisms are to be prepared.

Damping off a small (or even ephemeral) stream of water fed by shallow surface runoff or the few underground sources and being clogged, this pond represents an additional surface for water evaporation. It is known that, in the conditions of arid climate with a shortage of water resources, reservoirs and ponds considerably reduce the flow of rivers. In other words, they directly favor the destruction of rivers both as a water course and as an ecosystem. From the surface of the small, clogged ponds, the collected water is lost only to intensive evaporation, in the conditions of climate change with increasing temperatures in the summer months.

This is where the ambition takes shape: **Reducing surface runoff losses by eliminating the surpluses of non-functional reservoirs and restoring the natural runoff volume of small rivers throughout the territory of the Republic of Moldova.** In hydrology, the notion is the reduction of surface runoff losses.

A pilot project will be launched focusing on a catchment basin or sub-basin from an administrative district or development region. Then the activities will expand throughout the country. Normative acts will be developed for the possibility of application throughout the country.

1.1.4.3 Actions and Activities selected for inclusion in the TAP

Summary of barriers and measures to overcome barriers

Against the background of the aridification of the climate in the region, due to the acceleration of climate change, the topic of reducing the number of reservoirs is neither clearly described nor well analyzed in the perspective of adaptation to climate change. Even if the phrase "there is not enough water" is circulated for different sectors of the national economy; local and central authorities support the initiative to create reservoirs, ponds and ponds. This support is based on additional access to water for various uses. The subject is ambiguous, because it is not analyzed in depth. Each newly created reservoir has a period of operation and a regime of operation described in the technical sheet of the hydrotechnical construction.

After the intended period of operation, a lake clogs, becomes muddy and no longer fulfills its functions. It must then either be liquidated or cleaned. The sediment excavation procedure is very expensive and there are no economic premises to be applied in the Republic of Moldova.

One of the optimal ways is to liquidate these lakes and capitalize on the freed land (i.e. land from the lake beds).

Economic and financial barriers are common, as the implementation of new technologies requires significant investments. In our case, the problem is not so much economic, because the technology will not bring direct profit, but financial, because it requires significant investment.

In the case of small lakes, often abandoned or built illegally, without permits, the financing of these activities can be a very serious impediment to carrying out the works.

The legislative barrier includes the fact that legislation and normative acts are in constant reform, are not optimized and have large gaps. The old, even ex-Soviet methods and instructions, which are in force today, have led to only formal compliance with the legislation due to the creation of a new lake and the same in compliance with the rules for its exploitation. The lack of an approved procedure for assessing the available water resources is reflected in the issuance of documents for the creation of new lakes. On the other hand, there is no elaborate mechanism for regulating the number of lakes in a catchment basin, on a water course, and even more so for their liquidation and optimization.

Even if in the country there are procedures described in the legal framework for the liquidation of constructions, indicated in the "Law on the principles of urbanism and territorial development", it is not clearly stipulated from which financial sources the respective works will be carried out.

There are a wide range of **technical problems.** The most important of which is the calculation of the anthropogenic pressure exerted by regulating surface runoff from a catchment. In other words, there are no general or individual studies for each catchment area of small rivers in which the number of lakes that can in principle be built here and what volume of water they can regularize, or what is the maximum surface of the water mirror on which they can form it.

The liquidation of a lake (basically the hydrotechnical construction that forms it), from a technical point of view, is quite difficult. It can be achieved by breaking the dam and completely draining only the water. The topic is apparently outdated, but the environmental impact is still neglected. The dam must be demolished, and the accumulated alluvium and the land occupied by these alluviums must be naturalized or exploited. Here again, there is a lack of technical documentation regulating these measures.

The institutional barrier consists of the fact that the country is currently not ready for the application of the technology given by the awareness of the problem. It is difficult to explain that some abandoned 'puddle' essentially represents a 'boiling kettle' during the summer. The collaboration mechanisms between institutions (there is not even an institution specifically responsible) – the Moldavian Water Agency, SHS, the Ecological Inspectorate and the Ministry of the Environment – are not developed. In other words, the competences of the institutions for the implementation of the proposed technology are not institutionalized.

For these reasons, it is necessary to implement the technology on a pilot reception basin, to later liquidate all the deficiencies for a large-scale application, for the entire territory of the country.

The final problem arises from the lack of competent personnel. This problem begins with a lack of university-trained specialists with respective studies entering state institutions under the Ministry of the Environment.

Actions selected for inclusion in the TAP

The proposed technology provides for the identification of reservoirs (ponds, ponds) that do not fulfill their function and serve only as a source of additional evaporation, and their liquidation.

Under the conditions of climate change, the frequency and severity of droughts in the Republic of Moldova is increasing. The proposed technology is an adaptation tool, which will increase the volume of water resources in the basins of small rivers by increasing (more correctly, restoring) the volume of the natural flow of small rivers.

From here, the set of necessary measures is outlined:

Investigating the impact of runoff regularization. The financial expenses will be focused on assessing the impact of regulating the flow through reservoirs and determining their optimal number (surface area, retention capacity, functionality) for a small water course in the Republic of Moldova. In other words, an important measure will be the development of the calculation methodology for each small river, depending on the length, the area of the reception basin, the surface runoff and other environmental conditions, which will allow the determination of the anthropogenic pressure on this river through the reservoirs. In other words, it will be known how many reservoirs can in principle operate on this water course. Accordingly, the rest will be recommended for liquidation.

Technical actions to liquidate the reservoir. As mentioned, demolishing a dam, excavating the accumulated sediments and transporting them to another place is technically quite difficult and expensive. Certainly, these expenses cannot be included in the budgets of the LPAs. The owners of lakes or dams (as a rule, leased for a certain term) will not plan these works. Many small dams are generally abandoned. The approval of two current methods is an obvious requirement: To identify the lakes that need to be liquidated and to naturalize or capitalize on the freed surfaces. Here, it will also be necessary to consider the change in the cadastral status of these lands, because they will certainly pass from the water fund land to the agricultural fund or others.

Institutionalization actions (to adjust the legal framework). Certain financial sources will be necessary (but very difficult to estimate) for the optimization of the legal framework. Here it will be necessary to introduce changes to the water law (LAW No. 272 of 23-12-2011), where the need to evaluate the human pressure by regularizing the drain will be indicated. The development of the set of instructions and normative acts will also require financial expenses.

Another financial component consists in the maintenance of the unit that will deal with the identification of the lakes that need to be liquidated and the training of the staff.

Identifying the responsible institution, adjusting and delimiting the responsibilities between different institutions, in some cases even training the staff requires financial investment. The given activities can be done with little financial effort.

Activities identified for the implementation of selected actions

The activities identified for the implementation of the selected actions are the following:

Action 1. Adjusting the legal framework:

1. Identification of the responsible institution. Training of collaborators
2. Development and implementation of verification and control procedures

Action 2. Identification of liquidation lakes:

1. Testing and implementation of lake identification methodology
2. Elaboration of recommendations regarding the use of land after the liquidation of the lakes

Action 3. Liquidation of the identified lakes:

1. Liquidation of the identified lakes
2. Valorization of the lands after liquidation of the lakes
3. Evaluation of the change in runoff after liquidation of the lakes

Certain actions require more detailed description:

1. **Identification of the responsible institution**: The activity assumes that within the framework of the institutional reform, the duties of a selected institution will include the responsibility for monitoring the regularization of the surface runoff of small rivers in the country.

2. **Evaluation of the impact of the number of lakes on the flow of small rivers:** The action provides for the completion of scientific-applicative studies to evaluate the anthropogenic pressure exerted by reservoirs in concrete basins of small rivers. As a result, leakage losses will be calculated due to the negative influence of the surplus of reservoirs. In the case of exaggerated pressure, the maximum number of lakes that can be arranged on the course given by the lakes will be indicated (expressed by the maximum surface area of the water mirror of the lakes).

3. **Approval of the methodology for identifying the reservoirs that must be liquidated:** The action provides for scientific-applicative research in the development of the methodology for identifying the lakes, which do not perform their functions and

which of them must be liquidated. The methodology will be approved by the administrative board of the responsible institution and will be strengthened by ministerial order.

4. **Approving the method of naturalization or valorization of the freed lands:** A methodology will be developed for the use of the lands released after the liquidation of the lake, which will be focused either on their use in agriculture (in some cases they can also be used for other purposes, e.g. in construction) or they will be naturalized, for example meadows or wet areas.

5. **Approval of procedural instructions:** The action provides for the elaboration of some sets of procedural instructions, which will ensure the legality of the measures taken to liquidate the lakes and the subsequent exploitation of the lands.

6. **Identification and liquidation of identified lakes:** The action is purely technical and consists in the physical liquidation of the identified reservoir. The freed land will be used for predetermined purposes.

7. **Staff training:** The realization of the activities requires qualified personnel. For this, training courses will be held in the application of the developed methods, as well as in knowing the particularities of the legal (juridical) framework in the implementation of the action.

Actions to be implemented as project ideas

The technology is completely new in the Republic of Moldova. In its essence, multi-criteria analysis identifies the lake that no longer fulfills the function for which it was built.

First, it is necessary to develop and propose for implementation some changes in the legal framework of the Republic of Moldova related to the given subject. The changes are more about procedure, control and responsibilities. Certainly, most of the ponds (because pond dams as a hydrotechnical construction are in sight) are set up on the lands that belong to the pond beds. Ponds can be managed by APL or legal entities. It is necessary to develop the procedure clearly described and implemented in normative acts, which clearly describes who is responsible for the liquidation of the pond (dam).

Another normative act, which needs to be elaborated, is the identification of the economic agent responsible for liquidating the lake. It should be noted that the cost of liquidating a pond and reusing the accumulated sludge is a very expensive procedure. It makes more sense to just break the dam, allowing the river to continue to flow naturally. In time the, river will restore its natural bed without further human impact.

It should be noted that these ponds also present an increased danger in the case of floods.

The last normative act necessary to be developed and implemented is the control and penalty mechanism.

Optimizing the number of reservoirs in a small receiving basin (small river) will reduce the anthropogenic pressure on this river and by reducing additional evaporation losses will increase the volume of water resources in this basin.

All actions are gender neutral and envisage equal opportunities for men and women of all ages for their implementation.

Since the technology is new, it will need to be implemented at first on a small catchment area, below 1000 km^2. The results of the implementation within a pilot project will continue to be transposed throughout the country.

1.1.4.4. Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The main actors in the field of the selected technology were divided into several groups. The highlighting of these groups was done according to its role in relation to water resources. Without the involvement of these actors, it is impossible to implement the identified measures.

1. The "Integrated water resources management policies" department of MADRM, which directly deals with the development of policies in the given sector.

2. The "Bilateral Treaties" section of the Ministry of Foreign Affairs and European Integration. The management of transboundary water resources of the Dniester and Prut rivers requires support at the ministry level.

3. The Meteorological Center and the Hydrological Center of the State Hydrometeorological Service. It should be noted that monitoring and developing forecasts and warnings becomes difficult without the use of contemporary technologies. This institution is crucial in the implementation of new technologies for monitoring and evaluating water resources.

4. The "Environmental Quality Monitoring" Department of the Environmental Agency. This direction has an extremely high mandate in the management of the quality of water resources, but the potential (both of the direction and of the Agency as a whole) is currently very limited. This can be explained a period of painful reforms of organization and administration that has been undertaken.

5. The "Water Resources Management" Directorate of the "Moldova Waters" Agency. In this unit the situation is similar to that in the Environment Agency. The assessment and management of water resources is within the competence of this unit. However, the staff insufficiency limits the efforts made.

6. The "Geological" Directorate of the Agency for Geology and Mineral Resources. Groundwater is monitored and assessed through this facility. Unfortunately, the institutional potential of the entity is minimal.

7. Representatives from district councils and/or town halls in the country (APL). Only more active representatives from the given structures will be invited.

8. Representatives from the North, Center, South and UTA Gagauzia Regional Development Agencies. These agencies, through the implementation of development projects, are directly involved in the promotion of good practices and new technologies.

9. Representatives from environmental NGOs (Ecocontact, Oikumena, Ecotiras). These environmental NGOs have manifested themselves through the implementation (or participation in the implementation) of a series of projects oriented towards climate change adaptations in the field of water resources. We believe that the accumulated experience can be useful in achieving the intended objectives.

Scheduling and sequencing of specific activities

The approximate stages of carrying out the activities are presented in tabular form:

ACTIVITY	Duration of achievement
Adjusting the legal framework	1 year
Identification of the responsible institution	0.5 year
Development and implementation of verification and control procedures	1 year
Testing and implementation of lake identification methodology	1 year
Liquidation of identified lakes	2 years
Elaboration of recommendations regarding the use of land after the liquidation of the lakes	1 year
Land utilization after liquidation of the lakes	5 years
Evaluation of the change in runoff after liquidation of the lakes	0.5 year

1.1.4.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

The analysis of the institutional capacities for the implementation of the technology is difficult due to the fact that the institution that will be responsible for carrying out the activities is not known. Logically, it would be the "Moldova Waters" Agency, which is responsible for the management of water resources in the Republic of Moldova, but the Environment Agency or another newly formed institution within the institutional reform of the Ministry of the Environment could be identified with the same success.

In any case, however, in order to carry out the proposed lake liquidation activities, it is necessary for the responsible institution to have the permissive documents. That is, the legal framework must be adjusted. On the other hand, the subdivision within the enterprise must be equipped with qualified hydrological engineers and hydrotechnical engineers.

In the Republic of Moldova, there is experience in drafting normative acts (at the level of the ministry, national experts) and their application through the responsible institutions: The "Apele Moldovei" Agency, the Environmental Agency and/or the Ecological Inspectorate.

Estimates of costs of actions and activities

Operating costs are reduced to the expenses of drafting, granting and approving normative acts. Maintenance costs – when paying the employees who will implement the technology. Liquidation costs of hydrotechnical constructions are not included here, because there is a legal framework, which provides for the liquidation (demolition) procedure and these expenses will be borne by the economic agents.

But in a pilot project it is assumed that the total expenses can be estimated around 150 thousand EUR. Estimated cost calculations are presented in Table 1.1.4.7.

1.1.4.6 Management Planning

Risks and Contingency Planning

Potential risks can be of several types – political, technological, social and professional.

Political risks largely depend on political will. It is necessary to understand the fundamentals of the problem. In other words, the expression "ponds are the killers of rivers" is not an artistic imperative but an objective reality, more pronounced in the conditions of climate change and the diminishing water resources of rivers.

Therefore, the Ministry of the Environment must launch a campaign to develop normative acts, to perfect the legal framework aimed at ‘legalizing’ the activities of identifying the lakes that need to be liquidated and, in particular, to compel the structures responsible for the liquidation of these objects.

The technological risks at the start, i.e. for a pilot project, are high. Procedurally, it will not be clear how a dam will be demolished or where the material will be stored. For instance, how the alluvium from the lake will be excavated, where it will be transported, what will happen to it, etc. In the future, the old pond of the lake will be used, etc.

In the future, these risks will, naturally, decrease as the implementation algorithm is known, the lessons learned, and a robust legal framework is developed.

Social risks can arise when the local population does not understand the need to liquidate the lake (which they, the inhabitants, remember from their childhood, where they used to catch fish and go swimming). The benefits of saving or preserving water resources in the face of climate change, etc., will need to be explained.

Included here can also be a resistance of the owners of the lakes, who do not want to comply with the normative-legal framework.

The risk of the trained personnel, in most cases comes, down to the skill of identifying redundant lakes and in assessing the pressure exerted by lakes on small rivers.

Next Steps

One of the urgent needs is the approval of the legal framework necessary for the implementation of the technology. Without regulatory, permissive and procedural acts, it is impossible to launch the technology implementation process. The pilot project will only reveal the gaps and errors in the implementation of the works.

The critical needs require political will and the Ministry of Environment's understanding of the importance of reducing the number of lakes to reduce human pressure on small rivers. Understanding the need to promote policies to optimize the number of lakes in a small catchment area.

1.1.4.7 TAP overview table

<table>
<tr><th colspan="9">TAP overview table</th></tr>
<tr><td>Section</td><td colspan="8">Water resources</td></tr>
<tr><td>subsector</td><td colspan="8"></td></tr>
<tr><td>Technology</td><td colspan="8">Optimization of number of reservoirs based on hydrological indicators..</td></tr>
<tr><td>pique</td><td colspan="8">Reducing surface runoff losses by eliminating the surpluses of non-functional reservoirs and restoring the natural runoff volume of small rivers throughout the territory of the Republic of Moldova.</td></tr>
<tr><td>Benefits</td><td colspan="8">The major benefit lies in increasing the water resources of small rivers.
Economic benefits. No new jobs are expected to be created. The liquidation of lakes and the reduction of their number in a catchment will allow investments to be made in the unclogging, repair and effective maintenance of an optimal number of lakes on a river. It depends on the owner of the hydrotechnical construction (dam). The expenses will be borne by APL or the owners.
Social benefits. The volumes of water saved from additional evaporation can be used for various purposes (irrigation, for example). The population's understanding and awareness of the process of adapting to climate change manifested by increasing the volume of water in rivers. It will increase the volume of water resources, their quality and the overall quality of the environment.
Benefits for the environment. Obviously, the quality of the environment will be improved by increasing the wetting of the territory, by reducing additional evaporation and restoring (in some sectors) the natural flow of water through the riverbeds.
Adaptation/resilience benefits: The main adaptation measure to climate change is to reduce additional water loss through evaporation from the surface of redundant lakes. In this way, it will be ensured to increase the flow volumes in the small rivers not due to precipitation (which is decreasing) but by saving it by reducing water losses. The water saved can be used for various uses in the national economy or can be used to naturalize rivers.</td></tr>
<tr><td>Act</td><td>Activities to be implemented</td><td>Sources of funding</td><td>Responsible body and focal point</td><td>Time frame, years</td><td>Risks</td><td>Success criteria</td><td>Indicators for Monitoring of implementation</td><td>Budget per activity, thus. than EUR</td></tr>
<tr><td rowspan="2">Action 1 Adjusting the legal framework</td><td>Activity 1.1. Identification of the responsible institution. Training of collaborators</td><td>State budget</td><td>Ministry of the Environment</td><td>0.5</td><td>Political will</td><td>Identified institution, Availability of trained personnel</td><td>Responsible institution. No. of trained personnel.</td><td>5</td></tr>
<tr><td>Activity 1.2. Development and implementation of verification and control procedures</td><td>State budget</td><td>Ministry of the Environment, Moldavian Waters Agency</td><td>1.0</td><td>Political will</td><td>Adjusted legal framework</td><td>Set of approved normative acts</td><td>5</td></tr>
</table>

Action 2 Identification of liquidation lakes	Activity 2.1. Testing and implementation of lake identification methodology	State budget	**Waters of Moldova Agency**	1.0	Unpredictability in implementation, Lack of staff	Functional methodology	No. of tests on receiving basins	3
	Activity 2.2. Elaboration of recommendations regarding the use of land after the liquidation of the lakes	External donors	**Waters of Moldova Agency**	1.0	Unpredictability in implementation, Lack of staff	Set of elaborate recommendations	The recommendations applied. Opinion poll on the quality of recommendations.	2
Action 3 Liquidation of the identified lakes	Activity 3.1. Liquidation of identified lakes	State budget, external donors	**Moldova Water Agency,** APL, private sector	2.0	Social resistance	Liquidated lakes	No. of existing lakes according to recommendations	100
	Activity 3.2. Land utilization after liquidation of the lakes	State budget, external donors	**Moldova Water Agency,** APL, private sector	5.0	Unpredictability in implementation	Capitalized lands	No. of reclaimed land per catchment area	30
	Activity 3.3. Evaluation of the change in runoff after liquidation of the lakes	State budget	**Moldova Waters Agency,** SHS	0.5	Lack of staff	Leak rated	Determining the limit of anthropogenic pressure	5
							TOTAL	150

1.2 Project ideas for Water Sector

1.2.1 Brief summary of the project ideas for Water Sector

Next, 3 project ideas are proposed. Although these ideas are different, they hold a common generic: **The sustainable management of water resources under climate change conditions.**

Even if these project ideas have a different spatial coverage, a different institutional assignment and even different realized products, they are, by their essence, oriented to the adaptation of the water resources sector to climate change by protecting and enhancing them.

Core project ideas contribute to the transfer of contemporary technologies used in world practice on the territory of the Republic of Moldova by implementing new methods and models for measuring, evaluating and forecasting water resources, as well as their sustainable management and protection under climate change conditions. Their dissemination will be carried out from the start throughout the country and only the liquidation of the lakes that do not fulfill their functions will be carried out on a pilot basin, but the results will certainly be applied throughout the country. Certainly, the implementation of the project ideas has one common goal: adaptation to the rational use and sustainable management of water resources in the conditions of climate change (in the conditions of the reduction of available water resources).

The three project ideas are proposed here:

1. **Modernizing the hydrological monitoring network and improving the quality of services provided by SHS.** The technology provides for the optimization of the hydrological observation network, the adaptation of the methodologies to EU requirements and the implementation of new technologies for making hydrological forecasts of different durations. The operational exchange mechanism with the data collected between the branch institutions will be developed. The hydrometric observation stations will be modernized by equipping them with constructions and monitoring equipment.

2. **Sustainable management of water resources by applying the water management balance sheet.** The technology is based on the development of a software for the analysis and calculation of the balance of water management by water resource management sectors. The given tool will allow you to give a quick answer regarding the water resources available both for water resources management sectors and for a specific water body.

3. **Optimizing runoff regulation in small catchment areas by reducing the pressure exerted by small reservoirs (ponds).** The proposed technology consists in increasing water resources in small river basins by reducing runoff losses, especially through evaporation from the surfaces of reservoirs that no longer fulfill their functions (often abandoned).

The implementation of these projects can be a hysteria of success in adapting the water resources sector to contemporary climate changes.

1.2.2 Specific project ideas

The modernization of the hydrological monitoring network and the improvement of the quality of the services provided by the SHS was selected as a project proposal. This project idea could become part of a technologically oriented climate adaptation investment portfolio towards the production of high-quality climate services.

Background information	For the Republic of Moldova, climate change represents one of the biggest threats to sustainable development and constitutes one of the biggest environmental problems, with negative consequences on various daily activities. The accelerated pace of climate change and society's inability to quickly adapt to it, the lack of sectoral strategies to adapt to current and expected climate change, the agrarian orientation of the national economy, which largely depends on the weather and climate, determine the modernization of the network of hydrological monitoring and improving the quality of services provided by SHS. Currently there are 53 hydrological stations in Moldova, of which: ● 33 are classic positions. ● 14 have classic and automatic functions. ● 16 are automatic. From the total number of hydrometric stations listed, 41 are managed by the SHS of the Republic of Moldova, and 12 are subordinated to the Tiraspol Hydrometeorological Center. However, there is cooperation between the hydrometeorological services on both banks of the Dniester, based on partnership relations. However, the location of hydrological stations should be carefully considered. The basic criterion here is representativeness, i.e. the place chosen must be typical for the given region. It should be noted that the criteria for selecting the locations of the stations are described in specialized methodical instructions. Of the 53 stations, 38 are in the two main rivers (Dniester and Prut), while only 15 are in other watercourses. It is essential to implement hydrological models in SHS, especially for forecasting purposes, but also for risk and disaster management purposes. The implementation of hydrological forecasting models will increase the reliability of forecasting results, limit the time spent on daily forecasting and increase the possibility of automatic publication of hydrological forecasts.

	Currently, SHS provides hydrological forecasts, bulletins and alerts, which are sent to beneficiaries by e-mail or placed on the SHS web page. Regime data and information are not published in hydrological yearbooks or summary guides. The reason is simple: A lack of human and financial resources. There is a limited exchange of operational and regime information with branch institutions: The "Apele Moldovei" Agency, the Ministry of the Environment, the Civil Protection and Exceptional Situations Service, etc. Practice indicates that, in addition to forecasts, warnings (which are issued according to the regulation to the indicated institutions by e-mail) and predetermined information bulletins, there is also the need for access to hydrological information for branch institutions depending on the need and case. The subject is resolved through official steps at SHS to provide or give access to the information in question.
Objectives and outputs	The main objectives are the following: Optimizing the network of hydrological observations, adapting methodologies to EU requirements and implementing new technologies for making forecasts, bulletins and hydrological alerts of different durations. The focus will be on the automation of hydrological monitoring stations and the application of digital models in the development of hydrological forecasts. Contemporary flashflood forecasting systems will be applied by applying contemporary techniques (especially radar data), something that has not been done in the Republic of Moldova until now. The operational exchange mechanism with the data collected between the branch institutions will be developed. Even if the State Water Cadastre Automated Information System is already implemented, it does not provide for the operative updating of the information. He relies more on average data and indicators. It is proposed to develop and implement an operational data exchange mechanism between institutions related to the monitoring and management of water resources. The development and dissemination of forecasts, bulletins and hydrological alerts, water quality is considered. The hydrological observation stations will be modernized by equipping them with constructions and contemporary monitoring equipment. Currently, only the stations on the Dniester and Prut rivers, as well as a few internal rivers, are equipped with contemporary equipment. Along with the total automation of the hydrological observation network, the classic equipment,

	necessary for calibrating the automatic stations, will also be modernized. Automated hydrochemical stations are extremely expensive to operate and will be replaced by mobile sampling laboratories.
Link to country development priorities	The realization of the project aims to implement the following priorities of the country in terms of adaptation to climate change, which can be found in the following legislative and normative acts: ● Water Law no. 272 of 23.12.2011 ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013. ● Government Decision no. 932 of 20.11.2013 for the approval of the Regulation on the systematic monitoring and record of the state of surface water and underground water. ● Strategy of the Republic of Moldova for adapting to climate change until 2020. ● Government Decision no. 491 of 23-10-2019 regarding the approval of the Automated Information System Concept "State Cadastre of Waters". ● The national development strategy "Moldova 2030". ● The Sustainable Development Goals (SDGs) formulated by the 2030 Sustainable Development Agenda. ● INDC-2 of the Republic of Moldova.
Scope and activities	Purpose: Creating a representative monitoring network, supported by an efficient data collection and processing platform, developing forecasts based on contemporary methodologies and procedures based on WMO and EU standards/procedures and efficient exchange of information between the country's and international institutions. <u>Output 1. Refinement of leakage monitoring</u> Activity 1.1. Review of the spatial location of hydrological stations. The design of the new monitoring network.

	Activity 1.2. Identifying the set of modern equipment, machinery and construction, as well as the necessary software, their procurement and installation. Activity 1.3. Training of station workers. <u>Output 2. Improving hydrological forecasting</u> Activity 2.1. Procurement of specialized forecasting software. Activity 2.2. Implementation of contemporary forecasting methodologies and instructions. Activity 2.3. Training forecasting engineers. <u>Output 3. Improving the efficient exchange of information</u> Activity 3.1. Creation of a mechanism (software, IT platform), which will integrate all the data set collected from automatic and classic hydrological observation stations. Activity 3.2. Automating early warnings and alerts.
Timeline	The total duration of the project will be 2 years. Activities can run parallel. <u>Output 1. Refinement of leakage monitoring (18 months)</u> Activity 1.1. Review of the spatial location of hydrological stations. Design of the new monitoring network (6 months). Activity 1.2. Identifying the set of modern equipment, machinery and construction, as well as the necessary software, their procurement and installation (18 months). Activity 1.3. Training station workers (1 month). <u>Output 2. Improving hydrological forecasting (12 months)</u> Activity 2.1. Procurement of specialized forecasting software (6 months). Activity 2.2. Implementation of contemporary forecasting methodologies and instructions (12 months). Activity 2.3. Training of forecasting engineers (3 months).

	Output 3. Improving the effective exchange of information (12 months) Activity 3.1. Creation of a mechanism (software, IT platform), which will integrate all the data set collected from automatic and classic hydrological observation stations (12 months). Activity 3.2. Automation of issuing warnings and early alerts (3 months).
Budget	2.2 million EUR
Sources of funding	External donors
Measurement/Evaluation	Representative monitoring network; Functional automatic stations; Number of trained specialists; Functional specialized software; Applied contemporary methods and technologies; Functional data exchange platform, Automated alerting system implemented.
Potential risks	Potential risks can be of several types: High cost of equipment and software investments, implementation schedule, training and fluidity of trained personnel.
Project beneficiaries	The Government of the Republic of Moldova. Institutions subordinate to the Ministry of the Environment. State and private structures whose activity depends on hydrological forecasts. Academic environment. Civil society.
Adaptation/resilience benefits	Information with qualitative data, forecasts and qualitative warnings about water resources of all structures involved in the field of water management will be the major support in the development of climate change adaptation actions both at the country and local level. Knowing the real situation is the first step in correct management of the problem that has arisen.
Responsibilities and coordination	Ministry of the Environment. The project implementation unit. State Hydrometeorological Service.

The sustainable management of water resources by applying the water management balance sheet as a project proposal will facilitate the rational use of water resources through the issue of special water use permits. This project idea could become part of a technologically oriented climate adaptation investment portfolio towards a qualitative management of the country's water resources.

Background information	The essence of the water balance lies in knowing the difference between intake and consumption of water, that is, in evaluating the available water resources. The forecasting component allows the assessment of available water resources in the future as well. In other words, depending on the regional scenarios of climate change, the available water resources will be evaluated for different time intervals, for example from 10 to ten years (until the end of the XXI century) and according to the intensity of global warming. This moment is very important, because

	currently some beneficiaries obtain long-term special water use authorization, even up to 30 years, without considering the impact of climate change on water resources. That is, without arguing whether the requested volumes of water will generally be available. So, applying the indicated technology (WBS) depending on the presence, insufficiency or lack of water resources, special water use permits will be issued and management activities in the water resources sector will be planned for the near and medium future. Two main input data sets are used to calculate the water management balance – water resources (based on the water balance) and water use. The water management balance can be calculated at the point or for some area (water management sector, reception basin, river basin). For planning the use of water resources, the water management balance is calculated for the water resources management sectors (approved by the "Apele Moldovei" Agency). Water resource management sectors are identified at two levels, broad sectors and more detailed sectors. In both cases, the basin principle is respected. In the calculation of the water balance, one operates not with the measured runoff, but with the available runoff ensured, with a different exceedance probability. As a rule, P=50% (average runoff year), P=75% (dry year) and P=85, 90 or 95% very dry years. The results of the evaluation will be placed in the Automated Information System of the State Cadastre of Waters. For this, the calculation must be done using specialized software, which can be free, commercial or specially developed in the Republic of Moldova. The calculation algorithm is well known, applied all over the world and approved by the "Apele Moldovei" Agency.
Objectives and outputs	The major objective is the application of the water management balance sheet as a record tool in the transparent and sustainable management of the water resources of the Republic of Moldova under the conditions of climate change. The activities identified for the implementation of the selected actions are the following: 1. <u>Identification of the responsible institution:</u> The activity assumes that, within the framework of the institutional reform, the duties of a selected institution will include the

	responsibility for monitoring the regularization of the surface runoff of small rivers in the country. 2. Evaluation of the impact of the number of lakes on the flow of small rivers: The action provides for the completion of scientific-applicative studies to evaluate the anthropogenic pressure exerted by reservoirs in concrete basins of small rivers. As a result, leakage losses will be calculated due to the negative influence of the surplus of reservoirs. In the case of exaggerated pressure, the maximum number of lakes that can be arranged on the course given by the lakes will be indicated (expressed by the maximum surface area of the water mirror of the lakes). 3. Approval of the methodology for identifying the reservoirs that must be liquidated: The action provides for scientific-applicative research in the development of the methodology for identifying lakes that do not perform their functions and which of them must be liquidated. The methodology will be approved by the administrative board of the responsible institution and will be strengthened by ministerial order. 4. Approval of the method of naturalization or valorization of the freed lands: A methodology will be developed for the use of the lands released after the liquidation of the lake, which will be focused either on their use in agriculture (in some cases they can also be used for other purposes, e.g. in construction) or they will be naturalized, for example meadows or wet areas. 5. Approval of procedural instructions: The action provides for the elaboration of some sets of procedural instructions, which will ensure the legality of the measures undertaken to liquidate the lakes and the subsequent exploitation of the lands.
Link to country development priorities	The realization of the project aims to implement the following priorities of the country in terms of adaptation to climate change, which can be found in the following legislative and normative acts: ● Water Law no. 272 of 23.12.2011. ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013.

	• Government Decision no. 932 of 20.11.2013 for the approval of the Regulation on the systematic monitoring and record of the state of surface water and underground water. • Strategy of the Republic of Moldova for adapting to climate change until 2020. • Government Decision no. 491 of 23-10-2019 regarding the approval of the Automated Information System Concept "State Cadastre of Waters". • The national development strategy "Moldova 2030". • The Sustainable Development Goals (SDGs) formulated by the 2030 Sustainable Development Agenda. • INDC-2 of the Republic of Moldova.
Scope and activities	Main goal: Improving the sustainable management of water resources by applying the water management balance sheet. <u>Output 1.</u> Implementation of WBS calculation software. Activity 1.1. Identifying and procuring software (or developing native software). Activity 1.2. Creating the database, organizing the data flow and calibrating the software. <u>Output 2.</u> Implementation of the necessary normative acts for WBS calculation. Activity 2.1. Approval of procedural instructions. Activity 2.2. Review of reporting forms. <u>Output 3.</u> Increasing institutional capacities. Activity 3.1. Staff training and/or retraining. Activity 3.2. Training in the field of computer software.
Timeline	The total duration of the project will be 2 years. Activities can run parallel. <u>Output 1.</u> Implementation of WBS calculation software.

	Activity 1.1. Identifying and procuring software (or developing native software) (6 months). Activity 1.2. Creating the database, organizing the data flow and calibrating the software (24 months). Output 2. Implementation of the necessary normative acts for WBS calculation. Activity 2.1. Approval of procedural instructions (12 months). Activity 2.2. Review of reporting forms (12 months). Output 3. Increasing institutional capacities. Activity 3.1. Staff training and/or retraining (2 months). Activity 3.2. Computer software training (2 months).
Budget	Output 1 – 85 thousand EUR Output 2 – 10 thousand EUR Output 3 – 6 thousand EUR Total – EUR 101 thousand
Sources of funding	External donors, the state budget
Measurement/Evaluation	Calibrated, validated and used software; Functional database; Instructions approved and in force; Approved and used reporting forms; Number of trained specialists.
Potential risks	The potential risks fall into two major categories: Political will and institutional capacity.
Project beneficiaries	The Government of the Republic of Moldova. Institutions subordinate to the Ministry of Environment involved in the management of water resources. State and private structures – water users for different uses. Academic environment. Civil society.
Adaptation/resilience benefits	Water resources, which under the conditions of climate change, especially in the direction of its aridification, will be less and less and will be better managed through the implementation of the proposed technology. Issuance of water use authorizations based on the assessment of the WBS is an extremely good

	measure for adapting to climate change by using them rationally not only now, but also during the term of the authorization.
Responsibilities and coordination	Ministry of the Environment. The project implementation unit. "Apele Moldovei" Agency.

The liquidation of reservoirs that do not fulfill their functions and the optimization of their number based on hydrological indicators as a project proposal will facilitate the rational use of water resources by protecting them in the conditions of climate changes. This project idea could become part of a technologically oriented climate adaptation investment portfolio towards a qualitative management of the country's water resources.

Background information	The main objective is to reduce the runoff losses of small rivers in the Republic of Moldova. In hydrology the notion is the reduction of surface runoff losses. A pilot project will be launched focusing on a catchment basin or sub-basin from an administrative district or development region. Then the activities will expand throughout the country. Normative acts will be developed for the possibility of application throughout the country. Most ponds/lakes were built between the 1960s and 1980s. Correspondingly, their useful volume of water is considerably reduced. In 1995, an inventory was carried out regarding the state of 1253 ponds/lakes (ACVAPROIECT data). As a result, their degree of danger was determined for the localities located downstream of the dams in the case of high risk (dam break). Within the project EPTATF 2013-2016, Management and support for Technical Assistance regarding the protection of the territory of the Republic of Moldova against floods, financed by the EIB - Service contract No TA2011038 MD EST (TA-MDFRM 2013-2016), also an assessment was carried out for cases of breaking dams for several lakes. It was found that a good part of the ponds/lakes were built with deviations from the norms in force (СНИП), respectively about 40% of them present a real danger for the population in case of dam break (visual inspection). The prevailing height of the dams varies from 5 to 7m. All ponds/reservoirs in the Republic of Moldova are designed and built for seasonal water regulation. The technical parameters of the hydrotechnical edifices must ensure the drainage of rainwater

	with the probability of occurrence of the flow of 5% and 1% depending on the degree of reliability of the construction. At the same time, it is found that the density of ponds and reservoirs on the territory of the Republic of Moldova is higher than the optimal one, depending on the intrinsic (essential) characteristic of the hydrographic basin, also, the density of the location of ponds/lakes is uneven on the hydrographic basins. The high density of the location of ponds/lakes within a watershed, in many cases leads to the disappearance of water flow in small rivers. The disappearance of the water flow in the river means not ensuring the ecological flow, which in turn does not ensure the stable development of the biodiversity of the respective river. In 2017, about 3,900 reservoirs/ponds were inventoried (except UAT: Cantemir, Briceni, Ocnița, Soroca, Bălti municipality). Thus, the following can be established: ● Dry ponds – 166 units. ● Ponds with passports and technical sheets – 160 units. ● Ponds with exploitation regulations – 58 units. ● Ponds with damaged dams – 537 units. ● Ponds with damaged large water spillway – 289 units. ● Ponds with damaged bottom evacuator – 169 units. In the spring of 2017, by issuing the order of the district presidents, mixed commissions were created for the evaluation of reservoirs/ponds, which included representatives of APL, the Service of Civil Protection and Exceptional Situations, Territorial Ecological Inspections and companies subordinate to the Moldovan Water Agency. The joint commissions examined the current state of the hydrotechnical constructions of the reservoirs/ponds (dam, high water spillway, bottom drain), as well as the passporting of the reservoirs/ponds. The analysis of existing materials finds the following: ● Many hydrotechnical constructions of ponds/lakes are in damaged condition. ● The designed exploitation period of the lakes is 40-50 years. Considering that most of them were built in the

	years 1960-1980, it follows that many of them have expired the exploitation period, and the others are at the limit of the exploitation term. Estimates show that, due to the high level of clogging, the volume of reservoirs has decreased by an average of 0.50% annually. Thus, optimizing the number of lakes/ponds appropriate to the situation in the Republic of Moldova, becomes a priority, a fact that can be a good contribution to risk assessment, the development of measures to protect and improve aquatic resources, increase surface runoff, also to rural development.
Objectives and outputs	The major objective is to reduce surface runoff losses by eliminating the surpluses of non-functional reservoirs and restoring the natural runoff volume of small rivers throughout the territory of the Republic of Moldova. The proposed project is of pilot type, for a catchment area below 1000km^2. The activities identified for the implementation of the selected actions are the following: 1. <u>Identification of the responsible institution:</u> The activity assumes that within the framework of the institutional reform, the duties of a selected institution will include the responsibility for monitoring the regularization of the surface runoff of small rivers in the country. 2. <u>Evaluation of the impact of the number of lakes on the flow of small river</u>: The action provides for the completion of scientific-applicative studies to evaluate the anthropogenic pressure exerted by reservoirs in concrete basins of small rivers. As a result, leakage losses will be calculated due to the negative influence of the surplus of reservoirs. In the case of exaggerated pressure, the maximum number of lakes that can be arranged on the course given by the lakes will be indicated (expressed by the maximum surface area of the water mirror of the lakes). 3. <u>Approval of the methodology for identifying the reservoirs that must be liquidated:</u> The action provides for scientific-applicative research in the development of the methodology for identifying the lakes, which do not perform their functions and which of them must be liquidated. The methodology will be approved by the administrative board of the responsible institution and will be strengthened by ministerial order.

	4. Approval of the method of naturalization or valorization of the freed lands: A methodology will be developed for the use of the lands released after the liquidation of the lake, which will be focused either on their use in agriculture (in some cases they can also be used for other purposes, e.g. in construction) or they will be naturalized, for example meadows or wet areas. 5. Approval of procedural instructions: The action provides for the elaboration of some sets of procedural instructions, which will ensure the legality of the measures taken to liquidate the lakes and the subsequent exploitation of the lands. 6. Identification and liquidation of identified lakes: The action is purely technical and consists in the physical liquidation of the identified reservoir. The released land will be used for predefined purposes. 7. Staff training: The realization of the activities requires qualified personnel. For this, training courses will be held in the application of the developed methods, as well as in knowing the particularities of the legal (juridical) framework in the implementation of the action.
Link to country development priorities	The realization of the project aims to implement the following priorities of the country in terms of adaptation to climate change, which can be found in the following legislative and normative acts: ● Water Law no. 272 of 23.12.2011. ● The regulation on flood risk management, approved by Government Decision no. 887 of 11.11.2013. ● Government Decision no. 932 of 20.11.2013 for the approval of the Regulation on the systematic monitoring and record of the state of surface water and underground water. ● Strategy of the Republic of Moldova for adapting to climate change until 2020. ● Government Decision no. 491 of 23-10-2019 regarding the approval of the Automated Information System Concept "State Cadastre of Waters". ● The national development strategy "Moldova 2030".

	● The Sustainable Development Goals (SDGs) formulated by the 2030 Sustainable Development Agenda. ● INDC-2 of the Republic of Moldova.
Scope and activities	The main goal: reducing surface runoff losses by eliminating the surpluses of non-functional reservoirs and restoring the natural runoff volume of small rivers throughout the territory of the Republic of Moldova. Output 1. Adjustment of the legal framework. Activity 1.1. Identification of the responsible institution. Training of collaborators. Activity 1.2. Development and implementation of verification and control procedures. Output 2. Identification of liquidation lakes. Activity 2.1. Testing and implementation of lake identification methodology. Activity 2.2. Elaboration of recommendations regarding the use of land after the liquidation of the lakes. Output 3. Liquidation of identified lakes. Activity 3.1. Liquidation of identified lakes. Activity 3.2. Land utilization after liquidation of the lakes. Activity 3.3. Evaluation of the change in runoff after liquidation of the lakes.
Timeline	The total duration of the project will be 5 years. Activities can run parallel. Output 1. Adjustment of the legal framework. Activity 1.1. Identification of the responsible institution. Employee training (6 months). Activity 1.2. Development and implementation of verification and control procedures (12 months). Output 2. Identification of liquidation lakes

	Activity 2.1. Testing and implementation of lake identification methodology (12 months). Activity 2.2. Elaboration of recommendations regarding the use of land after the liquidation of the lakes (12 months). <u>Output 3.</u> Liquidation of identified lakes. Activity 3.1. Liquidation of identified lakes (24 months) Activity 3.2. Land utilization after liquidation of the lakes (5 years). Activity 3.3. Evaluation of the change in runoff after liquidation of the lakes (6 months).
Budget	Output 1 – 10 thousand EUR. Output 2 – 5 thousand EUR. Output 3 – 135 thousand EUR. Total –150 thousand EUR.
Sources of funding	External donors, the APL budget, lake owners
Measurement/Evaluation	Responsible institution identified. No. of trained personnel. Set of approved normative acts. No. of tests on receiving basins. The recommendations applied. Opinion survey regarding the quality of the recommendations made. No. of lakes liquidated according to the recommendations. No. of reclaimed land per catchment area. Determining the limit of anthropogenic pressure achieved.
Potential risks	**The technological risks** at the start, i.e. for a pilot project, are high. Procedurally, it is not clear how a dam will be demolished, or where the material will be stored. For instance, how the alluvium from the lake will be excavated, where it will be transported, what will happen to it, etc. How will the old lakebed be used in the future, etc. **Social risks** can arise when the local population does not understand the need to liquidate the lake (which they, the inhabitants, remember from their childhood, where they used to catch fish and go swimming). The benefits of saving or preserving water resources in the face of climate change, etc., will need to be

	explained. The resistance of the owners of the lakes, who do not want to comply with the normative-legal framework. **The risk of the trained personnel** mainly comes down to the skill of identifying redundant lakes.
Project beneficiaries	The Government of the Republic of Moldova. Institutions subordinate to the Ministry of Environment involved in the management of water resources. State and private structures – owners and/or managers of reservoirs. APL. Water users.
Adaptation/resilience benefits	The main measure of adaptation to climate change consists in reducing additional water losses through evaporation from the surface of redundant lakes. In this way, it will be ensured to increase the flow volumes in the small rivers not due to precipitation (which is decreasing) but by saving it by reducing water losses. The water saved can be used for various uses in the national economy or can be used to naturalize rivers.
Responsibilities and coordination	Ministry of the Environment. The project implementation unit. "Apele Moldovei" Agency.

The Technology Action Plan for the water resources sector was disseminated and discussed in the GLS. Due to the activities carried out jointly with GLS and previous discussions, there are no permanent objections to the presented Technology Action Plan text.

Appendix 1. The List of Stakeholders of Water Resources Sector

No.	INSTITUTION	Contacts
1	**The "Integrated management policies of water resources" department** of MADRM.	Sârbu Ana, Principal Consultant, ana.sirbu@madrm.gov.md
2	**The "Bilateral Treaties" section** of the Ministry of Foreign Affairs and European Integration.	Document management section and state diplomatic archive (for secretarial matters), secdep@mfa.gov.md
3	**The Meteorological Center and the Hydrological Center** of the State Hydrometeorological Service.	Anticamera - hidrometeo@meteo.gov.md; Chancellery - chancelleria@meteo.gov.md
4	**The "Environmental Quality Monitoring" Department** of the Environmental Agency.	Gâlcă Gabriel, Head of Directorate, g_gilca@mediu.gov.md
5	**The "Water Resources Management" Directorate** of the "Moldova Waters" Agency.	Anticamera - agentia_am@apele.gov.md
6	**The "Geological" Directorate** of the Agency for Geology and Mineral Resources.	Raducan Daniela, Head of Directorate, directia.geologica@agrm.gov.md
7	**The "Control Management of Water and Atmospheric Air Resources" Directorate** of the Environmental Protection Inspectorate.	Bragoi Natalia, Interim Head, bragoi.natalia@ipm.gov.md
8	the North, Center, South and UTA Gagauzia **Regional Development Agencies.**	ADR Nord, adrnord@gmail.com ; ADR Center, oficiu.adrc@gmail.com ; South ADR, adrsud@adrsud.gov.md ADR UTA Gagauzia, adr.utag@gmail.com
9	**The "Geography of landscapes" laboratory** from the Institute of Ecology and Geography.	Iurie Bejan, Head of Laboratory, iurie.bejan@gmail.com
10	**The "Hydrogeology" Laboratory** of the Institute of Geology and Seismology.	Moraru Constantin, Laboratory Head, cmoraru@yahoo.com
11	Representatives from the **faculty of "Cadastre and Law"** from the State Agrarian University of Moldova.	Dean: Oleg Horjan, PhD, associate professor, horjan@uasm.md
12	Representatives from the **"Geography" faculty** of the State University of Tiraspol.	Dean: Mironov Ion, PhD, associate professor, mironovioan@gmail.com
13	Representatives from environmental NGOs (**Ecocontact, Oikumena, Ecotiras**).	Ecocontact – Rodica Ioradnov, rodica.iordanov@ecocontact.md Oikumena – Vitalie Dilan, dilan.vitalie@gmail.com Ecotiras – Ilya Trombitsky, ilyatrom@mail.ru
14	Representatives from the joint-stock company **"Apa-Canal".**	Anticamera, acc@acc.md

Appendix 2. The roadmap for the identified and selected technologies in the water resources sector

The implementation of the technologies identified in the water resources sector is focused in an integrated manner on the strategic objective (OS 5.6) " **Increasing the resilience of the Water sector through investments in the climate field and reducing the risk of climate hazards** ". Practically, the results obtained by implementing technologies directly, indirectly or tangentially can be found in the achievement of this objective.

Among the sustainable development objectives, those that are a priority and can be achieved by implementing the identified technologies, should be mentioned:

- SDG 6. Clean water and hygiene.
- SDG 3. Health and well-being.
- SDG 13. Actions on the climate.
- SDG 15. Life on earth.

The group of technologies identified under the generic "DAMAGE REDUCTION DUE TO MAJOR FLOODS" have main objectives "Health and well-being" as well as "Life on Earth". Here, from secondary objectives, can be identified the following:

- True data and information.
- Qualitative forecasts.
- Rational use of water resources.
- Protection of the population.
- Protection of the population.
- Protection of the population and the business environment.

The group of technologies identified under the generic " REDUCTION OF DAMAGE DUE TO WATER DEFICIT " have the main objectives of " Clean water and hygiene" and "Climate action". Here, from secondary objectives, "Rational use of water resources" can be identified.

The group of technologies identified under the generic " SUSTAINING AND RESTORATION OF ECOSYSTEMS AND AQUATIC SPECIES ASSOCIATED WITH WATER " have the main objective of "Life on Earth". Here from secondary objectives, "Improving the quality of the environment" can be identified.

From the list of responsible institutions, the largest share goes to AAM, SHS, MM, MA, IGSU and Moldsilva.

The table is also similar for the three selected technologies, since each of them corresponds to the same generic.

The duration of the implementation of the selected technologies and actions is spread over the period of 2024-2029. It should be noted that the implementation of the expected technologies and activities can be conventionally divided into 3 large categories:

1. Those with permanent implementation - for example, *carrying out studies, investigations and analysis of the assessment of water resources - natural, real, ecological, available (of different assurance)*, i.e. those that can be carried out annually.

2. Those that are to be achieved predominantly in the years 2024-2026.

3. Those that have specific processes (with long-term actions). For example, the action *"Land utilization after the liquidation of lakes"*; a technological process that takes a long time - until 2029.

Next, in Table 1, the roadmap for the implementation of the 27 technologies identified for the water resources sector is presented. In Table 2, the actions carried out for the implementation of the three selected technologies are indicated.

Table 1
Roadmap for 27 identified technologies

	Impact	Tehnologia	An start	An finiș	Responsabili	Indicatori de succes	Riscuri	Cost estimativ, EUR	Obiectiv de adaptare
1	REDUCEREA DAUNELOR DE PE URMA VIITURILOR MAJORE	1. Perfecționarea monitorizării și prognozării scurgerii, calității apei și schimbul eficient de informații dintre diverse instituții	01/01/24	12/31/26	SHS	Rețea de monitoring reprezentativă, prognoze calitative	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	2 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
2		2. Inventarierea infrastructurii de protecție în scopul eficientizării combaterii inundațiilor	01/01/26	12/31/27	AAM	Infrastructură inventariată	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	300 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
3		3. Analiza și cartografierea riscului de inundare la nivel de comună, municipiu	01/01/25	12/31/25	IGSU, AAM, SHS	Hărți detaliate elaborate, raport elaborat	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	3 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
4		4. Dezvoltarea și implementarea sistemelor de alertă timpurie a inundațiilor	01/01/24	12/31/25	IGSU, AAM, SHS	Sistem implementat	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	2 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
5		5. Actualizarea și respectarea regulilor de exploatare a lacurilor de acumulare	01/01/24	12/31/26	AAM, SHS	Documente actualizate, cadru legal modificat	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	100 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
6		6. Restabilirea și optimizarea sistemului construcțiilor de protecție contra inundațiilor prin poldere și ecluze	01/01/25	12/31/26	AAM, ONG	Sisteme rabilitate și construite noi	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	3 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
7		7. Actualizarea și implementarea planurilor pentru situații excepționale cauzate de dezastre de inundații	01/01/24	12/31/25	IGSU	Planuri elabiorate și implementate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	500 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
8		8. Asigurarea riscurilor de inundații și secetă (inclusiv cu suport din partea statului)	01/01/25	12/31/26	AM, IGSU, SHS	Proceduri elaborate și implemetate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	250 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
9		9. Reabilitarea și construirea sistemelor de evacuare a apelor pluviale	01/01/26	12/31/27	APL	Sisteme elaborate și construite noi	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	10 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
10	REDUCEREA DAUNELOR DE PE URMA DEFICITULUI DE APĂ	10. Perfecționarea managementului durabil al resurselor de apă prin aplicarea bilanțului de gospodărire a apei	01/01/24	12/31/25	AAM	Bilnaț elaborat și implementat	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	100 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
11		11. Evaluarea și cartografierea riscului de secetă	01/01/25	12/31/26	SHS, IGSU, MA	Raport de evaluare și set de hărți elaborat	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	100 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
12		12. Realizarea studiilor, investigațiilor și analizei evaluării resurselor de apă – naturale, reale, ecologice, disponibile (de diferită asigurare)	01/01/24	12/31/29	SHS, Mediul academic	Studiu elaborat	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	75 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
13		13. Actualizarea și respectarea regulilor de exploatare a sistemului de lacuri de acumulare pe raurile Nistru și Prut	01/01/24	12/31/24	AAM, MM	Documente elaborate și implementate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	250 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice

Table 1

Roadmap for 27 identified technologies (continued)

ODD	2024				2025				2026				2027				2028				2029				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei	■	■	■	■	■	■	■	■	■	■	■	■													1. Perfecționarea monitorizării și prognozării scurgerii, calității apei și sc
ODD 3. Sănătate și stare de bine									■	■	■	■	■	■	■	■									2. Inventarierea infrastructurii de protecție în sc
ODD 3. Sănătate și stare de bine					■	■	■	■																	3. Analiza și cartografierea riscului de inundare la nivel de comună, municipiu
ODD 3. Sănătate și stare de bine	■	■	■	■	■	■	■	■																	4. Dezvoltarea și implementarea sistemelor de alertă timpurie a inundațiilor
ODD 3. Sănătate și stare de bine	■	■	■	■	■	■	■	■	■	■	■	■													5. Actualizarea și respectarea regulilor de exploatare a lacurilor de acum
ODD 3. Sănătate și stare de bine					■	■	■	■	■	■	■	■													6. Restabilirea și optimizarea sistemului construcțiilor de protecție contr
ODD 3. Sănătate și stare de bine	■	■	■	■	■	■	■	■																	7. Actualizarea și implementarea planurilor pentru situații excepționale cauzate de dezastre de in
ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei					■	■	■	■	■	■	■	■													8. Asigurarea riscurilor de inundații și secetă (inclusiv cu suport din parte
ODD 3. Sănătate și stare de bine									■	■	■	■	■	■	■	■									9. Reabilitarea și construirea sistemelor de evac
ODD 6. Apă curată și igienă;	■	■	■	■	■	■	■	■																	10. Perfecționarea managementului durabil al resurselor de apă prin aplicarea bilanțului de gosp
ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei					■	■	■	■	■	■	■	■													11. Evaluarea și cartografierea riscului de secetă
ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
ODD 6. Apă curată și igienă;	■	■	■	■																					13. Actualizarea și respectarea regulilor de exploatare a sistemului de lacuri de acumulare pe raurile Nistru și Prut
[illegible]									■	■	■	■	■	■	■	■									[illegible]

Table 1
Roadmap for 27 identified technologies (continued)

	Impact	Tehnologia	An start	An finiș	Responsabili	Indicatori de succes	Riscuri	Cost estimativ, EUR	Obiectiv de adaptare
14		14. Implementarea agrotehnicilor de reținere și conservare a apei	01/01/26	12/31/27	MA, Fermierii	Tehnici elaborate și implementate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	2 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
15		15. Implementarea tehnologiilor de colectare a scurgerii de pe versanți în acumulări de suprafață	01/01/26	12/31/27	MA, Fermierii	Tehnici elaborate și implementate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	3 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
16		16. Implementarea tehnologiilor de colectare a apei de pe acoperișuri	01/01/26	12/31/27	APL, sectorul privat	Tehnici elaborate și implementate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	5 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
17		17. Implementarea tehnologiilor de colectare, epurare și tratare a scurgerii pluviale urbane	01/01/26	12/31/27	APL	Tehnici elaborate și implementate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	20 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
18		18. Implementarea tehnologiilor de împădurire și înierbare în bazinele mici de recepție	01/01/26	12/31/27	Moldsilva, APL, sectorul privat	Tehnici elaborate și implementate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	1 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
19		19. Lichidarea lacurilor de acumulare care nu-și îndeplinesc funcțiile și optimizarea numărului lor in baza indicatorilor hidrologici	01/01/24	12/31/29	AAM, APL, sectorul privat	Număr de lacuri lichidate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	150 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
20		20. Conștientizarea populației despre schimbările climatice și contribuția ei la managementul, colectarea si consumul apei la nivel de gospodărie și localitate	01/01/24	12/28/29	ONG	Sondaje de înțelegere a problemelor	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	500 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
21		21. Modernizarea sistemelor de irigare prin decentralizarea lor și orientarea spre diferite surse de apă	01/01/25	12/28/28	AAM, Fermierii	Sisteme modernizate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	10 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
22		22. Mărirea volumelor de acumulare a lacurilor (curățirea lor de nămol)	01/01/25	12/28/27	AAM, APL, sectorul privat	Număr de lacuri curățite	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	3 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
23	SUSȚINEREA ȘI RESTABILIREA ECOSISTEMELOR ȘI SPECIILOR ACVATICE ASOCIATE CU APA	23. Perfecționarea monitorizării ecosistemelor și resurselor biologice și schimbul de informații (inclusiv transfrontalier)	01/01/24	12/31/26	AM, SHS	Sistem de monitoring implemetat	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	500 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
24		24. Reabilitarea cursurilor naturale ale râurilor mici	01/01/24	12/31/26	MM, APL, ONG	Număr de râuri reabilitate	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	10 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
25		25. Lupta cu braconajul și speciile intruse	01/01/24	12/28/29	Inspectoratul piscicol	Număr redus de infracțiuni	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	500 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
26		26. Extinderea spațiilor verzi urbane	01/01/24	12/28/29	APL	Spații verzi reabilitate și noi create	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	1 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
27		27. Restabilirea pădurilor, luncilor și zonelor umede aferente cursurilor de apă	01/01/24	12/28/29	AAM, APL, Moldsilva, ONG	Suprafețe noi împădurite	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare	3 000 000	Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice

Table 1

Roadmap for 27 identified technologies (continued)

ODD	2024				2025				2026				2027				2028				2029			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
ODD 6. Apă curată și igienă;																	14. Implementarea agrotehnicilor de reținere și							
ODD 6. Apă curată și igienă;																	15. Implementarea tehnologiilor de colectare a s							
ODD 6. Apă curată și igienă;																	16. Implementarea tehnologiilor de colectare a a							
ODD 6. Apă curată și igienă;																	17. Implementarea tehnologiilor de colectare, ep							
ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei																	18. Implementarea tehnologiilor de împădurire ș							
ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei																								
ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei																								
ODD 6. Apă curată și igienă;																					21. Modernizarea siste			
ODD 6. Apă curată și igienă;																	22. Mărirea volumelor de acumulare a lacurilor (							
ODD 15. Viața pe pământ													23. Perfecționarea monitorizării ecosistemelor și resurselor biologice și s											
ODD 15. Viața pe pământ													24. Reabilitarea cursurilor naturale ale râurilor mici											
ODD 15. Viața pe pământ																								
ODD 15. Viața pe pământ																								
ODD 15. Viața pe pământ; ODD 13. Acțiuni asupra climei																								

Table 2
Roadmap for 3 selected technologies

	Tehnologia	Acțiunea	An_start	An_finiș	Responsabili	Indicatori de succes	Riscuri	Cost estimativ, EUR
1	Perfecționarea monitorizării și prognozării scurgerii, calității apei și schimbul eficient de informații dintre diverse instituții	1. Revizuirea amplasării spațiale a posturilor hidrologice. Proiectarea noii rețele de monitoring	01/01/24	06/28/24	SHS, AM, AAM, AGRM	Ponderea stațiilor pe corp de apă	Lipsa finanțării, lipsa cadrelor, Imprevizibilitatea în implementare, voință politică	50 000
2		2. Identificarea setului de echipament modern, utilaje și construcții, precum și a softurilor necesare, procurarea și instalarea lor	06/28/24	12/31/26	SHS, AM, AAM, AGRM	Echipament contemporan instalat și operațional	Imprevizibilitatea în implementare	1 000 000
3		3. Instruirea muncitorilor de la stații	01/01/25	02/03/25	SHS	Număr de specialiști instruiți	Migrația cadrelor instruite	100 000
4		4. Procurarea softurilor specializate de realizare a prognozei	06/01/25	12/31/25	SHS	Soft specializat funcțional	Imprevizibilitatea în implementare	500 000
5		5. Implementarea metodicilor și instrucțiunilor contemporane de realizare a prognozelor.	01/01/25	12/31/26	SHS	Metodici și tehnologii contemporane aplicate	Lipsa cadrelor instruite	100 000
6		6. Instruirea inginerilor prognoziști	06/01/25	07/01/25	SHS, AM, AAM, AGRM	Nr de specialiști instruiți	Migrația cadrelor instruite	100 000
7		7. Crearea unui mecanism (soft, platformă IT), care va integra tot setul de date colectat de la posturile automate și clasice de observații hidrologice	01/01/26	12/31/26	SHS	Platformă de schimb de date funcțională	Imprevizibilitatea în implementare	300 000
8		8. Automatizarea emiterii avertizărilor și alertelor timpurii	01/10/26	12/31/26	SHS	Sistem de emitere automat	Lipsa cadrelor instruite	50 000
9	Perfecționarea monitorizării și prognozării scurgerii, calității apei și schimbul eficient de informații dintre diverse instituții	1. Identificarea și procurarea softului (sau elaborarea softului autohton)	01/01/24	06/28/24	AAM	Soft specializat instalat	Imprevizibilitatea în implementare	50 000
10		2. Crearea bazei de date, organizarea fluxului de date și calibrarea softului	01/01/24	12/31/25	AAM, SHS, AGRM, BNS, Apa-Canal	Bază de date completată	Impedimente birocratice în acordarea actelor normative	35 000
11		3. Aprobarea instrucțiunilor de procedură	01/01/25	12/31/25	AA, MM	Promovarea și aprobarea Instrucțiuni	Imprevizibilitatea în implementare	5 000
12		4. Revizuirea formelor de raportare	01/01/25	12/31/25	AAM, MM, BNS	Forme de raportare produse și aprobate	Imprevizibilitatea în implementare	5 000
13		5. Pregătirea și/sau reciclarea personalului	10/30/25	12/31/25	AAM	Personal instruit	Lipsa cadrelor instruite	3 000

Table 2
Roadmap for 3 selected technologies (continued)

Obiectiv de adaptare	ODD	Duration	2024–2029 (Q1–Q4)
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei	130d	1. Revizuirea amplasării spațiale a posturilor hidrologice. Proiectarea noii rețele de monitoring
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei	655d	2. Identificarea setului de echipament modern, utilaje și construcții, prec
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei	24d	3. Instruirea muncitorilor de la stații
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei	154d	4. Procurarea softurilor specializate de realizare a prognozei
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei	522d	5. Implementarea metodicilor și instrucțiunilor contemporane de realizar
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei	23d	6. Instruirea inginerilor prognoziști
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei	261d	7. Crearea unui mecanism (soft, platformă IT), care va integra tot setul d
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 3. Sănătate și stare de bine; ODD 13. Acțiuni asupra climei	255d	8. Automatizarea emiterii avertizărilor și alertelor timpurii
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă;	130d	1. Identificarea și procurarea softului (sau elaborarea softului autohton)
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă;	523d	2. Crearea bazei de date, organizarea fluxului de date și calibrarea softului
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă;	261d	3. Aprobarea instrucțiunilor de procedură
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă;	261d	4. Revizuirea formelor de raportare
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă;	45d	5. Pregătirea și/sau reciclarea personalului

Table 2
Roadmap for 3 selected technologies (continued)

	Tehnologia	Acțiunea	An_start	An_finiș	Responsabili	Indicatori de succes	Riscuri	Cost estimativ, EUR
14		6. Instruirea în domeniul softului de calcul	10/30/25	12/31/25	AAM	Personal instruit	Migrația cadrelor instruite	3 000
15	Lichidarea lacurilor de acumulare care nu-și îndeplinesc funcțiile și optimizarea numărului lor in baza indicatorilor hidrologici	1. Identificarea instituției responsabile. Instruirea colaboratorilor	01/01/24	06/28/24	MM	Instituție identificată, Disponibiliatatea de cadre pregătite	Voință politică	5 000
16		2. Elaborarea și implementare procedurilor de verificare și control	06/28/24	06/30/25	MM, AAM	Cadru legal ajustat	Voință politică	5 000
17		3. Testarea și implementarea metodologiei de identificare a lacurilor	06/30/25	06/30/26	AAM	Metodologie funcțională	Imprevizibilitatea în implementare, Lipsa cadrelor	3 000
18		4. Elaborarea recomandări privind utilizarea terenurilor după lichidarea lacurilor	06/30/25	06/30/26	AAM	Set de recomandări elaborate	Imprevizibilitatea în implementare, Lipsa cadrelor	2 000
19		5. Lichidarea lacurilor identificate	06/30/26	06/30/28	AAM, APL, sectorul privat	Lacuri lichidate	Rezistență socială	100 000
20		6. Valorificarea terenurilor după lichidarea lacurilor	06/30/26	06/29/29	AAM, APL, sectorul privat	Terenuri valorificate	Imprevizibilitatea în implementare	30 000
21		7. Evaluarea modificării scurgerii după lichidarea lacurilor	01/01/28	06/30/28	AAMi, SHS	Scurgere evaluată	Lipsa cadrelor	5 000

Table 2

Roadmap for 3 selected technologies (continued)

Obiectiv de adaptare	ODD	Duration	2024–2029 (Q1–Q4)
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă;	45d	6. Instruirea în domeniul softului de calcul
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei	130d	1. Identificarea instituției responsabile. Instruirea colaboratorilor
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei	262d	2. Elaborarea și implementare procedurilor de verificare și control
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei	262d	3. Testarea și implementarea metodologiei de identificare a lacurilor
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei	262d	4. Elaborarea recomandări privind utilizarea terenurilor după lichidarea lacurilor
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei	524d	5. Lichidarea lacurilor identificate
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei	784d	6. Valorific
Sporirea rezilienței sectorului Apei prin investiții în domeniul climei și reducerea riscului de hazarduri climatice	ODD 6. Apă curată și igienă; ODD 13. Acțiuni asupra climei	131d	7. Evaluarea modificării scurgerii d