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Comprehensive analysis of the disaster risk reduction system for the agriculture sector in the Republic of Moldova

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Abbreviations and acronyms

ACSA	National Agency for Rural Development
ADA	Austrian Development Agency
AIPA	Agency for Intervention and Payments in Agriculture
ALRC	Agency of Land Relations and Cadastral of the Republic of Moldova
ANRCETI	National Regulatory Agency for Electronic Communications and Information Technology of the Republic of Moldova
ANSA	National Agency for Food Safety
ASM	Academy of Sciences of the Republic of Moldova
CIAT	International Center for Tropical Agriculture
CRED	Centre for Research on the Epidemiology of Disasters
DAWBEE	Data Access for Western Balkan, Eastern European and Caucasian Countries project
DCRMP	Disaster and Climate Risk Management Project
DRA	disaster risk assessment
DRR	disaster risk reduction
EWS	early warning systems
FAO	Food and Agriculture Organization of the United Nations
FARM	Federation of Agricultural Producers from the Republic of Moldova
GCF	Green Climate Fund
GD	Government Decision
GDP	gross domestic product
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	greenhouse gas
GIES	General Inspectorate for Emergency Situations
GIEWS	FAO Global Information and Early Warning System
GIS	geographical information systems
GoM	Government of the Republic of Moldova
ICPA	Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo"
IDA	International Development Association
INDC	Intended Nationally Determined Contribution
INFORM	Collaborative Project of the Inter-Agency Standing Committee Reference Group on Risk, Early Warning and Preparedness and the European Commission
MAFI	Ministry of Agriculture and Food Industry
MANCP	Multi-Annual National Control Plan of the Republic of Moldova
MARDE	Ministry of Agriculture, Regional Development and Environment (currently, MAFI)
MDL	Moldovan leu
MIA	Ministry of Internal Affairs
NBS	National Bureau of Statistics
NDC	Nationally Determined Contribution
NFDARA	National Fund for the Development of Agriculture and Rural Areas
NFFM	National Farmers Federation of the Republic of Moldova
NGO	non-governmental organization
NHMN	National Hydrological Monitoring Network
NSDRM	National Strategy for Disaster Risk Management
RNOCL	National Network for Laboratory Observation and Control
SHS	State Hydrometeorological Service
SSAIHP	Special Service for Active Influence on Hydrometeorological Processes
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization

Executive summary

Natural and biological hazards. The Republic of Moldova ranks in the top ten countries in the world when it comes to the highest proportion of people affected by natural hazards.[1] The primary hazards in the country include flooding, drought, earthquakes, hailstorms, and extreme heat.[2] In addition to natural hazards, invasive species that affect production have appeared in the country and the danger of locust invasion is growing.[3] Agriculture is among the sectors that is most affected by these hazards. Farmland covers 75 percent of the Republic of Moldova's territory,[4] the highest proportion in Europe, while forest cover is lowest (at 11.4 percent). Forest degradation damages the sustainable functionality of ecosystem services and increases the vulnerability of agriculture to natural hazards.

Agriculture and food security. The agriculture sector employed more than 36.1 percent of the working population and generated 9.86 percent of the country's gross domestic product (GDP) in 2019.[5] Agricultural production relies on international markets for major inputs, including agrochemicals, fertilizers, seeds and fuel, which are subject to the volatility of world prices and impact on the agrifood supply chain. At the same time, the agriculture sector is highly dependent on climate variability and change, resulting in the increasing frequency of precipitation extremes as well as water scarcity. This leads to the expansion of irrigation, which may result in unsustainable land and water management practices.[6] Agricultural food exports account for roughly 50 percent of the country's total exports.[7, 8] There has been a substantial increase in bulk exports in the past 15 years, which reduces the value of products, with Moldovan wines being an example.[9]

Natural hazards in the Republic of Moldova can lead to severe damage that can reduce agricultural production through destroyed crops, diminishing soil fertility, and damaged equipment and agricultural infrastructure. Flooding, droughts and earthquakes occasionally result in sudden catastrophic impacts, while ongoing soil erosion is steadily though less visibly destroying the natural resource base. Flooding affects about 70 000 people every year in the Republic of Moldova and costs about USD 100 million in GDP.[10] At the same time, drought causes estimated losses of USD 20 million in crop production every year.[11]

Policy and legislative framework. Internationally, the Republic of Moldova has been formally engaged in climate-change discussions since ratifying the United Nations Framework Convention on Climate Change (UNFCCC) in 1995 and the Kyoto Protocol in 2003, and has presented four National Communications to the UNFCCC, in 2000, 2010, 2014 and 2018, respectively. The Republic of Moldova submitted its Intended Nationally Determined Contribution (INDC) in 2015 and its updated Nationally Determined Contribution (NDC) in 2020, highlighting the need for addressing both adaptation and mitigation. The priority adaptation sectors include agriculture, water, forestry, transport, health, energy and regional development, along with a number of cross-

[1] **United Nations Office for Disaster Risk Reduction (UNISDR) & Centre for Research on the Epidemiology of Disasters (CRED).** 2015. *The Human Cost of Weather related Disasters, 1995–2015.* www.unisdr.org/files/46796_cop21weatherdisastersreport2015.pdf

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[4] **Moldovan Investment Promotion Agency.** 2020. *About Moldova.* Key facts. http://invest.gov.md/about-moldova

[5] **NBS.** 2021a. *National Bureau of Statistics of the Republic of Moldova.* http://statistica.gov.md/index.php?l=en

[6] **United States Agency for International Development (USAID).** 2017. Climate change risk in Moldova. *Country Fact Sheet.* www.climatelinks.org/resources/climate-change-risk-profile-moldova

[7] **World Bank.** 2019. *World Development Indicators.* https://data.worldbank.org/country/moldova

[8] **World's Top Exports.** 2021. *Moldova's Top 10 Exports.* Cited 10 March 2020. www.worldstopexports.com/moldovas-top-10-exports/

[9] **American Association of Wine Economists (AAWE).** 2020. *Moldova's Wine Exports 2000–2018: From Bottled to Bulk.* Economics Department, New York University.

[10] **Global Facility for Disaster Reduction and Recovery (GFDRR).** 2017. *Moldova Natural Hazard Risk.* www.gfdrr.org/en/ moldova

[11] **Daradur, M., Cazac, V., Mihailescu, C. & Boian, I.** 2007. *Climatic Monitoring and Droughts.* (Monitoringul climei și secetele). State Hydrometeorological Service the Republic of Moldova, Institute of Ecology and Geography, Academy of Science of Moldova.

sectoral adaptation priority areas referring to capacity development. Additionally, since 1999, the country is party to the United Nations Convention to Combat Desertification (UNCCD) and has presented National Action Plan (2000) and National Land Degradation Neutrality (LDN) targets.[12]

In 2015, the Republic of Moldova signed the Sendai Framework for Disaster Risk Reduction 2015–2030, the successor of the Hyogo Framework for Action 2005–2015 (which the Republic of Moldova did not sign). The Ministry of Agriculture, Regional Development and Environment (MARDE) was appointed as the responsible entity for implementation of the Sendai Framework. In 2021 MARDE reverted to its former name, the Ministry of Agriculture and Food Industry (MAFI), and the responsibilities over the Sendai Framework returned to the re-established Ministry of Environment.

The Republic of Moldova has established a legal and institutional framework that is focused on disaster risk reduction (DRR). The sectoral approach in DRR and climate-change adaptation dominates the current stage of the country's development; however, cross-sectoral and subnational approaches are gaining more consideration.

Institutional framework. The direct management of civil protection is exercised by the General Inspectorate for Emergency Situations (GIES), which is subordinated to the Ministry of Internal Affairs (MIA). Civil protection includes the leadership and management, in respect of the state of the environment and potentially dangerous facilities, the human resources and equipment for eliminating the effects of disasters, and the training system for civil protection. It has branches in all territorial administrative units, and it comprises all sectors of the national economy, its organization being mandatory. The responsibility for the preparedness of civil protection authorities lies with the Government of the Republic of Moldova (GoM), ministries, departments, local public authorities, and enterprises. According to DRR legislation, the specialized central public authorities are obliged to ensure, during peace or war time, the protection of the population, of material goods and cultural values, to limit and to eliminate the consequences of disasters.

Disaster management functions are split among several ministries and state departments, local public authorities, and economic entities. Overall direction is provided by the National Commission for Emergency Situations, and vertical lines of authority within the system work adequately in most instances. However, there is little feedback going up the chain of command, and horizontal linkages among many institutions appear to be inadequate in many instances. A multidisciplinary, multisectoral and multistakeholder national platform for DRR does not exist. The Commission for Emergency Situations and the GIES create emergency preparedness and response plans for a period of five years, which are discussed, regularly updated, and ratified. Emergency planning at the district and local levels is updated on an annual basis, based upon public consultations and data collected by the authorities. There are also a number of sector plans, however, there is a lack of intersectoral linkages.

Early warning systems. The early warning systems (EWS) of the SHS is focused around three main components: (i) the monitoring of the network of surface hydrological and meteorological automatic and classical stations; (ii) the satellite and internet components of the Global Telecommunication System of the World Meteorological Organization (WMO); and (iii) the analysis and forecast centre based at the SHS meteorological and hydrologic forecasting centres at all the stations. The SHS issues warnings on weather-related hazards; GIES assists with dissemination of these, as they may entail mobilization for possible intervention and relief effort where needed. The weather stations cooperate with local public authorities and provide to them information upon request. At the same time, the SHS informs the recipients by developing specialized daily, weekly, fortnightly, monthly and quarterly forecasts, as well as annual reports of a more detailed nature (with more hydrometeorological information).

AgraVista is an online portal of the Federation of Agricultural Producers from the Republic of Moldova (FARM) that inputs and provides information on the connection between the business environment and agricultural producers. It includes some market information and promotes domestic markets. In spite of this and other initiatives, a lack of market information remains one of the main problems for Moldovan producers and processors. This results in poor links from primary producers to end markets and poor communication down the value chain.

[12] **Daradur, M., Cazac V., Mosoi, Iu., Leah, T., Shaker, R., Josu, V. & Talmaci, I.** 2018. *National Land Degradation Neutrality Targets* (Republic of Moldova). Chisinau, State Hydrometeorological Service. www.unccd.int/sites/default/files/ldn_targets/ Moldova%20LDN%20TSP%20Country%20Report.pdf

Agrometeorology services. The SHS, which is a subordinate unit of the Ministry of Environment, monitors, forecasts and issues warnings related to meteorological, hydrological, and agrometeorological hazards. Agrometeorological monitoring is done at 13 meteorological stations and 15 agrometeorological posts in the Republic of Moldova. The SHS also monitors agroclimatic aridity. In 2016, the agrometeorological network was upgraded with new equipment for determining soil moisture. Agrometeorological monitoring is performed to provide information to the government, the National Bank, agricultural associations, farmers and other interested parties. The weather stations provide information to local public authorities upon request. The SHS informs the recipients by developing specialized daily, weekly, fortnightly, monthly, quarterly and biannual forecasts, as well as annual reports with more detailed information. Farms receive information from the SHS through the SHS website and the media, or the SHS provides special information upon request. In addition, the SHS provides certain agrometeorological information for a fee. There is a lack of local equipment for monitoring climate-related factors and issuing irrigation forecasts, and a lack of equipment for monitoring the condition of dams and irrigation facilities.

Disaster risk reduction in the agriculture sector. The disaster risk assessment (DRA) is one of the most important baseline documents for comprehensive disaster risk management, and DRA methodology exists at the national and local levels. Its compatibility with the European Union DRA Guidelines is only partial, thus further elaboration and updating of the methodology is needed in order to achieve full compliance. Spatial planning and scenario studies including hazard mitigation are strongly improved by the use of geographical information systems (GIS) – GIS technology is scattered over different institutes, but GIS information and spatial data (such as maps) are available for the general public on a number of web portals.

There is currently no systematic post-disaster needs assessment being carried out for the agriculture sector in the Republic of Moldova, which would include damage and loss assessment. However, there is a methodology for assessing damage and losses to agriculture, and the reports are submitted to MAFI when a disaster occurs. Due to the fact that a majority of farmers do not have insurance, they do not receive payments for losses in agricultural production.

The National Bureau of Statistics (NBS) collects, processes and disseminates statistical data about the country's demographic, social, economic and ecological state; however, it does not collect data on disasters and DRR measures.

Programmes and projects related to DRR. Various United Nations (UN) agencies, the World Bank and other International Financial Institutions (IFIs), the European Union, international organizations, donors and funding, together with key national institutions, are implementing a number of programmes and projects related to DRR, EWS, agrometeorology services, and adaptation to climate change (Annex VI). National public authorities and other national disaster risk management structures joint analysis and evaluation of implemented projects would facilitate the identification, dissemination and further upscale of best practices in the field of DRR and climate change in the agriculture and food security sectors.

Conclusions. The vulnerability of the Republic of Moldova to climate change, along with projections of how agriculture will be specifically impacted by it in the near future – due to the expected increase in and severity of extreme weather events – is highlighted in multiple documents. An effective DRR system needs to be in place in order to mitigate such risks, especially with regard to the significant impacts that these hazards can have on the agriculture sector. The Republic of Moldova has established a legal and institutional framework for disaster risk management; nevertheless, it remains mostly response-oriented. Less attention is devoted to prevention measures such as a systematic risk assessment, EWS, emergency plans, land-use planning, and information sharing with the public. The Republic of Moldova has sectoral legislation and standards for emergency classification and damage assessment, as well as modern and up-to-date IT systems for recording disaster data. Most legal and regulatory documents do not link climate change and disaster risks.

Currently, the Republic of Moldova is in the process of shifting from emergency response towards a more proactive DRR approach. Although DRR is referenced in many policies and strategies, it is necessary to mainstream it further into the national and sectoral policy framework. This should be done through risk management, vulnerability assessment, and formulation and mainstreaming of adaptation measures in the planning frameworks and processes at different levels (national, sectoral, local) for the agriculture sector. The developed resilience measures included in the planning documents should address climate impact in the

medium and long term. The main gaps are the lack of adaptation to climate change measures included in the planning framework for the agriculture sector, the limited use of a climate-smart agriculture approach, and investments not directly targeting climate-change needs on the ground.

There is a lack of clarity regarding the roles and responsibilities of the Ministry of Environment as the national focal point and being responsible for Sendai Framework activities, and MIA, which is responsible for the development of the National Strategy for Disaster Risk Management (NSDRM). In addition, the Republic of Moldova does not yet have a national platform for DRR, which would bring all relevant stakeholders from various sectors together and would facilitate interinstitutional coordination, collaboration and communication to advance its national commitment to reduce disaster risks as a member of the Sendai Framework for DRR 2015–2030. Some climate risk assessments were conducted during preparation of National Communications to the UNFCCC and NAP-1.[13] However, there is still a need to conduct more comprehensive risk assessments in the country. Different institutions use different methodologies, criteria and data to determine possible consequences of disasters in agriculture, and there is not one united disaster risk assessment document that would make risks comparable and risk levels determined at the national level. Communication and coordination between involved ministries and parties needs to increase in order for the full assessment of risks to take place at national, regional and local levels.

Recommendations for improving the DRR systems in agriculture in the Republic of Moldova include:

Policy recommendations:

- Develop a risk-reduction action plan for rural livelihoods in the Republic of Moldova, leading to revising legislative mandates and regulatory frameworks.
- Consult with national stakeholders on the benefit of having intersectoral actions for DRR and preparedness, based on lessons learned from past hazards.

Recommendations for improvement of institutional framework and coordination mechanisms:

- Establish a national platform for DRR to advance the national commitment to reduce disaster risk and enhance the institutional coordination, collaboration and communication on DRR actions.
- Clearly outline the roles and responsibilities of all relevant stakeholders in DRR, climate-change adaptation and laws, strategies, plans and policies, along with expected actions. In particular, clarify the roles and responsibilities of the Ministry of Environment, as the national focal point for the Sendai Framework, and MIA, responsible for the development of the NSDRM.
- Strengthen the coordination and collaboration of DRR and disaster risk management, and climate-change adaptation activities, in particular for agriculture.
- Establish a working group and clarify roles and responsibilities across line ministries and other relevant organizations regarding risk assessment and mapping, especially for the agriculture sector.
- Enhance capacities and cooperation with institutions that are involved in the development of GIS database and mapping at local, national and regional levels.
- Create a national ecological network and promote organic agricultural practices, disseminate information and knowledge as well as exchange of experiences in this field, and create ecological production networks in relation to agricultural emergency management at local and national levels, which eliminates the use of chemicals in production and, ultimately, prevents degradation and chemical pollution of the natural environment, which provokes agricultural disasters.
- Encourage synergy and harmonization of actions between focal points and working groups of the Sendai Framework, UNFCCC, UNCCD, and United Nations Convention on Biological Diversity.
- Increase communication and coordination between involved ministries and parties for carrying out full assessments of risks to take place at national, regional and local levels, as well as development and implementation of DRR and climate-change adaptation actions.

[13] The Republic of Moldova has initiated a National Climate Change Adaptation Planning process (NAP), through the country's 2014 National Climate Change Adaptation Strategy, which is considered its first NAP (or NAP-1).

- Focus the institutional capacity improvements on identifying seeds for drought-tolerant varieties and temperature-tolerant livestock breeds on the international market for adoption in the Republic of Moldova.
- Train farmers in efficient use of water and to make use of weather forecast and market information.

Recommendations for improvement of early warning systems:

- Reinforce national capacity and update operational systems on extensive data collection, processing, analysis, prediction capability and dissemination, and ensuring the required budgeting.
- Develop user-friendly and effective systems for accessing early warning information by farmers and agrifood supply chain operators with clear recommendations for certain hazards.
- Adapt the existing FAO Global Information and Early Warning System (GIEWS) food price tool at national level and harmonize it with the existing information systems.
- Promote good international scientific practice in order to create a radiolocation system for early warning about torrential rain, hailstorms, strong winds, flooding, and so on.
- Carry out an analysis of regional and global trends of market prices and the availability of basic products, taking into account the emergencies in the agriculture sector, for providing a price forecast and early warning.
- Build capacity of MAFI and extension service staff in the GIEWS and the UN World Food Programme's (WFP) Alert for Price Spikes (ALPS) tool, to analyse observed price deviations, and forecast seasonal prices and provide recommendations.
- Develop a dissemination and feedback mechanism for forecast and early warning products.
- Strengthen the agricultural extension and emergency warning capacities on the identification and dissemination of risk mitigation measures adapted to frost-, hail- and storm-vulnerable regions and appropriate to the lead time the SHS could provide.
- Enhance GIS database capacity that will help to link and improve mapping of risks and vulnerabilities, in particular for the agriculture sector.

Recommendations for improvement of agrometeorology services:

- Provide agricultural activity guidance based on crop calendar; provide regular agrometeorology bulletin.
- Develop and implement mobile applications for the distribution of agrometeorological information, including warnings.
- Connect with agricultural extension service for the dissemination of meteorology forecasts to farmers.
- Develop plant and animal pest and disease forecasts linked to weather warning alerts.
- MAFI to take lead responsibility to coordinate the implementation of prevention, mitigation and preparedness activities regarding natural hazards in agriculture.

Recommendations for the improvement of the disaster risk reduction system

- Develop a standardized national risk assessment framework for all potential hazards in agriculture.
- Align the country's post-disaster damage and losses evaluation and compensation methodology with international standards.
- Study the possibility of using modern technologies (approved by WMO) related to the artificial increase of precipitation.
- Establish a database which systematically collects historical hazard data by sector, and update the database regularly, and improve interinstitutional coordination for accessing the database. The NBS could play a substantial role in data collection and processing.
- Enhance knowledge and strengthen awareness and capacities of the relevant national organizations on DRR by providing training on data collection, analysis and management.
- Develop and disseminate guidelines with agricultural measures that help to reduce the adverse impacts of natural hazards, which can also reduce the magnitude of long-term soil degradation processes. Enhance farmers' access to knowledge and information about new crop varieties and livestock breeds, as well as on agriculture-related DRR and climate-change adaptation practices and technologies.

- Enhance capacity of local communities in undertaking climate risk assessment and identifying prevention measures. Encourage a bottom-up approach and use of participatory tools with the engagement of local public authorities, local non-governmental organizations (NGOs), and local private-sector representatives, in identifying local-level risks and response measures.
- Strengthen the DRR capacities and knowledge of the agricultural extension network and agroenvironmental organizations.
- Restructure the insurance system in agriculture to make it part of a stable economic system, and secure from possible risks, in accordance with the systems that exist in advanced economies, in order to ensure farmers' support in the event of natural disasters.
- Train and inform farmers and administration about the necessity for insurance of agricultural activities against natural hazards.
- Invest in data systems and support research and design of agricultural insurance products.
- Use the best international practices in insurance to spread risk and help farmers to avoid agricultural damage and catastrophic losses.
- Investigate and apply options for reforming crop insurance to decrease administration costs and improve affordability for smallholders.
- Analyse and identify options for tailoring crop insurance system to smallholder needs by improving affordability and providing crop insurance prior to investments instead of after.
- Introduce weather index-based insurance paired with other options and services for farmers.
- Include DRR, disaster preparedness information and activities into the curriculum of primary and secondary schools, and agricultural institutions.

Introduction

The Europe and Central Asia (ECA) region is prone to various natural hazards, including flooding, drought, hail, avalanches, landslides, and storms. With climate change, these extreme weather events, as well as temperature and precipitation changes, are expected to increase in frequency and severity and threaten to reduce yields and productivity in crops, livestock, fisheries and forestry in many areas of the region. This could also impact food security, nutrition and ecosystem services. The agriculture sector and in particular smallholders, herders, fishers and foresters, are vulnerable to the adverse impacts of climate change – the majority of them are dependent on the sector and its activities for their food and livelihoods.

This Comprehensive analysis of the disaster risk reduction system for the agriculture sector in the Republic of Moldova is part of a series of country baseline studies on the DRR system in the agriculture sector, conducted by FAO's Regional Office for Europe and Central Asia (REU). The other countries included in the series are Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. Similar reports analysing the DRR and management system for the agriculture sector in Western Balkan countries (Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia) were completed in 2018.

The country baseline studies review the current status of DRR, EWS and agrometeorology services in the agriculture sector, including legislation, policies, capacities and services related to the DRR system, and assess the gaps and what is needed to strengthen these areas. The results of the country studies will be used as technical background reports for the development and implementation of capacity-development initiatives.

This report was developed based on primary (interviews) and secondary (literature review) data sources. Information on gaps, challenges, constraints and opportunities was collected through semi-structured interviews with relevant national officials and experts, following provided guidelines and a questionnaire. Questions were largely based on the questionnaire of the Capacity for Disaster Reduction Initiative (CADRI) Capacity Assessment and Planning Tool for Disaster Risk Management for Food Security and Agriculture and for Climate Services.[1] Interviews were conducted with staff from the agency Moldsilva, Apele Moldovei agency, State Hydrometeorological Service, Agency for Land Relations and Cadastre, National Agency for Rural Development, Environmental Agency, Inspectorate for Environment Protection, National Federation of Farmers of the Republic of Moldova, State Agrarian University, and farmers. The interviews took place in April and May 2020; the list of people interviewed can be found in Annex I.

This study was conducted under the REU Regional Initiative 3 that focuses on "managing natural resources sustainably and preserving biodiversity in a changing climate."

[1] CADRI brings together six United Nations organizations – FAO, OCHA, UNDP, UNICEF, WFP and WHO. This UN-led interagency initiative delivers customized capacity development support in DRR.

Country background

The Republic of Moldova is a landlocked country in Eastern Europe with a total area of 33 850 km^2, and bordered by Ukraine and Romania along the Prut river (Republic of Moldova, 2019). The country is vulnerable to natural hazards such as severe drought, flooding, hail and storms. In 2007, the country experienced one of the most severe droughts in recorded history, affecting up to 80 percent of the country's population and leading to a significant economic decline (USAID, 2017).

The country is located in the northeast of the Balkans and belongs to the Black Sea basin countries. Its landscape consists of valleys and ravines and hills in the central part of the country – with Balanesti Hill its highest peak (at 428 m), formed by neotectonic movements, erosion and landslide processes – as well as lowlands in the northwestern and southern areas, where the average elevation is around 147 m (FAO, 2015).

The Republic of Moldova has a rich variety of flora and fauna, and a great number of animal species, along with rare species of vertebrates and invertebrates due to the country's unique geographical location, topography and favourable climate. Forests cover around 11 percent of the total land, and prevalent forest reservations are located in the middle of the Republic of Moldova, where 45 types of local tree species, 81 species of shrubs, and three species of wood vines can be found (Republic of Moldova, 2019). The country has five major natural reserves – including the Codrii, Playul Fagului, Prutul de Jos, Padurya Domnyasca and Yagorlyc – which occupy 19 000 ha and include forest, flood-plain and water reservations. The Republic of Moldova has designated 20 percent of its total forested area primarily for social services, which is the third-highest percentage in the world (FAO, 2020a).

The Dniester and Prut rivers, part of the Black Sea basin, provide around 60 percent of the country's water resources, mostly in the southern region. Other important rivers are the Raut, Cogilnic, Bic, Botna, Ialpug, Ichel, and Ciuhur, as well as around 3 000 smaller streams (USAID, 2017).

The Republic of Moldova's climate is relatively continental, with short mild winters and long warm summers. The country can be divided into different climate zones, including the northern forest steppe, central forest zone, and southern steppe, which results in some variation in temperature and precipitation (USAID, 2017). The average annual air temperature is 8 °C to 9 °C in the north and 10 °C to 11 °C in the south, while annual precipitation depends on the region – it is between 600 mm and 650 mm in the north and centre, and 500 mm to 550 mm in the south.

Since 2000, the Republic of Moldova has made significant progress across most Millennium Development Goals (MDGs). According to the Third MDGs Report (2013), the main drawback observed across all eight goals was the gap between rural and urban living standards, which continued to increase. People in rural areas had limited access to basic assets and services, such as water and sewerage supply, and health and education services (GoM and UN, 2013). This conclusion was confirmed by the Voluntary National Review 2020 of Sustainable Development Goals (SDGs). Inequalities persist and the risks related to food security and access to energy are high. Prompt measures are necessary to ensure inclusion of the most vulnerable and to reduce income and non-income inequalities (GoM, 2020a).

Despite recent progress, the Republic of Moldova remains one of the poorest countries in Europe. With a moderate climate and productive farmland, the Republic's economy relies heavily on its agriculture sector and depends on annual remittances of about USD 1.5 billion – more than 20 percent of GDP – from the roughly one million Moldovans working in Europe, the Russian Federation, and other countries such as the United States of America (Moody's Analytics, 2018).

The lack of economic and social infrastructure, together with the absence of viable economic alternatives, forces the population to migrate. The participation of women in the decision-making process, especially at higher levels, is modest, and women have fewer economic opportunities compared to men. The perpetuation of

these development problems could magnify emigration trends in the near future, which in spite of short-term advantages, actually carries a long-term risk – a "brain drain" from both a qualitative and quantitative point of view.

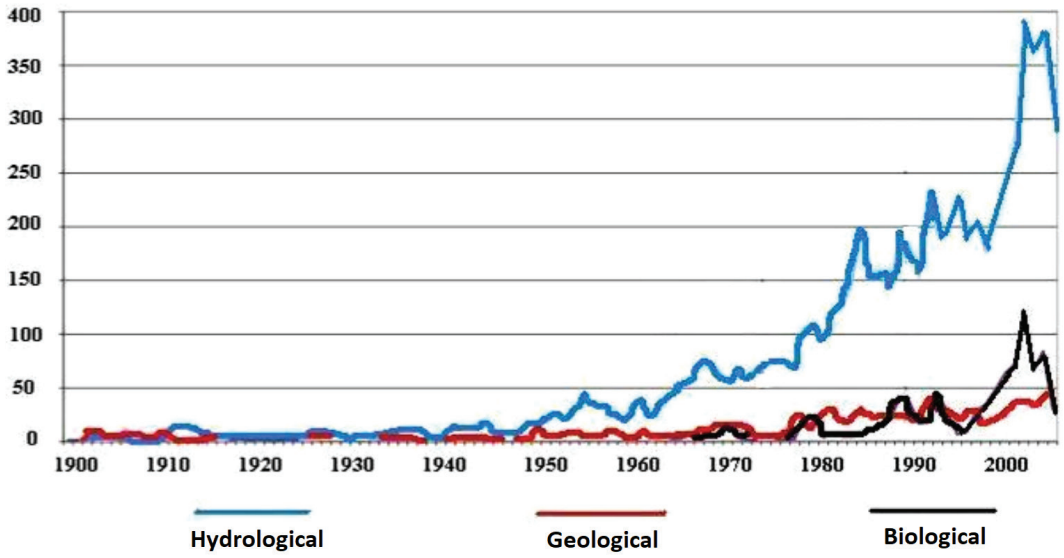
The country's economy depends heavily on the agriculture sector and food production, which includes fruit, vegetables, wine and wheat (Central Intelligence Agency, 2021). Agriculture, forestry and aquaculture made up 9.86 percent of GDP in 2019 (NBS, 2021a). Natural and biological hazards have the potential to impact adversely crop and livestock production and cause significant damage to critical infrastructure such as irrigation systems, livestock shelters, and storage facilities. Increasing the levels of resilience to climate variability and change is therefore crucial for the people whose livelihoods are partially or entirely dependent on the agriculture sector.

Natural hazards profile

Natural hazards

Beside anthropogenic hazards and risks (industrial accidents, pollution, and nuclear contamination), there are a number of natural hazards that threaten the Republic of Moldova. The number of the risk phenomena caused by weather conditions and climate change has increased by 5.5 times, and at the same time the number of natural hazards caused by other factors has increased only by 2.4 times, since the middle of the last century (Constantinov and Nedealcov, 2007) (Figure 1).

Figure 1. Natural hazards caused by weather conditions or other natural factors in the Republic of Moldova



Source: **Constantinov, T & Nedealcov, M.** 2007. Evaluation of climatic risks manifested on Republic of Moldova territory. *Present environment and sustainable development, nr. 1.* http://pesd.ro/articole/nr.1/Constantinov_Nedealcov.pdf

The Republic of Moldova is in the top ten countries in the world when it comes to the highest proportion of people affected by natural hazards (UNISDR and CRED, 2015). Flooding (both river and urban), earthquakes, storms, and extreme heat are the primary hazards in the country (EM-DAT, 2019) (Table 1).

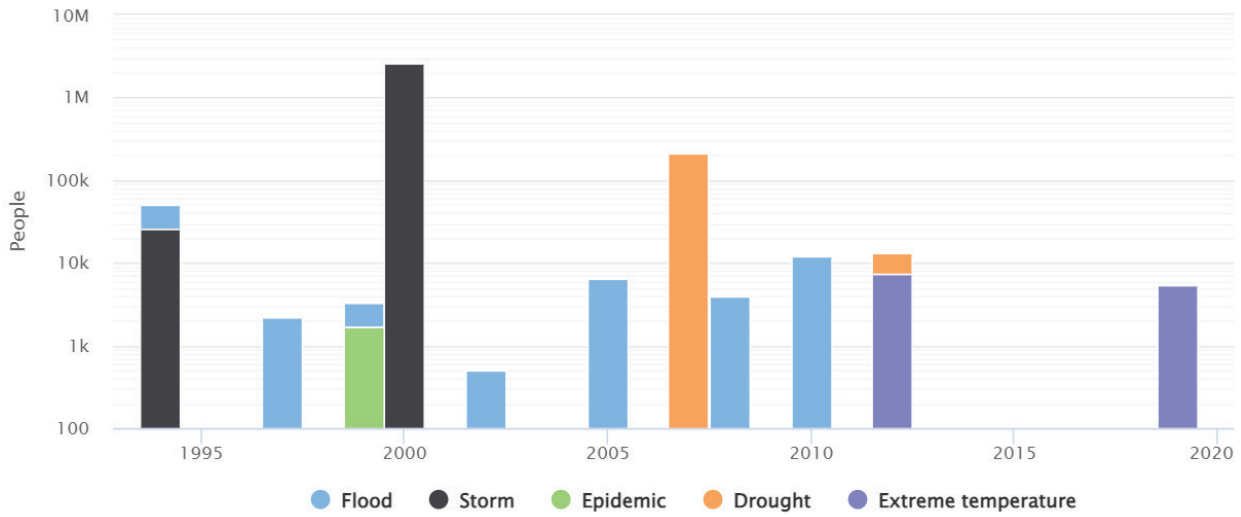
Table 1. Major natural hazards and level of hazard in particular areas of the Republic of Moldova

Type of hazard	Hazard level	Projected area
River flooding	High	Majority of administrative boundaries
Urban flooding	High	Cahul, Lapusna, Tighina, Dabusari, Orhei
Wildfire	High	All
Earthquake	Medium	All
Water scarcity	Medium	All
Extreme heat	Medium	All
Coastal flooding	Very low	All
Landslide	Very low	Chisinau, Ungheni
Cyclone	Very low	All

Source: **GFDRR (Global Facility for Disaster Reduction and Recovery).** 2021. *ThinkHazard! – Moldova.* https://thinkhazard.org/en/report/165-moldova

Figure 2 illustrates historical data on the occurrence of the most frequent natural hazards in the Republic of Moldova and the number of people affected during the 1993–2018 period. Almost half of all major natural hazards involved flooding (44 percent), while other common hazards included drought and extreme temperatures (19 percent in both categories), followed by storms (12 percent) and epidemic (6 percent) (EM-DAT, 2019). The heavy storm that occurred in 2000 impacted over half the country's population and was one of the largest disasters that affected the greatest number of people during the 1993–2018 period.

Figure 2. Overview of natural hazards and number of people affected, 1994–2019



Source: **World Bank.** 2019b. *Climate Change Knowledge Portal.* Cited 20 October 2019. https://climateknowledgeportal.worldbank.org/country/moldova/vulnerability

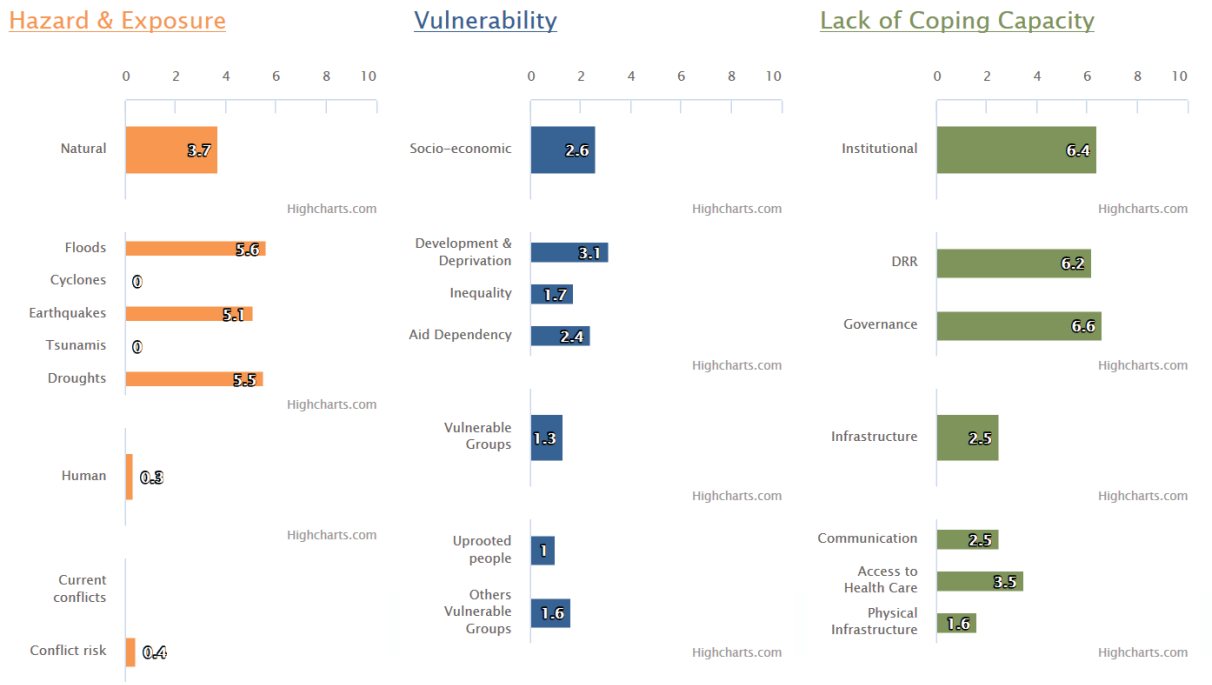
According to the INFORM Global Risk Index,[2] over the 2017–2021 period, the Republic of Moldova ranked 119-128th out of 191 assessed countries in terms of the overall risk. This trend shows an improvement, compared to 2015–2016 period, when the country ranked 82-95th. However, according to the INFORM Risk Index 2023, the Republic of Moldova ranked 99th, which is still considered a low risk class. Some of the highest risk indicators included agriculture drought probability and physical exposure to flooding. With regard to a "lack of coping capacity",[3] the country was ranked 85th, which seems particularly critical. This is related to many indicators of the institutional, DRR and governance capacities to manage disaster risks (INFORM, 2022).

The INFORM risk assessment tool ranks earthquakes as a hazard on the same level as flooding and drought for the Republic of Moldova (Figure 3).

[2] INFORM, the index for risk management, is the first global, open-source tool for assessing the risk of humanitarian crises by country. The INFORM index has three main dimensions: hazard and exposure, vulnerability, and lack of coping capacity. It brings together disaster risk-related information from around 50 indicators and presents the results in an aggregated form.

[3] This parameter considers the existence of DRR programmes, available resources and infrastructure for emergency response and recovery.

Figure 3. INFORM Index 2019 (0 is the lowest, 10 is the highest)



Source: **INFORM (Index for Risk Management).** 2019. Country Risk Profile: Republic of Moldova. *Index for Risk Management (INFORM).* Inter-Agency Standing Committee Task Team for Preparedness and Resilience and the European Commission. http://www.inform-index.org

Flooding

Flooding is a natural hazard that can affect various economic sectors as well as people and their livelihoods. Flooding has occurred frequently in the Republic of Moldova over the past three decades, and has affected many people. For instance, in 1991, 21 people died due to torrential rain followed by flooding, 8 000 houses were damaged, and 400 000 ha of farmland was flooded. In 1994, torrential rain, accompanied by strong wind and hail, affected 16 districts of the country and economic losses caused by the events amounted to about USD 100 million (Mihailescu and Boian, 2005). The flooding of 1994 affected approximately 25 000 people, 35 000 ha of vineyards and orchards in central Moldova were flooded, 86 000 acres of crops were ruined, 70 000 hens drowned, while 120 cattle and 1 000 pigs died, total damage was estimated at USD 75 million (1994 Global Register of major flood events).

Flooding events in 2008 and 2010 were among the most devastating for the country, with damage and losses to households and infrastructure estimated at USD 120 million (UNDP, 2018). Following the heavy rain of 2008, over 150 houses were destroyed in 46 flooded villages, 8 000 people were left homeless, and 10 500 ha of farmland was subject to runoff by water. The 2010 rain damaged more than 60 communities in 14 districts, with a total of 13 000 people affected, and over 4 000 people evacuated, about 1 105 houses destroyed, and 4 308 ha of farmland, 4 800 ha of pastures and 930 ha of forest destroyed (Publika.md, 2012). In 2010, flooding caused by heavy rain destroyed critical infrastructure, washed away crops and livestock, and damaged homes, with damage and losses estimated at nearly USD 42 million (GFDRR, 2017). Heavy hail and rain in 2016 affected thousands of households and agricultural crops (CPESS, 2016). Every year, flooding affects about 70 000 Moldovans and costs about USD 100 million in GDP (GFDRR, 2017).

Flooding of the Dniester and Prut rivers is potentially catastrophic in the event the Republic's flood control infrastructure fails. On smaller rivers, the level of flood protection depends very much on the technical state of the dams and dikes, which are now in need of substantial repair. The safety of small dams is a major area of concern. Many storage dams are scattered throughout the Republic's upland areas. Due to the propensity of these works to fail during major storm and flood events, they tend to increase the level of flooding hazard in their basins rather than decrease it (World Bank, 2007; GoM, 2020b).

The total area of Moldovan land subject to periodic flooding is over 600 000 ha, about 20 percent of the total area of the country. The meadows of small rivers used for cultivating agricultural crops are in the agricultural

risk area in the climate conditions specific to the Republic of Moldova. On the territory of the country, in the riverbeds of the large rivers (Dniester and Prut), there are 16 ponds with a volume over 1 million m^3 of water. In the riverbeds of small rivers, 3 000 ponds were built, most of which are in the form of cascades, and located 1 km to 5 km from each other. Many of them have dams, which were constructed without observing technical standards; they have no channels for flow relief and drainage, therefore the rupture of one dam upstream will lead to the rupture of the others downstream with catastrophic consequences. Such cases occurred in 1991 in Soldanesti district, and in 1994 in Hincesti district (Mihailescu and Boian, 2005). The vast majority (65 percent) of rainwater flooding forms on farmland (Jeleapov, 2017).

Current land use and soil management practices in areas with steep slopes lead to up to 20 percent to 30 percent soil fertility losses from torrential rain, and annual losses of nutrients caused by erosion far exceed replenishment by fertilizers. In irrigated landscapes, nutrient depletion in soil is aggravated by rising groundwater levels. By evaluating discharges during the flooding of 2008, it was found that over four days, 35 times higher amounts of ammonium (NH_4+) were leaked, while the amount of suspensions was 12 times higher than during a normal drainage regime. It was documented that flooding in 2007–2010 had a disastrous impact on species such as *Rana ridibunda*, *Triturus cristatus*, *Triturus vulgaris* and Bombinabombina, which led to the total or partial displacement of these populations from their natural habitat in the Prut river basin, especially in the area of cities and agrocenoses in the centre and north of the country (Ministry of Environment, 2011). Thus, unsustainable land management practices, together with other human-related activities such as the violation of technical standards for dam building, aggravate natural hazards and increase environmental pollution.

River flooding is classified as a high risk in the Republic of Moldova, which means that the possibility of occurrence of this type of hazard is significant. River flooding threatens most of the country's districts, except for Ungheni and Edinet municipalities, where the river flooding risk is relatively low. It has been predicted that in future, river flooding may occur in the Republic of Moldova at least once every decade (GFDRR, 2019).

Drought

Around 90 percent of crop production in the country is rainfed, which makes the agriculture sector highly vulnerable to climate variability. Drought is a major risk in the country, with an estimated annual loss in crop production of USD 20 million, assuming catastrophic drought events every seven years. It is also a major determinant of human development in the Republic of Moldova and can compromise progress in health and nutrition due to the dependency of the majority of the country's population on agricultural income (Daradur *et al*., 2007).

The northern part of the Republic of Moldova faces significant drought every decade; central Moldova experiences such hazards on average at least once every five to six years; while drought occurs quite regularly in the south – once every three years (European Union, 2013). Drought can happen in some districts every year.

Drought events in 1896, 1899, 1928, 1946, 2000, 2003, 2007, 2012 and 2020 are believed to be the most intense to have occurred in the Republic of Moldova (Cazac and Daradur, 2013; Stiri.md, 2020).

From 1990 to 2015, 11 drought events were registered in the Republic of Moldova (Starchenko, 2017). The Cahul, Tighina, Taraclia and Orhei districts are highly prone to drought. During the years 1990, 1992 and 2003, drought extended throughout the entire vegetation period (April to September), while in other years drought was reported in summer. Most drought events affected more than half of the territory, and some (in 1946, 1986, 1994) affected the entire country (SHS, 2012). The drought of 2000 had devastating consequences for the country, resulting in dramatic cultivation losses as a result of lack of rain for 45 days (European Union, 2013). It affected 2.6 million people (UNISDR and World Bank, 2008). The drought that occurred in 2007 had a substantial impact on the agriculture sector and almost all crops were affected. Yields of cereal crops dropped by 70 percent, while the World Bank estimated that total losses from the disaster were USD 1 billion (UNDP, 2018). The 2012 drought led to agricultural losses estimated at USD 1.25 billion (UNDP, 2019).

Specialists at MARDE claim that drought has become a common phenomenon in the Republic of Moldova and can no longer be treated as an exceptional one, with an increase in frequency, intensity and territorial coverage over the past 20 years. The average frequency of drought is one or two episodes over a decade in the northern region, two or three in the central region and as many as six in the southern region (Nedzelschi, 2020).

According to farmers' opinion, the drought of 2020 compromised the yields of cereals and sunflowers by 80 percent, and corn by 100 percent in the southern and central regions (Stiri.md, 2020). According to the preliminary estimates of the NBS, the 2020 harvest was characterized by a decrease in the overall production of most crops due to drought. The overall harvest in 2020 was lower than the previous year – corn by 71.6 percent, wheat in autumn and spring by 46.5 percent, soybean by 47.8 percent, sunflowers by 47.3 percent, grapes by 37 percent, sugar beet by 34.3 percent, barley by 37.2 percent, and legumes by 33.3 percent (NBS, 2020).

According to a country reports by Expert-Grup (2020, 2021), Republic's economy was hit by two strong shocks in 2020 – the COVID-19 pandemic and drought. The country's GDP declined by 7 percent, mainly due to the reduction in gross value added in the agriculture and transport sectors (Expert-Grup, 2021). Thus, the largest decrease was forecast for agriculture (33.8 percent), followed by the transport sector (16.7 percent), and industry (8.2 percent). These declines account for four to five years of lost growth. The country report predicted a 10 percent drop in consumption in 2020, amid an 8 percent drop in wages, while the budget deficit could exceed 10 percent of GDP (Expert-Grup, 2020). In 2020, remittances played a stabilizing role, helping address the challenges caused by COVID-19 and decline in agricultural productivity - while exports of goods and services decreased by 11.5 percent, remittances remained more or less on the same level (Expert-Grup, 2021). According to the GIEWS Country Brief (FAO, 2020b), below-average rain, particularly in April 2020, negatively affected yields of winter crops, mainly wheat, in southern wheat-producing areas. Consequently, the wheat yield for 2020 was estimated to be 30 percent below average (FAO, 2020b). The impact of the drought also led to 24 percent of the rural population anticipating job losses (Expert-Grup, 2020).

The National Bureau of Statistics (NBS) confirmed the substantial decrease in the productivity of certain crops in 2020 compared with 2019. According to the NBS, global agricultural production was 72.8 percent of the 2019 figure in all types of households (agricultural enterprises, farms, and households). This decrease (27.2 percent) was due to the decrease in vegetable production by 35.9 percent (which reduced the overall index of global agricultural production by 26.1 percent) and in livestock production by 3.8 percent. The average productivity in 2020 for winter and spring wheat decreased by 42 percent, for corn by 56.8 percent, for sunflowers *(Helianthus annuus)* by 42.3 percent, for sugar beet by 18.3 percent, for tobacco by 29.2 percent, for soybeans by 31.2 percent, for potatoes by 22.1 percent, for field vegetables by 30.1 percent, for fruit, nuts and berries by 22.8 percent, and for grapes by 28.5 percent (NBS, 2020).

Drought is becoming more frequent, and thus damage from such events is increasing, particularly for local communities that depend on the agriculture and food-processing sectors. Climate change is one of the factors that contributes to this risk (EM-DAT, 2019).

Earthquakes

The Republic of Moldova is vulnerable to earthquakes generated in Romania's Vrancea seismic zone (GFDRR, 2019). Earthquakes occurred in 1940, 1977, 1986 and 1990 affecting mainly urban areas, infrastructures and housing (Mihailescu and Boian, 2005; PPRD East, 2015). Limited or no impact was reported in the agriculture sector.

Wildfires

Another important hazard relevant to the agriculture sector is wildfires, which are becoming more common due to climate change and global warming. During the 2008–2012 period, there were 13 952 fires with estimated material loss related to fires of about MDL 177 million (about USD 14.5 million). In 2019, there were 1 606 fires with material loss related to fires estimated at about MDL 71 million (about USD 4.1 million) (GIES, 2019). Statistics show that forty percent of all fires in the Republic of Moldova, occurred in urban areas, and 60 percent in rural areas with housing being the sector mostly affected by fires. (GIES, 2009–2020). The largest area of forests (791 ha) affected by wildfires is reported in 2007 (NBS, 2002–2018). No other data related to fires is available for the agriculture sector.

Landslides

The total area at risk of landslides in the country is about 750 000 ha, of which predominate the old stabilized slides, but there are about 84 000 ha of active landslides and ravines, mostly on farmland. Although some landslides were forested, the affected area continues to rise: in 1970–1975 the average growth was 18 500 ha, in

1976–1980 it was 8 800 ha, in 1981–1985 it was 23 600 ha, in 1986–1990 it was 6 200 ha, and in 1990–2015 it was 4 400 ha (Leah, 2017). Large-scale landslides, which caused destruction of buildings, constructions, motorways, and farmland, took place in 1912, 1933, 1948, 1967, 1970, 1973, 1985 and 1997. The most dangerous areas for landslides are in Codru region, Tigheci plateau, and in the valleys of the Prut and Dniester rivers.

In 2005, about 12 percent of farmland in the country (350 000 ha) was of low productivity due to landslides and soil erosion (Mihailescu and Boian, 2005). As already discussed in the section on flooding, torrential rain together with current land use and soil management practices in steep slopes cause soil fertility losses and are linked to soil erosion (Ministry of Environment, 2011).

In the period 1970–2015, as a result of human activity, landslides and gullies increased by 62 800 ha, with an annual increase of 1 400 ha. Currently, the annual growth of landslide areas is about 1 000 ha. Annual irreversible losses constitute about MDL 93 million (USD 5 million). According to data from the 2016 land cadastre on farmland, there are 31 300 ha of stabilized and semi-stabilized landslides with partially deformed soils and 39 600 ha of active slides with completely destroyed soils. Out of 15 000 landslides, 2 300 occur in localities and affect over 12 500 ha of land occupied by various buildings (Leah, 2017). There are several localities where the danger of landslides either persists, or they have been affected in the past ten years, such as Climautii de Jos, Soldanesti, Balasinesti, Briceni, Straseni, Calarasi, Criuleni, Nisporeni, Ungheni, Vadul-lui-Voda, Cahul district (Publika.md, 2011), Cazaclia (Gagauzinfo.MD, 2016), Baurci (Bloknot-moldova.md, 2019).

Hail, storms, and frost

Hail is a solid form of precipitation, falling during the warm period of the year, from cumulonimbus clouds, in dense ice particles of different sizes. Hail tends to occur in the Republic of Moldova due to the country's geographic location, being surrounded by mountain regions and the Black Sea, and can impact crops and lead to severe localized yield decline. Over a period of 65 years, between 1955 and 2020, there were 35 days of hailstorms on the territory of the Republic of Moldova on average per year, with a minimum of 21 days and a maximum of 53 days (SSAIHP, 2021). The Republic of Moldova is a country with frequent intense hailstorms, causing areas of plant damage of 1 000 ha or more, and a level of damage of between 50 percent and 100 percent in some situations. Severe hail is responsible for 13 percent of the total damage from high-impact weather and climate events, and costing MDL 215 million (USD 14.5 million) in 2012 (FAO and WMO, 2018). Crop yield losses were between 70 percent and 100 percent in the Stefan Voda raion (district) in April 2016 (World Bank and CIAT, 2016). A torrential hailstorm in June 2019 caused disaster in Chisinau. Huge damage was recorded in several localities following torrential rain. According to the GIES, heavy rain destroyed kilometres of road and tens of hectares of sunflowers (Dobrescu, 2019).

In November 2000, storms and frost in the Republic of Moldova caused an economic loss of USD 20.8 million (UNISDR and World Bank, 2008). In recent years, frost has compromised the spring and autumn crops of farmers in many localities in the country (Publika.md, 2016). For example, in March 2019, a storm knocked down dozens of trees and electricity poles in the city of Balti, destroyed the roofs of houses and left several localities in Orhei, Telenesti and Criuleni districts without electricity (Publika.md, 2019).

In the Republic of Moldova, various types of weather disasters can occur in the same year. For example, in 2012 there was frost, torrential rain and hail, and a drought during summer, which was considered catastrophic by meteorologists – 90 percent of the country's territory was affected by the drought (Publika.md, 2012b). The 2019/20 season was characterized by drought as well as torrential rain with hail, resulting in the flooding of the Nistru and Prut rivers, which had a huge impact on agriculture, especially on smallholders, and also within the context of the COVID-19 pandemic. As a result, there is a huge amount of uncertainty on top of the hazards, which can potentially adversely affect the country's agricultural production and marketing systems. Neither the government nor farmers are prepared to deal with such a situation.

Biological hazards

Many invasive species that affect production have appeared in both agricultural and forestry crops in the Republic of Moldova. In addition, the impact of invasive species is increasing due to climate change. The periodic, but increasingly frequent, appearance of orthoptera in the country shows that the danger of locust invasion is growing (Volosciuc, 2012).

According to the Global Forest resources Assessment (FAO, 2020a), in 2015, 19 percent of the forest area in the Republic of Moldova was affected by insects, which was the highest percentage in the world (of the reporting countries). In the same year, only 0.1 percent of the forest area of reporting countries in Europe was disturbed by insects (FAO, 2020a).

In the Republic of Moldova, like in neighbouring countries, wild boars eat field crops and are thus spreading swine diseases, adversely affecting the health of domestic pigs. In total, during the 2016–2018 period, 46 outbreaks of African swine fever were registered, and 642 domestic pigs and 20 wild boars we killed due to the disease. In 2019, there were 30 outbreaks, of which 26 were among domestic pigs kept in households, leading to 402 pigs and 13 wild boars being killed (ANSA, 2019a).

According to FAO (2018), Ukraine, the Republic of Moldova and Belarus may face a new challenge in the near future – a livestock disease, lumpy skin disease, which has appeared in the Caucasus and in the Russian Federation, and which might spread to other countries in eastern Europe. In addition, there is an increased risk of contagious ecthyma development in Central Asia, Western Europe, and Central and Eastern Europe, which could affect sheep and goats in the Republic of Moldova.

In 2019, 11 cases of rabies were found in the Republic of Moldova, in cattle, dogs, cats and foxes in Leova, Glodeni, Taraclia, Stefan Voda, Ribnita, Causeni, Taraclia, Slobozia, Ungheni and Floresti districts (ANSA, 2019b). Only detected cases of this zoonosis are officially announced, with the chances that the number of sick animals, which can transmit the rabies virus to humans, may be higher. Rabies is preventable by vaccination; however, the disease, once it infects humans, is deadly with no cure. The Republic of Moldova ranks second in Europe for the number of rabies cases, so the risks to people are immediate and persistent.

Specialists from the National Agency for Public Health (ANSP) warn that during the hot period of the year, particularly between June and August, in addition to acute diarrheal diseases, leptospirosis – a disease common in humans and animals and transmitted via the urine of rodents – is prevalent. The disease is one of the most widespread zooanthroponoses in the Republic of Moldova, especially in the northern part of the country (Timpul, 2018).

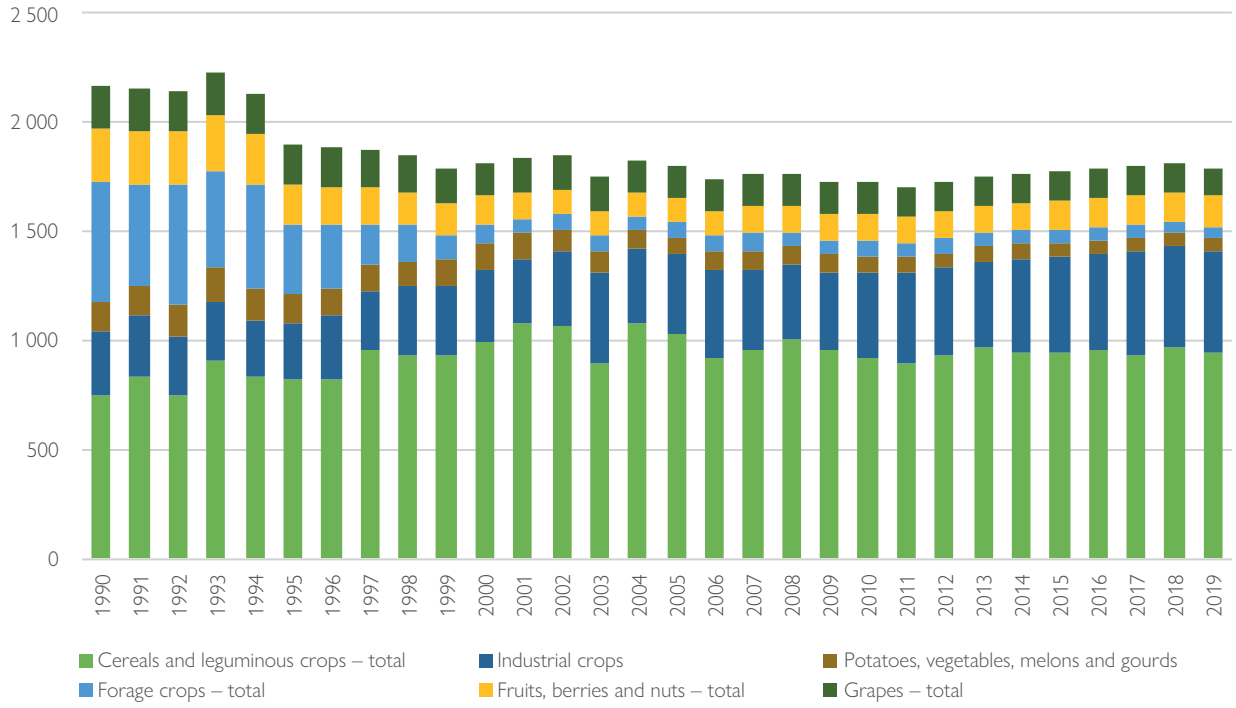
Agricultural and food security profile

Agricultural profile

Agriculture is an important economic sector for the Republic of Moldova and in 2021 accounted for almost 10.4 percent of the country's total GDP (NBS, 2021b). According to the NBS, in 2021, the population of the Republic of Moldova was around 2.6 million people, out of which around 58 percent, or 1.5 million people, lived in rural areas (NBS, 2021a). In addition, out of the total working population, around 21.5 percent (or 181 200 people) was employed in the agriculture, forestry and fishery sector. The percentage of men employed in the agriculture sector is higher than women with an average share calculated over a period of eight years (2014–2021) of 59.6 percent men and 40.4 percent women (NBS, 2021a).

The most important agricultural products in the Republic of Moldova include cereals (wheat, maize and barley) and fruit and berries (apples, walnuts, grapes) (Figure 4), which are mainly exported. Favourable geographical and climatic conditions, fertile soils and abundant water resources, make the agriculture sector quite beneficial for the country, despite the expected adverse impacts of climate change on the sector (Republic of Moldova, 2013).

Figure 4. Area covered by agricultural crops (ha thousands), 1990–2019



Source: **NBS (National Bureau of Statistics of the Republic of Moldova).** 2021b. Statistical Databank. Economic Statistics. Agriculture. *National Bureau of Statistics of the Republic of Moldova* http://statbank.statistica.md/PxWeb/pxweb/en/40%20Statistica%20economica/40%20Statistica%20economica__16%20AGR__AGR020/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774

Soil is considered a main source of wealth in the Republic of Moldova – about 75 percent of the country is covered in black soil, or also known as chernozem. About 80 percent of farmland is situated on the slopes, and as a result of the lack of soil conservation measures, it is continuously degrading. Farmers' and national food security depends on the quality and fertility of the soil. The decrease of soil quality (at least since 1970) is to be attributed to a range of soil degradation processes including soil erosion, landslides, decrease in humus, deterioration of the soil structure through compaction, increase in soil salinity and soil drought caused mainly by intensive use of land resources and poor adaptability of applied agricultural practices, along with ineffective risk governance.

Despite the generally high level of soil fertility, agricultural productivity indicators in the Republic of Moldova are very low (UNDP, 2009). Therefore, if the issue of soil protection is not pursued seriously and soils continue to deteriorate at the present rate, agricultural productivity and farmers' incomes will decline further.

A little over a third (34 percent) of farmland is degraded to a certain extent due to poor agricultural practices, including the extensive use of fertilizers, pesticides and irrigation (World Bank, 2019). The irrigation sector has declined since the collapse of the USSR, mainly due to the economic factors and the old irrigation systems being unfit for the newly emerging pattern of private farming (FAO, 2020c). Additionally, overgrazing, illegal tree logging and unattended land has led to soil erosion, and as a result, the agricultural area declined consistently from 1997 to 2016. Productivity declined between the 1970s and the 1990s, but since the end of the 1990s it has been increasing. At the same time, 2020 has been characterised by a noticeable drop in production of some of the key crops (compared to 2019) due to severe drought, combined with hail storms and floods affecting some regions of the country (World Bank and CIAT, 2016; FAOSTAT, 2020).

Regarding land use, in 2021, around 62.9 percent of the country's total area was associated with the agriculture sector, and in particular crop production (NBS, 2021a). In 2020, out of all agricultural land, 75.1 percent was arable land, 14.9 percent were under permanent meadows and pastures, and 10 percent were under permanent crops (FAO, 2022).

In the Republic of Moldova, most farmland is privately owned (76 percent) at present. Tenure rights are ensured; however, use rights (lease) are generally less secure than ownership rights (FAO, 2020c). There is an existing duality with a relatively small number of large corporate farms at one extreme, and a large number of very small and fragmented family farms at the other. While smallholders operate some 99.5 percent of farms, they farm less than 39 percent of the total utilized agricultural area (Hartvigsen, Gorgan and Palmer, 2013).

According to FAO (2020c),[4] 36 percent of all farms are smaller than 1 ha, 57 percent are between 1 ha and 5 ha, and 7 percent are bigger than 5 ha.

Country's agriculture sector has a dual structure, comprising two major subsectors: the corporate sector, composed of large-scale enterprises, and the individual sector, which includes peasant farms and household plots under private ownership (FAO, 2020c). A General Agricultural Census (GAC) conducted in 2011 reported an average farm size of 2.5 ha. The majority of agricultural producers in the Republic of Moldova are smallholders (98.8 percent) who farm up to 10 ha of farmland. They cultivate 36.4 percent of the total farmland of the country (FAO, 2020c).

Smallholders usually practise a mix of farming of high-value crops (vegetables, berries, herbs, vines, and others), and grains (usually maize and wheat), which they use to feed their animals and poultry. In 2017, smallholders and family farms generated over 62 percent of the total volume of agricultural produce in the country, thus contributing fundamentally to overall food production and food security.

Large-scale enterprises are specialized in the production of low value crops, and employ fewer people due to the high mechanization level of their farm operations. Typical crops for medium-scale farms (of between 10 ha and 50 ha in size) are wheat, maize, sunflowers, soybean, fruit, table and wine grapes. These farmers support the processing industry of the country. Large-scale farmers (farms bigger than 50 ha) cultivate sugar beet, orchards, and vineyards (table and wine grapes) (World Bank and CIAT, 2016).

Between 1990 and 2020, livestock numbers fell – cattle decreased by 89 percent, pigs by 81 percent, sheep by 59 percent, horses by 43 percent, and bee families by 53 percent – due to the inefficient restructuring of large animal and poultry farms, as a consequence of natural hazards, which required mass slaughtering of animals, and also as a result of a lack of investment (NBS, 2021b).

Plant production comprised 67.8 percent of total agricultural production in 2020, while animal production and services comprised 30.4 percent and 1.8 percent, respectively (NBS, 2021b).

[4] In the FAO study (FAO, 2020c), smallholders are considered agricultural holdings and peasant farms holding an area of less than 10 ha of land; and so-called rural households are mostly family farms with less than 1 ha of land, based on the availability of statistical data.

Only around 36 percent of all farmers are women, while only 19 percent of all agricultural holdings are headed by women, who have an average farm size of 0.81 ha and own less than 12 percent of agricultural machinery in the country. Around 81 percent of all farms are headed by men, who have on average 1.2 ha of land (World Bank and CIAT, 2016).

Overall, imports of agricultural and other related products are lower than exports (NBS, 2021a). Agrifood exports account for roughly 50 percent of the country's total exports. The following agricultural products were included in the respective export groups in 2021: cereals (11.7 percent of total exports), oil seeds (8.2 percent), fruit, nuts (7.4 percent), beverages, spirits, vinegar (7.3 percent), and animal/vegetable fats, oils, waxes (3.9 percent). Agricultural unprocessed export commodities are: walnuts, apples, wheat, maize, and barley. Imports of wheat (flour), meat, dairy, vegetables (tomatoes) used for both human and animal consumption are meant to compensate for the agricultural production deficit (World Bank, 2019; World's Top Exports, 2021).

Food security profile

Socioeconomic information

The population of the Republic of Moldova is shrinking. One of the main reasons for this decline is emigration to other countries, which has been ongoing since the 1990s. In 2018, there were about 346 336 circular labour migrants who travelled to the Russian Federation and Europe to seek job opportunities. Most of them are of working age and mainly from rural areas. This phenomenon is leading to a growing share of older people in the population (United Nations Moldova, 2020).

In 2018, the absolute poverty rate was 31.6 percent in rural areas and 10.6 percent in urban areas. The poverty rate is declining in both cases; however, the economic vulnerability of people is greater in rural areas, where income levels are 1.4 percent lower than in urban areas. The rural population is more dependent on remittances than the urban population. Remittances from abroad make up 16 percent of the income of the rural population, compared with 8.5 percent for the urban population (United Nations Moldova, 2020).

Food production and food security

The main crops cultivated in the Republic of Moldova include sunflower, wheat, and maize, which constitute from 14 percent to 20 percent of the total harvested area, followed by livestock and fruit including grape, apple, and tomato (FAOSTAT, 2022; World Bank and CIAT, 2016). Table 2 provides basic data on the average land use, production, and yields of the key crops in the Republic of Moldova over 2011–2020 period.

The food energy requirements for country's residents are largely being met. Dietary energy supply in 2018 was estimated at 2 357 kcal per capita per day (FAOSTAT, 2022), which is above the amount of dietary energy required by an individual to maintain body function, health and normal activity. However, as of 2019, 4 percent of

Table 2. Area harvested, production, and yields of key crops in the Republic of Moldova, average over 2011–2020

	Area harvested		Production	Yield
Unit	ha	%*	thousand tonnes	kg/ha
Maize	467.6	20.7	1 511.2	3 211.0
Wheat	340.5	15.1	974.6	2 830.8
Sunflower	332.3	14.7	583.4	1 736.6
Grapes	125.7	5.6	604.8	4 815.6
Barley	81.0	3.6	188.5	2 387.3
Apples	52.2	2.3	419.1	8 112.2
Sugar beet	22.3	1.0	735.7	33 324.4
Tomatoes	4.7	0.2	52.5	11 110.4

* Percentage of the total agricultural land of the country.
Source: **FAO.** 2022. *FAOSTAT Database.* Statistics Division. https://www.fao.org/faostat/en/#home

the population was estimated to have insufficient dietary energy intake (FAO, 2020d). These rates suggest that the problem is not deficit, but the purchasing power of the population.

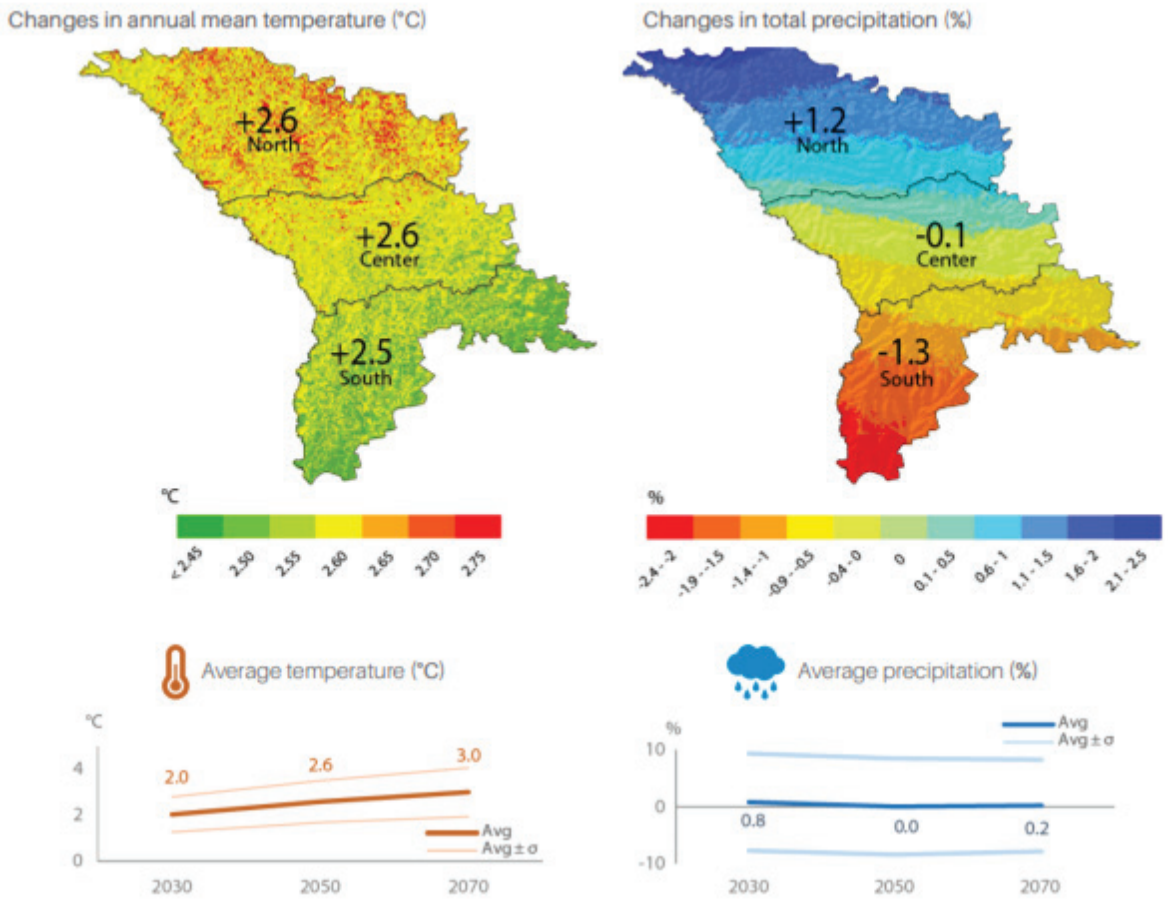
According to the FAOSTAT data (FAO, 2020d), two important food insecurity indicators (SDG2 indicators) substantially increased in the Republic of Moldova during a short period of time. The prevalence of severe food insecurity in the population increased from 1.6 percent in 2014–2016 to 4 percent in 2017–2019, while the prevalence of moderate or severe food insecurity in the population increased from 19.3 percent in 2014–2016 to 27.5 percent in 2017–2019. Climate change is one of major drivers of the increase. In 2016, around 18.9 percent of adult population was obese, and around 26.8 percent of women of reproductive age had anaemia (FAO, 2020d).

Climate change

The Republic of Moldova is highly vulnerable to climate change and increased variability, which can bring droughts, late spring frosts, hail, floods and severe storms (USAID, 2017). Some of the most direct consequences of climate change for the agriculture sector include water scarcity and water supply, reduction of animal feed, lowering agricultural outputs, crop and animal diseases, and deforestation. About 60 percent of the country population resides in rural areas where agriculture is a dominant economic sector, which means that climate change could have a particularly severe effect on the livelihoods of rural people.

Over the past two decades, most of the recorded warm years in the Republic of Moldova occurred in more recent years. The highest temperature rise of 0.68 °C was recorded in the northern part of the country, while it was 0.35 °C in southern areas (USAID, 2017). Climate projections suggest that this trend will continue in the future.

Figure 5. Climate change projections by 2050 (temperature and precipitation)



Source: **World Bank & International Center for Tropical Agriculture (CIAT).** 2016. *Climate-smart agriculture in Moldova.* CSA Country Profiles for Africa, Asia, Europe and Latin America and the Caribbean Series. Washington DC, the World Bank Group. https://climateknowledgeportal.worldbank.org/sites/default/files/2019-06/CSA%20Moldova.pdf

A 2016 study of the World Bank and the International Center for Tropical Agriculture (CIAT) estimated that as a result of climate change, surface water flows in the Republic of Moldova may decrease by about 20 percent in the next 20 years. The study also anticipated that by 2050, the average temperature may increase by 2 °C to 3 °C and that the frequency of drought and variability of rain will also increase, which may result in water scarcity leading to both damage and losses in the industrial and agriculture sectors (USAID, 2017). By 2070, it is estimated that the annual average air temperature may rise by around 3 °C. At the same time, changes in precipitation will vary depending on the part of the country – northern Moldova is likely to experience a rise in total precipitation (by around 1.2 percent), while rainfall may decline in the south (by 1.3 percent), as shown in Figure 5 (World Bank and CIAT, 2016).

The Republic of Moldova can be divided into three major agroclimatic zones (Table 3):

- the northern zone that occupies the northern plateau along the Dniester river, the Transnistria highlands and the Balti rolling plain.
- the central zone that covers the Codrii highlands, where hilly terrain and deep valleys alternate.
- the southern zone including the hilly terrain interspersed with plains and large valleys of the Bugeac plain and the Tigheci highlands.

Table 3. Climate and soil parameters in the agroclimatic zones of the Republic of Moldova

Indicator	I: North (moderately hot, semi-humid)		II: Centre (hot semi-humid)		III: South (hot-arid)
	Subzone Ia (NW plain)	Subzone I (plain front Nistru hills)	Subzone IIa (Central plain and Codrii)	Subzone II (terraces of Nistru, Prut and other rivers)	Southern plains, lower Nistru and Prut terraces
Average annual temperature °C	7–8	8–8.5	8.5–9	9–9.5	9.5–10
Annual precipitation (mm)	550–630	550–600	550–600	500–550	450–550
Potential evaporation (mm)	650–700	700–800	800–820	800–850	850–900
Moisture coefficient, K	0.7–0.9	0.65–0.8	0.7–0.8	0.6–0.65	0.5–0.6
N° droughts in 10 years	1	1–2	1–2	2–3	3–4
Altitude (metres)	200–300	100–300	200–400	50–200	50–200
Main type of soils	Brown soil, levigated chernozem	Typical and levigated chernozem, brown soils	Brown and grey soils	Casual chernozem	Casual chernozem, carbonated and southern varieties
Soil match to agriculture crops	Seed bearing orchards, sugar beet, tobacco, potato, vegetables, grains, fruit, rape, soy	Seed bearing orchards, nuts, sugar beet, tobacco, vegetables, grains, sunflower, fruits, rape, soy	Vineyards, orchards, walnuts	Vineyards, orchards, walnuts, fall grains, sunflower, vegetables for irrigation, fruit, rape	Vineyards, kernel orchards, fall grains, vegetables for irrigation, aromatic and oil plants
Restrictions for some crops	Vineyards	Vineyards (only above 200 metres altitude)		Sugar beet, soy, spring grains	Sugar beet, spring grains

Source: **Daradur, M., Cazac, V., Mihailescu, C. & Boian, I.** 2007. *Climatic Monitoring and Droughts*. (Monitoringul climei și secetele). State Hydrometeorological Service the Republic of Moldova, Institute of Ecology and Geography, Academy of Science of Moldova.

As shown in Table 3, the second subzone from the central zone and the whole southern zone are the most vulnerable to drought. As national climatic projections show, these regions belong to those parts of the country where the aridity index is expected to increase the most in the next 100 years. Currently, the humidity coefficients in these areas have small values, both in relative and absolute terms. A drought may harm 80 percent to 90 percent of the grain harvest in the Republic of Moldova (Daradur *et al*., 2007). At the same time, soil is less fertile in these regions compared to the other zones, which further increases potential losses from the expected changes to the climate.

One of the simplest drought indexes used worldwide for fire risk assessment is the Swedish Angstrom Index (Willis *et al*., 2001). The index is based on the statistical relationships between the reported number of fire events and several antecedent weather-related data. According to the Angstrom index, in 1966–2015 fire conditions were favourable ($I= 3.0<I<2.5$) for July and August only for southern and partially for the central part of the Republic of Moldova, while by the end of the century, over the period 2071–2100, the meteorological conditions

for fire will cover almost the entire country (MARDE and UNEP, 2018). The vulnerability analysis at national and subnational level based on vulnerability indices points out some issues that require primary attention, including water availability, food security, health and economic development (UNDP, 2009).

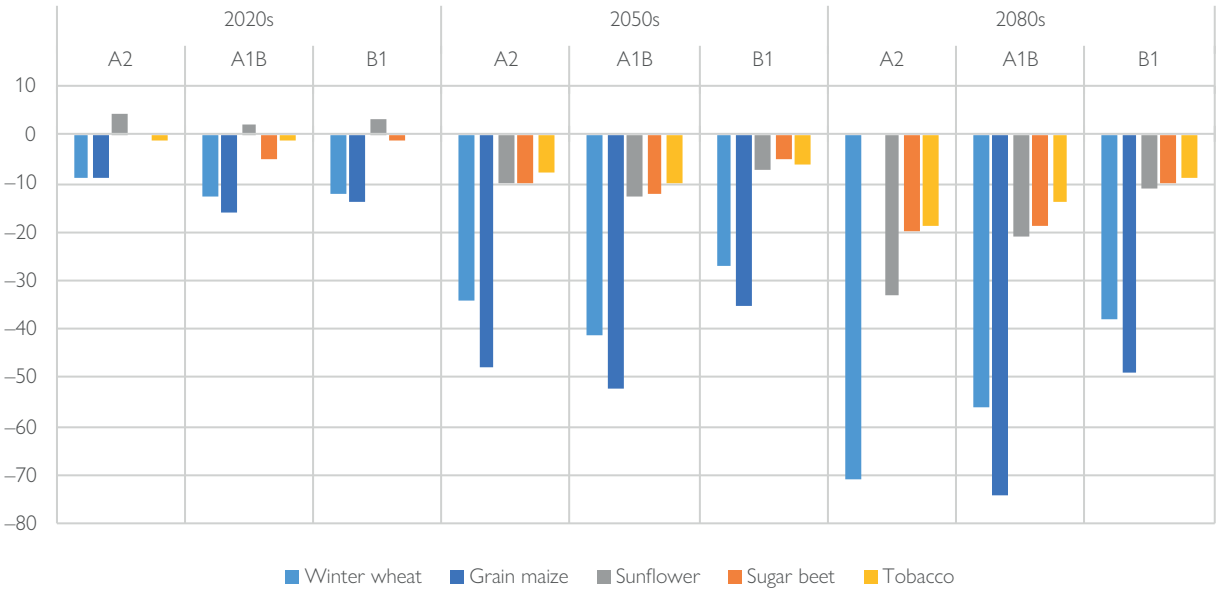
The risk of water scarcity is also growing in all regions of the Republic of Moldova. The water scarcity area, has, as it extends northwards, already reached the most populated areas, which place the biggest load on water resources and are most intensive in water use. The most vulnerable regions will be the south, centre and Chisinau municipality, which an expert judgment has said is the highest level of risk, very likely related to the anticipated climate-change impacts (Sirodoev and Knight, 2007; Ministry of Environment and UNEP, 2013).

The distribution of the water flow in rivers throughout the year shows, especially in the summer (due to frequent drought), a flow that is well below the norm, which most likely will lead to drying up of rivers, especially in the south of the country.

Climate-change impact on the agriculture sector is expected to be quite significant for the Republic of Moldova. Because of that, projections of changes in temperature and precipitation would be very useful for enhancing the government's response to expected changes and overall preparedness for disasters. Monitoring and short-term prognoses are done by the State Agrometeorological Service, while the projections of changes in temperature and precipitation are carried out by the Institute of Ecology and Geography of the Academy of Sciences and Climate Change Office of the Ministry of Environment.

Climate change, manifested through heat and water stress, is expected to reduce nearly all crop yields, if no adaptation measures are taken into account, and considering the current water shortage and irrigation infrastructure situation. An impact assessment performed at national level in 2013 by Taranu concluded that the negative effect of global warming, according to an ensemble from ten General Circulation Models (GCMs) for high (SRES A2),[5] medium (A1B) and low (B1) emission scenarios in the twenty-first century, will not be offset by an increase in precipitation. In these circumstances, without undertaking any adaptation measures, it can be expected that by the 2080s there will be a significant drop in productivity of grain corn (of between 49 percent and 74 percent), of winter wheat (38 percent to 71 percent); a medium drop in productivity of sunflowers (11 percent to 33 percent), of sugar beet (10 percent to 20 percent), and of tobacco (9 percent to 19 percent), in comparison with the average productivity of country's major agricultural crops over 1981–2010 (Figure 6) (Ministry of Environment and UNEP, 2013; Taranu, 2014).

Figure 6. Projected changes in productivity of major agricultural crops, relative to 1981–2010 (%)



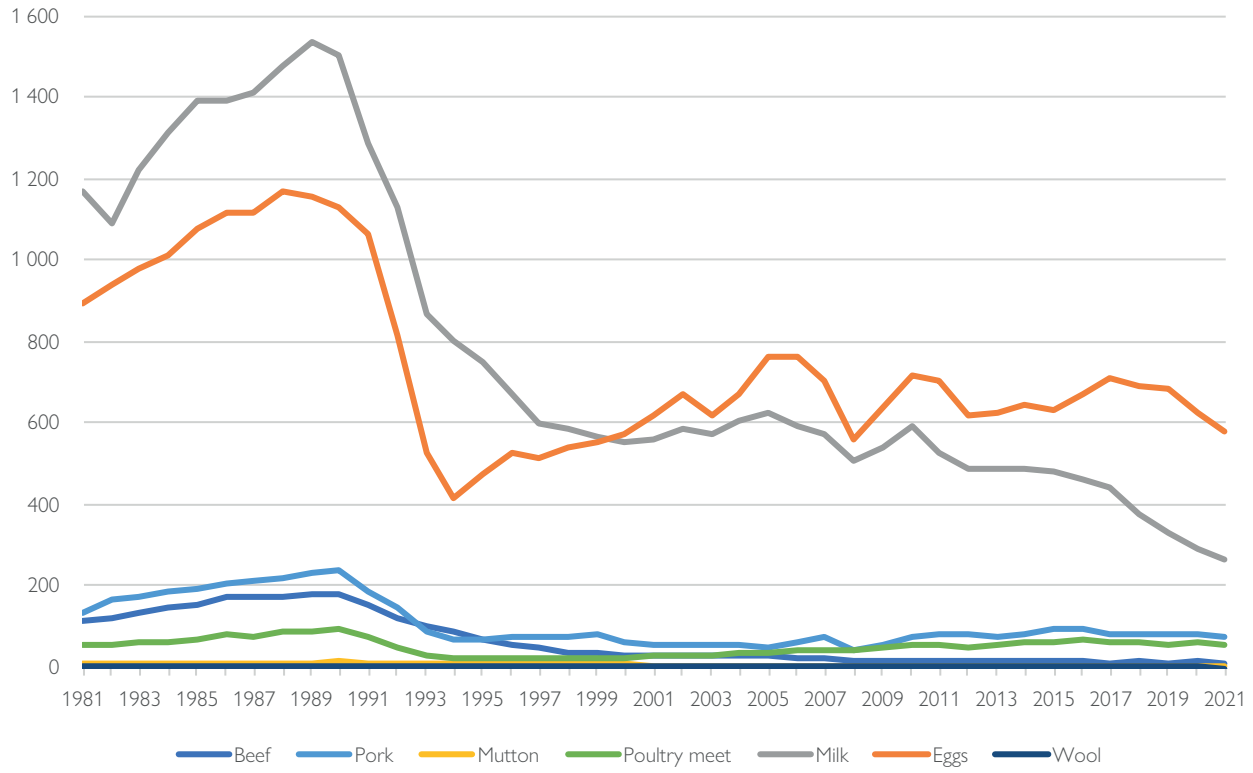
Source: **Ministry of Environment & UNEP (United Nations Environment Programme).** 2013. *Third National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change.* http://www.clima.md/lib.php?l=ro&idc=81&

[5] Special Report on Emissions Scenarios, a report by the Intergovernmental Panel on Climate Change (IPCC) that was published in 2000.

Based on the different scenarios on the impact of the main climate and crop predictor variables, a study conducted in 2014 by Taranu predicted that livestock production in the Republic of Moldova could decrease as follows: milk production from 22 percent by the 2020s to 93 percent by the 2080s, egg production from 10 percent by the 2020s to 70 percent by the 2080s, wool production from 4 percent by the 2020s to 37 percent by the 2080s, beef production from 41 percent by the 2020s to 84 percent by the 2050s, pork production from 28 percent by the 2020s to 87 percent by the 2050s, mutton production from 15 percent by the 2020s to 87 percent by the 2080s, and poultry production from 19 percent by the 2020s to 79 percent by the 2080s (Ministry of Environment and UNEP, 2013; Taranu, 2014).

Predictions of a future decreasing trend is the case for the majority of livestock production, but the percentage decrease is much higher than was predicted for the 2020s. If we look at the 1981–2021 period, egg production dropped by 25.6 percent, wool production by 49 percent, pork production by 32.8 percent, mutton and goat meat production by 62.5 percent, milk production by 70.7 percent, and beef production by 85.1 percent. Only poultry production increased by 11.8 percent (Figure 7).

Figure 7. Livestock production, 1981–2021 (tonnes thousands, eggs in million pieces)[6]



Source: **NBS (National Bureau of Statistics of the Republic of Moldova).** 2021b. Statistical Databank. Economic Statistics. Agriculture. *National Bureau of Statistics of the Republic of Moldova* http://statbank.statistica.md/PxWeb/pxweb/en/40%20Statistica%20economica/40%20Statistica%20economica__16%20AGR__AGR020/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774

The effects of extreme climate events have been included in impact assessments, but other effects such as those related to biotic hazards (such as pests and diseases) still need to be explored (Garrett *et al.*, 2013; Launay *et al.*, 2014). Year-to-year variability in yields is generally expected to increase throughout Europe, due to extreme climatic events and other factors, including pests and diseases (Ferrise, Moriondo and Bindi, 2011; Kristensen, Shelde and Olesen, 2011; Taranu, 2014). A longer growing season will, in many cases, allow for the introduction of new crop species that were previously unfavourable owing to low temperatures or short growing seasons, but it may also increase the spread of pests and diseases (Roos *et al.*, 2011; Taranu, 2014).

[6] Sales of cattle and poultry for slaughter (in live weight).

A series of effects of climate change on the forestry sector have been identified, including increasing the length of the vegetation season, endangering species sensitive to temperature changes, increasing vulnerability to forest fires, deteriorating phytosanitary condition, changes in the composition of the forests, intensification of the risks of invasive species, modification of adaptation capacity of native species, and change in the success rate of forest regeneration. These climate effects also have socioeconomic consequences – impoverishment of firewood, reduction of biodiversity, reduction of forests' regulatory functions in the field of soil erosion, landslides, flooding, and so on (MARDE and UNEP, 2018).

The key climate impacts are increased risk of pests and diseases in agriculture, reduced feed, forage and pasture, reduced productivity of livestock, increased risk of food insecurity, increased risk of forest fires, expansion of dry forests, leading to loss of forests such as beech and oak in forest ecosystems (USAID, 2017).

There are some actions that farmers are already taking in different localities to adapt to climate change and severe climate events:

- expanding water supply for irrigation by building small-scale storage reservoirs, harvesting rainwater, and making greater use of local water sources for irrigation, such as creeks and groundwater;
- applying protective measures such as moving vegetable production to greenhouses, using mulch or other plant protection on soil, installing plant protection belts, and using hail nets; and
- changing agronomic practices, such as planting patterns, crop rotation and inter-cropping, chemical soil augmentation, using drought-resistant varieties.

Farmers have also identified several key impediments to effective adaptation to the effects of climate change:

- lack of timely meteorological information to respond effectively, especially to extreme events such as drought;
- lack of access to alternative crop varieties (particularly seeds) and the know-how through extension and other services, to make the best use of these varieties; and
- poor or limited access to irrigation water and to technologies to make the most efficient use of irrigation infrastructure.

On-farm adaptation responses have been numerous and partially successful, but farmers believe that larger investments in infrastructure are needed. These include improved water storage, and drainage and irrigation systems (Boehlert *et al*., 2013).

Institutional structure for disaster risk reduction in the agriculture sector

Legal framework supporting disaster risk reduction, early warning systems, and agrometeorology services

The Republic of Moldova has been formally engaged in climate-change discussions since ratifying the UNFCCC in 1995 and the Kyoto Protocol in 2003, and has presented four National Communications to the UNFCCC, in 2000, 2010, 2014 and 2018.

The Republic of Moldova submitted its Intended Nationally Determined Contribution (INDC) under the Paris Agreement in 2015, highlighting the need for addressing both adaptation and mitigation, which was reconfirmed in its updated NDC in 2020 (GoM, 2020c). The adaptation component, as a forward-looking document, incorporates the 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 until 2020 (approved by Government Decision no. 1009/2014), 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. The adaptation priority measures in agriculture were defined as follows: sustainable soil management (conservation, precision, organic agriculture, and so on); promoting efficient irrigation systems; promoting diversity and resilience of agricultural crops; increased food security; promoting integrated food, water, and energy systems in a smart and climate-change resilient agriculture. Most of the adaptation actions specified under agriculture and other sectors have a clear impact on mitigation (GoM, 2020c). Additionally, since 1999, the country is a party to the UNCCD and has presented National Action Plan (2000) and National Land Degradation Neutrality (LDN) targets (Daradur *et al.*, 2018).

In 2015, the Republic of Moldova signed the Sendai Framework for DRR for 2015–2030, the successor of the Hyogo Framework for Action 2005–2015, which was not officially signed by the country. The Ministry of Agriculture, Regional Development and Environment (MARDE) was appointed as the responsible entity for implementation of the Sendai Framework. In 2021 MARDE reverted to its former name, the Ministry of Agriculture and Food Industry (MAFI), and the responsibilities over the Sendai Framework returned to the re-established Ministry of Environment.

The Republic of Moldova has established a legal and institutional framework that is focused on DRR. It is on its way to transition from an emergency response-oriented approach towards a more proactive DRR one.

The legislation framework of the Republic of Moldova in the field of disaster risk reduction (DRR) comprises laws and government regulations. Laws address the General Inspectorate for Emergencies Situations (GIES)

under the Ministry of Internal Affairs (5 April 2007, no. 93), types of emergencies (24 June 2004, no. 212), state material and mobilization reserves (22 September 1995, no. 589), civil defence (9 November 1994, no. 271) and fire security (9 November 1994, no. 267).

Government regulations address regulations on institutional bodies responsible for DRR and response (1 August 2018, no. 803, 5 November 2014, no. 908), framework regulation of the receipt of emergency aid (6 June 2016, no. 408), use of postal net for emergency needs (30 December 2016, no. 1453), civil defence (21 November 2016, no. 1267), annual plans for preparedness of civil protection (14 March 2005, no. 282; 19 December 2017, no. 1092; 26 December 2018, no. 1272), emergency-related information (16 November 2010, no. 1076), transportation of hazardous goods (21 January 1994, no. 45).

Early warning systems (EWS) and DRR activities are seen as a responsibility of the government (9 November 1994, Law no. 271). They include the national emergency call service 112 (5 December 2018, no. 1207), education (9 November 1994, no. 271), functioning of a State Reserves Agency (3 October 2018, no. 946) and of a Centre of Emergencies Management, responsible for early warning and monitoring (1 August 2018, no. 803), climate-change prevention, enacted by the environmental agency (regulation no. 549), epidemics early warning and DRR (29 December 2016, no. 1431, 15 August 2016, no. 973, 3 July 2014, no. 531), and the functioning of a public peace centre (2 November 2016, no. 1206).

When agriculture and climate are mentioned, the focus is on protection of agricultural produce in case of emergencies by the State Reserves Agency (3 October 2018, no. 946), establishment of anti-epizootic commissions (15 August 2016, no 973). Agricultural buildings are seen as fire-hazardous (8 August 2016, no. 960) and epizootics and epiphytotics are considered as emergencies (16 November 2010, no. 1076). There are sanitary rules for small-scale waterworks, which are the main source of water in rural areas (30 December 2016, no. 1466). Water usage can only be restricted in times of emergencies by the Emergency Commission (20 August 2018, no. 810) and flood mitigation plans are strongly linked with agriculture (21 June 2018, no. 590). The National Agency for the Safety of Provision is responsible for early warning in terms of agriculture-related emergencies (29 December 2016, no. 1431).

The country's legislation covers mostly human-induced disasters, while the legal framework for disasters caused by natural and biological hazards is less developed. The disaster management system is mostly response-oriented. The legislation covers in detail the responsibility and rights of responders from the service, as well as citizens and NGO volunteers. Less attention is devoted by the legislation to prevention measures such as systematic risk assessment, EWS, emergency plans, land use planning, information to the public, and establishment of a national platform for DRR. The Republic of Moldova has sectoral legislation and standards for emergency classification and damage assessment; modern and up-to-date IT systems for recording disaster data. There is a regional mechanism in place for sharing disaster loss data among members of the Commonwealth of Independent States.

Most legal and regulatory documents do not link climate change with disaster risks and proposed measures. There are only a few laws that use the terms forecast, warning, prevention, reduction, or disaster preparedness, such as Law No. 1536 which says that the State Hydrometeorological Service (SHS) shall ensure the implementation of a set of works in the field of meteorology, hydrology and adjacent fields, including climatology, agrometeorology, monitoring the state and pollution of the environment, as well as presentation of information on the condition of the environment and environmental pollution, and hazardous phenomena. Law No. 228 also uses other terms for DRR, such as liquidation of consequences. Thus, Law No. 228 provides, *inter alia*, for the analysis of phytosanitary risks, development and implementation of special programmes for forecasting, prevention, control and liquidation of outbreaks of harmful organisms and quarantine organisms; phytosanitary monitoring and forecast, surveillance and control, scientific research in the phytosanitary field, establishment of an integrated system of training and retraining of plant protection staff; calculation of potential crop loss or sold volumes of agricultural production. Other normative acts use some key words of DRR, but in general terms (Annex II and III), and they are not mainstreamed into economic development and improvement of the social conditions of the population.

An overview of the main legislation relevant for DRR, EWS and agrometeorology services in the Republic of Moldova is provided in Annex II. Below, the provisions of the most important legislative acts, grouped by topic, are presented.

Civil protection

The **Law on Civil Protection** (No. 271 of 9 November 1994) establishes the General Inspectorate for Emergency Situations (GIES) as the designated national authority and provides clear roles and responsibilities for the office of the president, parliament, and key ministries. Responsibilities for initial emergency response to all major hazards lies with the GIES. Protocols exist for issuance of water-related hazard warnings from MARDE (currently MAFI) agencies, following which the GIES communicates and coordinates with their own and other central, regional and local civil defence agencies as appropriate for prevention, mitigation, rescue and relief operations. Among the competences of ministries and other central public authorities, we can list the following:

- to develop, in conjunction with the GIES, regulations, standards, norms, rules, instructions and guidelines regarding civil protection and to submit them for approval in due manner;
- to plan and implement prevention measures to reduce the likelihood of the occurrence of disasters, to reduce the size of such events, to increase the security of the operation of national economy facilities in conditions of disasters;
- to ensure implementation of relief and other works in conditions of disasters;
- to organize the activity of scientific research in the field of civil protection; and
- to organize training and verification of knowledge among executives and other specialists in enterprises in the area of civil protection.

The **Civil Protection Preparedness Plan** at different levels of participation is an annex to the regulation on training in the field of civil protection (Decision No. 282 of 14 March 2005). The training of all categories of the population in civil protection is general in nature and it is mandatory from the age of eight in general profile schools, as well as in vocational schools, specialized educational institutions and universities within the general study timetable. In enterprises and companies, such training shall be carried out during work hours, while training in residential areas shall be implemented outside the working hours, according to specifically developed programmes.

The Law No. 93 of 5 April 2007 on **Organization, Function, Duties and Responsibilities of the Civil Emergency Service** states that the central specialized public authorities and the local public authorities, the legal persons, regardless of the legal form of organization, and the responsible persons for the DRR area are obliged to ensure unconditionally, within the limits of their competence, free access at any time to subordinate entities and to provide support to the GIES in the activity of preventing and eliminating consequences of disasters. Thus, the Inspectorate is entitled:

- to request information on the state of civil protection and protection against fires in companies and enterprises in case of risks of disaster occurrence or risks of fires;
- to request the information necessary for organizing and coordinating the work to prevent or eliminate the consequences of disasters, fires;
- to train, according to the law, specialists within scientific research and design entities, practitioner specialists and other employees from the legal entities in development of civil protection and fire protection measures, in carrying out related expert evaluation activity; and
- to request, in the event of disasters, fires, to provide vehicles, equipment, fuel, lubricants, devices, means of communication and human resources.

According to the Government Decision No. 1076 of 16 November 2010 On classification of emergency situations and way to collect and submit information in the field of population and territory protection in emergency situations, the central specialized public authorities and local public authorities, jointly with territorial subdivisions of the GIES, shall carry out in due manner the collection, processing and submission of information on the emergency situations at territorial, local and at facility level to the respective service in order to take timely measures to prevent and eliminate consequences of emergency situations. It shall also inform the population about the danger of starting or occurrence of such disasters. The consequences of disasters are resolved with the forces and the facilities of organizations, institutions and enterprises, regardless of the form of legal organization, and with those of local public authorities of the territory in which the disaster has occurred, under the leadership of the commissions for emergency situations. If own forces and facilities are not sufficient to eliminate consequences of a disaster at enterprise level, local, territorial and national level, commissions for

emergency situations may ask for assistance from hierarchically higher commissions for emergency situations. Criteria for evaluating disasters for different phenomena are also specified as related to disasters of a technogenic nature, disasters caused by natural hazards, and disasters of a biological–social nature:

- regarding accidents at enterprises and their consequences, which result in a large number of victims, including the deceased;
- regarding the appearance of episodes and epiphytes;
- on losses to agricultural production as a result of exceptional situations; and
- regarding the course and the results of the liquidation of the consequences of the exceptional situations.

The Programme for Strengthening the Rescue and Fire Service in Rural Areas for the period 2013–2020, approved by Government Decision No. 202 of 14 March 2013, is a medium-term strategic planning document drawn up to strengthen the rescue and fire service, by creating territorial stations for rescuers and firefighters, strengthening two to three communities, which will represent the primary intervention force until the arrival of the certified basic forces of the GIES, in order to improve fire prevention and extinguishing, and save human lives and material goods from fires and other exceptional situations in rural areas.

The provisions on purpose of use, mode of allocation, the recording and the control of money from the reserve fund and from the intervention fund of the government (hereinafter referred to as emergency fund) are given in the Regulation on management of emergency funds of the government, approved by Government Decision No. 862 of 18 December 2015. The purpose of the emergency fund is to provide to the government the opportunity to respond promptly to certain financing needs in unpredictable and emergency situations, which may occur during the budget year. The emergency fund is intended to finance urgent expenses related to eliminating consequences of natural hazards, in the event of epidemics, as well as in other emergency situations of a technogenic nature (fires, explosions, accidents), natural hazards (geophysical, geological, meteorological and other such events), and biological–social disasters (infectious diseases, mass poisoning). The allocation of funds from the emergency fund is made according to the government decisions, within the limits of the allocations stipulated in the state budget for the respective funds and only through central and local public authorities, in their area of competence. The applications for allocation of funds from the emergency fund shall be accompanied by supporting materials and well-founded calculations; they shall be submitted to central public authorities, in their area of competence. In the case of the intervention fund, the applications shall be prepared and submitted to central public authorities based on a decision of the Commission for Emergency Situations or, as the case may be, based on a decision of the National Extraordinary Commission for Public Health.

Fires

In the technical regulation General Rules of Protection against Fires in the Republic of Moldova, there are provisions regarding the development of guidelines on measures for fire protection (RT DSE 1.01-2005) that refer to central and local public authorities. However, the specific measures are not included, except for the step-by-step necessary actions that should be taken.

There are also some interdepartmental regulatory documents regarding fire protection. Thus, in line with the general rules for fire protection (Governmental Decision No. 1159 of 24 October 2007), there are also fire protection rules for the environmental protection authorities of the Republic of Moldova (order no. 12 of the Ministry of the Environment of 30 January 2013). These rules establish the conditions for fire protection of institutions within the Ministry of Environment. For agriculture no such rules exist; thus, this area is governed by general rules, which are regulations developed by the GIES.

Data collection

The Decree of the Chief of the GIES no. 139 on 4 September 2012 on the statistical record of emergency situations and their consequences in the Republic of Moldova establishes a unique way of collection and registration of statistical evidence of exceptional situations and their consequences. The decree aims at ensuring that the requirements on timely information by the state and society are met, and, in addition, complete and truthful

statistical information on exceptional situations is collected and provided. However, this decree is mainly related to fires.

A working group of the European Union-funded Programme for Prevention, Preparedness and Response to Natural and Man-made Disasters in the Eastern Partnership Countries (PPRD East 2) developed an Operational Decision to amend the Decree no. 139 on the disaster loss data registration and collection in emergency situations and their consequences in the Republic of Moldova and its adaptation according to the Joint Research Centre (JRC) – Disaster Loss Data Guideline and the Sendai Framework (PPRD East, 2019). The GIES has prepared an amendment to national legislation related to disaster loss data registration and collection (including a subdivision for economic sectors); however, it is not yet approved. The procedure of definition of new indicators was based on comparison of the Republic of Moldova indicators and JRC indicators; recommendations of PPRD East 2 on the need to define or introduce additional indicators; and on identification of national indicators in relation to the ones that are already collected.

Early warning systems

The Decision No. 259 of 9 March 1998 on the system for warning, information, classification of natural and technogenic disasters and enhancing the capacity of intervention of public authorities provides for:

- establishing universal criteria for classification and estimate of natural and technogenic disasters;
- determining competences of ministries and departments in preventing disasters and eliminating their consequences; and
- regulation on rapid reaction service of the civil protection dispatch service.

Hydrometeorological activities

The Law No. 1536 of 25 February 1998 on hydrometeorological activity aims at meeting the needs of the population, economy and national defence, as well as needs of the public authorities in weather-related information. This includes the link to agrometeorology and the dissemination of information to interested stakeholders. The hydrometeorological activity is carried out on a uniform basis throughout the territory of the country based on the provisions of the Constitution, this law, the recommendations of the World Meteorological Organization (WMO), and the international conventions in the field of hydrometeorology to which the Republic of Moldova is party. In conformity with the Resolution of the Parliament No. 210-XIII of 29 July 1994, the Republic of Moldova has joined the WMO and the SHS director is the country's WMO representative.

Weather information

The Decision No. 935 of 11 October 1999 on approval of the regulation regarding use of weather information in economic activity of enterprises regulates the mechanism of using weather information for protecting the population, as well as prevention or reduction of damage caused by adverse weather events. Areas of application of the regulation include agriculture, transport, communication, water management, energy, construction, and utilities. The enterprises, which depend on the impact of weather conditions, are obliged to:

- develop, together with the SHS, outlines of plans and other technical documentation necessary to establish the mode and volume of weather data use;
- organize, in conjunction with the SHS, a way of receiving and disseminating forecast information related to dangerous weather events;
- exercise control over the use of weather data in the activity of subordinate units;
- rapidly inform territorial units of the SHS, and local public authorities, about accidents and disasters conditioned by weather events; and
- improve the conditions for use of weather data, by using modern scientific and technical tools, other forms and methods, including the insurance system.

Land use management

The **Land Code**, Law no. 828-XII of 25 December 1991, embraces a wide range of issues relating to land use and management. The Land Code has provisions dealing with soil monitoring, soil protection and improvement. Moreover, the code specifies that the ecological protection of land shall have priority over other activities. However, these are more declarative statements without a clear mechanism for implementation.

The **Forest Code** (1996) regulates sustainable forest management by rational use, restoration, protection and forest protection, maintenance, preservation and improvement of forest biological diversity, provision of forest resources to current and future needs of society based on their multifunctionality. It does not address actions for climate-change adaptation. There are no chapters on agroforestry, afforestation of degraded land, or planting of forest protection belts on agricultural land, and so on.

The **Law on Afforestation of Degraded Lands** (2000) establishes the legal basis of afforestation improvement of degraded land, the procedures for identifying such land, as well as sources of financing. Although the law highlights the impact of natural hazards on degraded lands and the importance of afforestation to reduce the impacts of landslides, and although it includes provisions on improvement of degraded land to restore ecosystems, it does not address actions for climate-change adaptation, such as how to reduce the adverse impacts of flooding.

Animal diseases and plant protection

In accordance with Article 29 of Law Lo. 221-XVI of 19 October 2007 **on Sanitary-Veterinary Activity**, the National Agency for Food Safety (ANSA) has competences to: (1) develop regulatory documents on protection measures against outbreaks of some diseases on the territory of some countries with which the Republic of Moldova carries out trade in live animals, products and by-products subject to sanitary–veterinary surveillance and control and which may constitute a risk imminent for the health of animals or humans, as well as on protection measures of countries, trading partners of the Republic of Moldova, when an animal disease outbreak occurs on their territory that poses a risk to trade in live animals, animal germs, products and by-products subject to sanitary–veterinary supervision and control; (2) develop and implement the Programme of Strategic Actions for Surveillance, Prevention and Control of Animal Diseases, Prevention of Transmission of Diseases from Animals to Humans and Protection of the Environment, which shall be reviewed annually; (3) draw up slaughter of necessity and warning programmes for certain diseases based on the list of the International Office of Epizootics.

The Law No. 228 of 23 September 2010 **on plant protection and phytosanitary quarantine**. The purpose of this law is to strengthen the legal and institutional framework, to create adequate economic–legal conditions for the organization and conducting of plant protection and phytosanitary quarantine, to ensure: a) prevention of mass spreading of harmful organisms, avoiding yield loss and obtaining a high volume of agricultural production, especially organic production; b) protection of the territory of the country against introduction, spreading or migration, including from other countries, of harmful organisms. The phytosanitary control authority shall ensure the training and certification, every two years, of the inspectors involved in activities of control, phytosanitary certification and laboratory expert evaluation according to the programmes coordinated with MARDE (currently MAFI). The law outlines roles and responsibilities of relevant institutions. However, there is no reference to climate change and the expected increase in outbreaks of pests and diseases and the need to prevent, control and manage these risks. Pursuant to Article 4 of Law No. 228 of 23 September 2010 on plant protection and phytosanitary quarantine, ANSA shall develop, approve and implement special programmes for forecasting, prevention, control and elimination of outbreaks of harmful organisms and quarantine organisms. Article 7 of the law provides for the development and implementation of scientifically justified comprehensive state programmes, for prevention of risks of introduction and spread of harmful organisms, especially extremely dangerous ones, and for their elimination. Contingency plans are available for diseases including classical swine fever, African swine fever, avian influenza, bluetongue, and foot-and-mouth disease.

The **Contingency plan against swine plague** (10 July 2017, no. 235) transposes into national law the Council Directive 2002/60/EC of 27 June 2002 laying down specific provisions for the control of African swine fever and

amending Directive 92/119/EEC as regards Teschen disease and African swine fever, published in the Official Journal of the European Union series L no. 192 of 20 July 2002.

The Regulation on **state cereal reserves** (10 February 2009, no. 128) stipulates the creation, administration, coordination and control of a special food wheat fund, meant to ensure the food security of the country and the protection of the population in exceptional situations, caused by natural hazard-induced disasters, epidemics, epizootics, industrial accidents, social or economic phenomena, and external circumstances.

The General Supervisory Inspectorate on **phytosanitary and seed control** (9 December 2008 no. 1402) was created to ensure the organization and coordination of actions in the field of phytosanitary, seed control, quality of cereals and derived products, aimed at increasing productivity and improving the quality of agricultural crops and derived products, maintaining the ecological balance, and improving the phytosanitary situation.

Disaster risk reduction

The Governmental Decision No. 1030 of 13 October 2000 on a national programme **for flood protection** for 2000–2025 with a total cost of about USD 80 million included many actions for the protection of an overall area of 72 600 ha and a population of 100 000 – however, due to a lack of funding, only some actions were implemented.

Government Decision No. 1120 of 27 October 2005, amended by Decision No. 1143 of 21 November 2018, regarding some efficiency measures for **hail fighting works**, regulates the organization and performance of anti-hail works on the territory of the Republic of Moldova.

The Regulation on **flood protection** levees (2012) establishes the requirements for the design, construction, reconstruction, repair and operation of dams, their operation and monitoring of status, as well as enforcement responsibilities. Though dams are considered essential flood protection for localities, climate-adaptation issues are missing because responsibilities for their functions and duties are not articulated.

The Regulation for the **management of flood risks** (2013) establishes the normative framework for the management of flood risks, including preliminary flood risk assessment, development of hazard and flood risk maps, step by step integration of flood risk management plans into river basin district management plans, and so on. Climate-adaptation issues are partially included due to the fact that actions are based on the impact assessment report, thematic maps of river basins, and inventory of receptors at risk of flooding. The institutions involved are included; however, agriculture is not mentioned.

The Regulation on Drought Management Planning (2012) was developed in accordance with the provisions of articles 47 and 48 of the Water Law no. 272. This regulation establishes a national framework for the assessment and management of drought risks, which includes: a) identification of drought vulnerability at river basin and sub-basin level, with appropriate policies and actions to reduce long-term drought vulnerability; b) use of the hydrometeorological monitoring system and measurement of standardized indicators to prevent imminent drought and use of the severity thresholds of these indicators to define the increasing stages of drought development; and c) elaboration of drought management plans that will detail concrete actions and measures to be subsequently implemented depending on the level of drought severity to minimize adverse effects on humans, the environment and the economy.

The Regulation on financial support to agricultural producers affected by the late frosts in spring of 2016 was approved by a Government Decision on 5 April 2017.

Starting in 2005, subsidized agricultural insurance was implemented on the Moldovan insurance market, based on Law No. 243/2004 on **subsidized insurance of production risks in agriculture**. Over 14 years after enacting of the law, a large number of gaps, ambiguities and drawbacks were found, which hampered the development of subsidized agricultural insurance and prevented meeting the needs of farmers.

The Law about subsidized insurance in agricultural industry (2020) reflects medium-term actions to boost the role of insurance in agriculture, which includes the following provisions with impact:

- The insurance relationships also include the beneficiary of the insurance, which may be both commercial banks' lending to farmers and providers of goods and services, which have the guarantee of getting their investment back in case of insured risks.
- The manner of establishing the insured amount for all the goods subject to insurance has been provided in detail.
- The scope of the law has been extended, by offering the possibility of subsidizing the quality of harvested crop.
- The way of establishing the amount of insurance for growing animals was regulated, according to a methodology approved by MARDE (currently MAFI).
- The possibility of insuring fish and beehives was provided.
- The possibility of ensuring animal health was provided by covering the costs of diagnosing and treating them.
- The right of the insurer was provided to check observance of the agrotechnical rules, sanitary–veterinary norms and other measures established by the contract or the regulatory acts by the insured.
- Provisions have been included to prevent the exercise of the right of parties to termination of the contract in bad faith.
- The maximum threshold of contract management expenses was increased from 10 percent to 15 percent of the value of the premiums covered in the insurance contract.
- The possibility of paying the insurance premium in more than two instalments was provided for.
- The ministry has been allowed, depending on the evolution of risks and policies in different areas of agriculture, to expand the list of risks and agricultural assets eligible for subsidized insurance.
- The share of subsidy in the insurance premium was increased from 50 percent to 70 percent, by establishing a dynamic mechanism to decrease or increase the share of subsidy in insurance premiums depending on the total size of the National Fund for the Development of Agriculture and Rural Areas (NFDARA), taking into account the cumulative value of subsidies for subsidized insurance authorized for payment.
- A statement on the insured's own responsibility regarding the existence of insured property was included.
- Included was the possibility of insurance relationship subjects to negotiate the size of the franchise (share of the damage to be covered by the insured) and the method for its calculation, with no need to change insurance terms and conditions.

The Guide on issuing the notice attesting the justifying impediment in the relations between economic agents in the agricultural field, as a result of natural events (2020) has been developed on the basis of the new regulation on the issuance of the notice of attestation of the impediment to the non-performance of the obligation and provides the necessary information support to farmers, in particular in assessing damage to agricultural crops. The guide contains information on: the manner and conditions for attesting the justifying impediment; the basic criteria for recognizing events as a justifying impediment; the procedure for submitting the request for issuing the opinion attesting the justifying impediment; the procedure for ascertaining and assessing the damage to the agricultural crops.

Other laws include provisions for safe settlement planning, urban design and building construction, as well as provisions for flood risk assessment and management. The issues related to DRR and climate-change adaptation in agriculture depends a lot on the management of the Nistru and Prut rivers, which could affect the population, and agricultural crops, during disasters.

The Republic of Moldova has signed **a number of agreements with countries in the region** and is a member of several organizations responsible for cross-border emergencies and the prevention of industrial accidents.

The Agreement between the Government of Romania and the Government of the Republic of Moldova (GoM) on cooperation for the protection and sustainable use of the Prut and Danube waters was ratified in 2010. Bilateral cooperation between the Republic of Moldova and Ukraine (Dniester river) takes place through a cooperation framework, as follows:

- Agreement between the GoM and the Cabinet of Ministers of Ukraine on joint use and protection of transboundary waters, drawn up in Chisinau, 23 November 1994.
- The Treaty of the Dniester River Basin between the GoM and the Cabinet of Ministers of Ukraine was ratified by the Republic of Moldova in 2012 and by Ukraine in 2017. The agreement and the treaty include provisions of the Water Directive and envisages the establishment of a river basin commission.
- Moldovan–Ukrainian Cooperation Regulation on protection against floods in inland and border watercourses.

The Republic of Moldova has fully approximated its national legislation with the European Union Floods Directive of 2013 – via the Governmental Regulation on Flood Risk Management no. 887 of 11 November 2013.

According to the GIES (2019), the existing legal framework needs to be significantly improved. The list of all types (and subtypes) of interventions for which the GIES subdivisions shall be prepared needs to be defined. The organization model of the "interventions" field must be correlated with the types and subtypes of interventions performed by the GIES. In this way, more clarity will exist in organizing the activity, while gradual planning of the processes targeted towards development of the general operational capacity of the GIES will be facilitated. The training of GIES employees in the field of interventions is to be improved; it must become systemic and continuous. The logistical support for interventions must be systemic and dynamic, flexible and predictable, and comprehensive and clear. It is necessary to develop an internal system for the evaluation of interventions and intervention capacity, and for participation in international missions.

Policy framework related to disaster risk reduction and management

Development policies, strategies and plans

Several important policy documents were developed and approved at cross-sectoral and sectoral levels in which economic, social and environmental issues were included, such as: the National Development Strategy Moldova-2020, draft National Strategy of Natural Hazards Mitigation and Climate Change, Climate Change Adaptation Strategy 2014–2020, the Low-Emissions Development Strategy (LEDS) (2013–2020) (approved by Government Decision 1470/2016), Small and Medium Enterprises' Sector Development Strategy for 2012–2020, National Programme Moldovan Village (2005–2015), National Strategy on Regional Development, Economic Growth and Poverty Reduction Strategy. However, a mechanism for implementation of the policies provisions is lacking, which allows for no harmonization between economic, social and environmental considerations. As a result, the planning is still sectoral in nature, while the environmental and social issues are included as separate chapters in the government programmes, but are not integrated as components of national economic development.

The **National Development Strategy of the Republic of Moldova** for 2012–2020 addresses climate change and natural hazards as a means to achieve qualitative economic development and poverty reduction. Measures include ongoing monitoring and research of climate-change impacts, related social and economic vulnerability, and regular updating of climate scenarios. The government is prioritizing: a) strengthening institutions to better prepare for and respond to disasters; b) reducing the agriculture sector's vulnerability to climate change; c) improving the ability to forecast severe weather and the quality of local forecasts; and d) strengthening regional collaboration and knowledge sharing on disaster risk management.

A significant contribution to the country's sustainable development priorities which are embodied in the **National Development Strategy: "European Moldova 2030"**[7] (approved by the Parliament of the Republic of Moldova in October 2022) is provided by the adaptation planning process. In particular, ensuring the Republic of Moldova has a system and capacities in place for medium to long-term adaptation planning and budgeting with the overall aim to reduce the vulnerability of the population and key sectors to the impacts of climate change.[8] In addition, the LDN framework contributes to the overarching adaptation goal of the Paris Agreement, as well as to achieve by 2030 no net loss of productive land/soil, and increase drought resilience, adaptation capacity and biodiversity services of agricultural ecosystems. The objectives of the National Development Strategy "European Moldova 2030", Strategic Objective 10 "Ensuring a healthy and safe environment" are: (i) improvement of the quality of water, air and soils; (ii) sustainable increase in the area of wooded land and natural areas protected by the state; (iii) ensuring sustainable consumption of natural resources; (iv) ensuring resilience to climate change by reducing risks related to climate change and facilitating adaptation in six priority sectors – agriculture, water resources, health, forestry, energy, and transport; and (v) active transition towards the green and circular economy (GoM, 2022). The strategy mentions that in the context of climate change, it is necessary to reduce greenhouse gas (GHG) emissions and implement measures to adapt to climate change (SDG 1.5, 9.4, 13.1, 13.2, 13.3). Some of these measures are related to land afforestation and sustainable management of land use categories, which could reduce the level of soil degradation, improve the quality and quantity of water resources, and contribute to the development of communities at the local level through provision of ecosystem services (SDGs 15.2, 15.3, 15.5, 15.9).

[7] https://multimedia.parlament.md/strategia-nationala-de-dezvoltare-moldova-europeana-2030-a-fost-aprobata-de-parlament/
[8] https://www.adaptation-undp.org/projects/moldova-nap-process

The **National Strategy of Regional Development for 2016–2020** aims to ensure the sustainable development of the country's regions, citizens' access to professional public services, boost sustainable economic growth in the region, and improve the normative and legislative framework on the sustainable development of Moldovan settlements. The strategy contains the context for sustainable development of three regions of the Republic of Moldova, that partially incorporate mitigation and adaptation action. However, the strategic document lacks explicit relevance to climate-change mitigation and adaptation, linking rural and urban as well as an agriculture sector focus.

The **Strategy for the Development of Rural Extension Services** for the period 2012–2022, approved through the Government Decision no. 486 of 5 July 2012, foresees a rapid transition to a modern model of organization of rural extension services, that generates high added value, based on knowledge and innovation and oriented towards continuous improvement in quality of life in rural areas. The development of the rural extension services does not include raising awareness on DRR, such as the application of practices to reduce the adverse impacts of flooding on agriculture.

The **Food Safety Strategy for 2018–2022** aims to achieve the highest feasible level of protection of human health and consumer interests concerning food. There is no analysis of the link between product quality and climate change; or food security and food safety in terms of global warming.

Climate change and disaster risk reduction policies, strategies and plans

The plan of action for implementation of the **Strategy for Sustainable Development of the Forest Sector** 2004–2020 includes specific actions to implement the strategy of sustainable development of the forestry sector in the Republic of Moldova. The plan provided ways to mitigate the negative influences on the forest from climate change in the years 2004–2020. The responsible implementing agency is Moldsilva, but this strategy has not been implemented due to legal challenges.

With support from UNDP and the UN Office for DRR (UNDRR) for Europe a National Strategy for Disaster Risk Management (NSDRM) and the Action Plan for implementing the NSDRM were developed in 2015 but not yet approved by Government Decision. The item, "Development and approval of draft National Strategy for Disaster Risk Reduction (responsible entity – the Ministry of Internal Affairs)", was included in the government's Action Plan for 2020–2023. However, the situation turned out to be ambiguous as MARDE was responsible for Sendai Framework activities (currently – Ministry of Environment), and MIA is responsible for the development of the strategy.

The **National Strategy of Natural Hazards Mitigation and Climate Change** (NSNHM) 2014–2020 is one of the first strategic documents aimed at mainstreaming climate change and natural hazards into the national policy setting. The main objectives of the NSNHM are to: 1) increase the level of adaptation of natural resources, ecosystems and agriculture to climate change; 2) maintain low levels of GHG emissions; 3) consolidate the institutions involved in management and alleviation of extreme events; and 4) raise institutional and community awareness concerning natural risks and climate change. In order to accomplish the strategic vision, the NSNHM focuses on: (i) the development of infrastructure, including related to agriculture, for disaster mitigation; (ii) the development and implementation of insurance instruments, including for agriculture, against natural hazards; (iii) the implementation of adaptation measures for anticipation and mitigation of natural hazard risks; and (iv) the strengthening of the institutional and legal framework for coordination of activities between national and international organizations in responding to natural hazards.

Climate change, agriculture and DRR have a level C of national development priority, with A being the most prominent (18 April 2018, No. 350).[9] Disaster risk reduction and climate-change mitigation are identified as priority areas of sustainable development of agriculture in the **2014–2020 National Strategy on Agriculture and Rural Development** (4 June 2014, No. 409) as well as in the new Strategy on Agriculture and Rural Development 2023–2030 (in process of approval).[10] The national energy efficiency strategy also addresses

[9] A – ongoing policy measures with financial coverage at baseline; B – policy measures additionally accepted at baseline; C – new policy measures.

[10] https://particip.gov.md/ro/document/stages/ministerul-agriculturii-si-industriei-alimentare-anunta-incepand-cu-data-de-22-iulie-consultari-publice-repetate-pe-marginea-proiectului-strategiei-nationale-de-dezvoltare-agricola-si-rurala-2023-2030/9428

climate change, which includes the use of biofuels and biogas as the only reference to the agriculture sector (10 November 2011, No. 833).

At national level, a number of national strategies, programmes and regulations have been designed and implemented over recent decades to build a **sustainable and efficient agriculture and food industry sector**. The INDC refers in particular to the country's **Climate Change Adaptation Strategy** (CCAS) for the 2014–2020 period and its Action Plan, which provide an integrated vision on the development opportunities to react in a resilient manner to the impact of climate change. It provides an analysis of the Republic's vulnerability to climate change and its main directions to adapt. The Republic of Moldova is actively working to ensure adaptation is mainstreamed in national and subnational planning processes. In this context, the country has initiated a National Climate Change Adaptation Planning process (NAP), through the CCAS, which is considered its first NAP (or NAP-1). The NAP-1 process was advanced through the implementation of the project Supporting Moldova's National Climate Change Adaptation Planning Process, implemented from 2013 to 2017 with financial support provided by the Austrian Development Agency (ADA), and implemented by UNDP (known as National Adaptation Planning Process in the Republic of Moldova 1 – NAP-1). Building on this project, the Republic of Moldova submitted two NAP readiness proposals to the Green Climate Fund (GCF) in partnership with UNDP and FAO (NAP 2, and Agriculture Sector Adaptation Planning Process, or Ag. SAP, respectively). These proposals aim to kickstart country's second NAP cycle, to address the remaining barriers identified under the NAP-1 process (FAO, 2020e) and to launch sector-specific support to mainstream adaptation in planning processes in agriculture. Both the NAP 2 and the Ag. SAP project are approved by the GCF and the inception phase was launched in early 2021.

FAO has received financing from the GCF to implement Ag. SAP, which will provide support (FAO, 2020e) in most of the areas included at national and farm level plans of the Ministry of Agriculture and Food Industry.

The **Action Plan for the implementation of the Climate Change Adaptation Strategy by 2020** includes many actions related to DRR, climate-change adaptation and EWS. Among them, the following in particular are related to the agriculture sector:

- Vulnerability and risk assessment for the agriculture sector at the regional or district levels.
- Conduct studies on climate-change impact on basic crops and main categories of livestock reared in the country.
- Assessment of risk/opportunities for human health and sustainable development of sectors vulnerable to climate change (agriculture, forestry, water resources, etc.) caused by the increased number and higher intensity of extreme events.
- Identification of vulnerable areas and sectors and assessment of needs and opportunities of alternative crops and varieties more resistant to change in response to climate change.
- Develop a programme of measures to conserve water in the soil and adjustment periods for conducting agricultural activities on climate change.
- Support for agricultural research and experimental production in the selection of crops and development of the best varieties that are better suited to the new climate conditions.
- Capacity development for adaptation to climate change through awareness of stakeholders.
- Developing irrigation plans based on an assessment of their impact, the future water availability and water needs, taking into account the balance between supply and demand.
- Creating tools for risk management and crisis to cope with the economic consequences of events due to climate change.
- Assure availability of water at source through the development of the infrastructure for transforming water resources into socioeconomic ones.
- Undertake measures to combat drought and water scarcity.
- Switch the national system of early warning on natural hazards, including climate ones, to a regional system of early warning on climate-related natural hazards.
- Create an EWS on natural hazards climatic origin, providing public access to data and information needed to assess climate risks and impacts.
- Create national databases on climate change containing periodic hydrometeorological and climatic information, information on current climate change adaptation projects and activities.
- Extend the databases on climate-change adaptation at the local level.

- Ensure proper management of flood risks, through protective infrastructure, (re)construction of dams, flood forecasting, information and alert systems (budget of USD 117 500).
- Develop and implement programmes and materials accessible e-learning (books, brochures, and so on) on adaptation to climate change in order to improve the skills of farmers, medical professionals, civil protection and emergency service engineers in the energy, transport and construction sectors, and other specialists.

The **National Environmental Strategy 2014–2023** ensures long-term environmental strategic planning congruency with European Union norms. The strategy contains the context for development and approval of DRR, climate mitigation and adaptation strategies including agriculture, but lacks the institutional framework that would support the drafting of participatory strategies. The following actions are included related to agriculture: improving the irrigation system through expansion and rehabilitation of 11 irrigation systems, ecological restoration of degraded lands subject to landslides and used for the extraction of minerals, restoring farmland buffer strips and creating natural carcass of soil conservation by linking them to existing forest area, mitigating the impact of soil desertification by implementation of resource productivity technologies, development of subventions and subsidies system that would contribute to the rational use and protection of soil resources and decontamination of lands historically contaminated with pesticides, including from the persistent organic pollutants category.

The **Water Supply and Sanitation Strategy in communities of the Republic of Moldova** (2014) for the years 2014–2028 aims to ensure gradual 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. The strategy takes into account various climate-change impact scenarios on water resources and includes some actions for climate-change adaptation (UNDP, 2013). The strategy also promotes sustainable development measures and environmental protection of water resources by harmonizing the national legal framework with the European Union *acquis*. The strategy does include adaptation action, such as use of surface water management, but the action plan foresees the development of the group water mains from the Nistru and Prut rivers, while for remote communities, the strategy refers to groundwater, which is known as being of high heterogeneity.

The **Strategy of Biological Diversity and Action Plan for 2015–2020** addresses the reasons that determine the loss of biodiversity by integrating the requirements to stop the process of losing biodiversity, reduce direct pressure on biodiversity and promote sustainable use, improve the conditions of biodiversity by safeguarding ecosystems, species and genetic diversity, enhance benefits resulting from biodiversity and ecosystem services, building capacities for strategy enforcement by participatory planning, knowledge management and building legislative and institutional capacities. It makes the link between environmental degradation, reduced biodiversity/ecosystem services and the vulnerability to extreme weather events and climate change by referring to the aim to mitigate the effects of flooding, soil erosion and runoffs. The Action Plan includes the creation of a National Ecological Network, part of the Pan-European Ecological Network.

Flood risk management plans for the Dniester, Danube-Prut and the Black Sea river basin districts for the period 2020–2025 have the following general objectives: a) flood risk reduction and prevention, which is focused on activities at the district level that would contribute to flood risk reduction; b) reducing the consequences during and after the flood, include emergency planning, forecasting, preparedness and response and recovery activities after the flood; and c) capacity development in institutions, include activities based on the implementation of non-structural measures.

Agriculture sector policies, strategies and plans

The **National Land Consolidation Strategy for 2012–2027** aims to create the conditions to reduce fragmentation and enlarge farm sizes, to develop rural infrastructure, to ensure rational use of natural resources, protection and restoration of valuable natural areas and to promote sustainable rural development. Several long-term actions related to rural development: to coordinate actions of land consolidation with rural development initiatives of the government in rural areas within rural and regional development strategies, including restoration and development of irrigation and drainage systems and afforestation of heavy degraded land, areas for public needs, protected and other highly valuable natural sites.

The **National Strategy on Agriculture and Rural Development 2014–2020** is the main strategy in agriculture. The main goal of the strategy is to increase the competitiveness of the agrifood sector, sustainable management of natural resources, and improving standards of living in rural areas. The strategic document underlines drought as one of the main natural hazards for agriculture and includes an objective referring to climate-change adaptation, but not DRR or extreme weather events, except mentioning mainly drought, and including the following actions: a) support to adaptation and mitigation of climate-change effects on agricultural production; and b) support environmentally friendly production technologies, organic production and products ensuring biodiversity; however, there are no distinct actions to achieve this. Other measures related to aspects of adaptation are mentioned under the specific objectives: support sustainable agricultural land and water management practices; support environmentally friendly production technologies, organic production and products ensuring biodiversity. This strategy lacks an action plan to protect the environment within the context of impacts of climate change on the agriculture sector. A new Strategy on Agriculture and Rural Development for 2023–2030 has been developed, which includes adaptation measures for the agriculture sector, formulated with support from FAO. The draft is expected to be approved in spring 2023.

The draft **Strategy for Adaptation of the Forestry Sector to Climate Change** (2017) aims to be an efficient way of achieving the maximum potential of the forestry sector in the Republic of Moldova in the shortest possible time to adapt to the predicted climate changes and to mitigate their overall effect. This strategy defines the main lines of action for the next nine years to adapt the forestry sector to the consequences of climate change, to maintain a normal flow of forest ecosystem services and to mitigate the impacts of climate change on the forestry sector. Part of the strategy includes an Action Plan for its implementation, although it has not yet been approved. It includes ecosystem activities for social well-being or adaptation, with most of them in support of other adaptation measures (for example, infrastructure). These activities deal mainly with regulating services (soil rehabilitation, erosion control) and provisioning services (fuel wood). They also have the potential to promote integrative and cross-sectoral adaptation, as many of them consider multiple ecosystem services and beneficiary sectors. However, more technical, political and financial support is needed to foster the role of ecosystem services in adaptation at the implementation stage (MARDE and UNEP, 2018).

The Multi-Annual National Control Plan of the Republic of Moldova (MANCP) in the area of supervision of food safety, animal and plant health 2016–2020 indicated measures to be taken within the official control in the mentioned areas. The document contains a clear description of the legal provisions of the Republic of Moldova on the roles and responsibilities of the competent food safety authority and on the cooperation with other national associated institutions and organizations, involved in the actions related to the official control of this area. The plan describes the mechanisms that are established or are to be established to ensure the increase of consistency and efficiency in all control systems, in all areas, and at all stages of the food, feed manufacturing flow, health and welfare of animals, and plant health. MANCP fully covers the planned official control activities of the competent authority and the priorities established for the plan implementation period. The document describes also the MANCP implementation progress monitoring and reporting procedures. MANCP was developed according to the principles and requirements of Law of the Republic of Moldova No 113 of 18 May 2012 on food safety, Law No 221 of 19 October 2007 on sanitary veterinary activity, Law No 228 of 23 September 2010 on the protection of plants, the Regulation of the European Parliament No 882/2004 of 21 May 2007 on guidelines to assist the Member States in preparing the single integrates Multi-Annual National Control Plan and Commission Decision 2007/363/EC on guidelines to develop MANCP.

The fishery and aquaculture sector is regulated in the Republic of Moldova by normative acts as detailed below.

The Law on Fisheries Fund, Fisheries and Aquaculture No. 149 (2006) regulates: procedures and conditions of the establishment and protection of fish stocks; reproduction, cultivation, and harvest of aquatic organisms; and amelioration of fishery waterbodies. It defines the principles of public authorities who have the right to manage aquatic biological resources. According to the law, the competencies of the Ministry of Environment, MAFI, Academy of Sciences of the Republic of Moldova and other research institutions local public administration bodies are specified. Law no.149 of 08 June 2006 on the fish fund, fisheries and fish farming was amended on 05 April 2018. The changes in the law were published in the Official Gazette no. 142-148 (6537-6543) on 4 May 2018. Prohibiting trolling, and increasing the compensations in the case of fishing, marketing, illegal export or destruction of natural resources in aquatic areas for some fish species.

Water Code No. 1532 (1993) regulates the responsibilities of legal entities and individuals who are water users of fishery waterbodies to: carry out amelioration and take technical measures that ensure the improvement of the status of waterbodies, conditions of fish stocks, reproduction and maintenance of waterbodies under proper sanitary conditions; implement measures for the protection and reproduction of fish stocks; keep a state inventory of water resources.

Law on Foodstuffs No. 78-XV (2004) establishes: a legal framework for the production, processing, and distribution of foodstuffs; basic conditions governing the circuit of these products, including safety standards to protect human health and consumers' interests in relation to foodstuffs. It also promotes fair practices in the field of food trade.

Government Decision no. 888 (2007) establishes the authorization of industrial or commercial fishing, sport and amateur fishing, fishing for scientific and control purposes, as well as the amount of fishing fees in the natural aquatic fisheries of the Republic of Moldova.

In the context of European integration, the Republic of Moldova has signed a **plan for managing and improving people's living conditions and the protection, restoration and sustainable use of water resources for the years 2018-2023 (first phase) and 2021-2027 (second phase)**. Thus, the Republic of Moldova has partially transposed the European Union Water Framework Directive 2000/60/EC (DCA) into the Waters Law no. 272 of 23 December 2011, which entered into force on 26 October 2013. One of the objectives of the aforementioned law is the development of river basin management plans, which play an important role. A key component of the plan is the analysis of the situation of surface water and groundwater, the principles of identification and delimitation of surface water bodies (rivers and lakes) and of groundwater.

The National Programme for **expansion of the areas covered with forest vegetation** for the years 2014–2018 aims to slow down soil degradation processes by extending the areas covered with forest vegetation. It also provides regionally disaggregated indicators regarding the areas to be recovered. It does not refer to a programmatic approach in building and maintaining stable diversified forests adapted to climate change.

Institutional framework for disaster risk reduction in the agriculture sector

This report has been developed during a period of significant structural changes in the Government of the Republic of Moldova. In late 2017, the Parliament approved a new Government structure. As part of this central public administration reform, the number of ministries decreased from 16 to nine and, consequently, the Ministry of Agriculture and Food Industry (MAFI), the Ministry of Environment, and the Ministry of Constructions and Regional Development, were merged into a single national authority – the Ministry of Agriculture, Regional Development and Environment (MARDE). In June 2018, a new Agency for Environment was created under MARDE and took over some responsibilities from the SHS that mainly related to environmental quality monitoring. In August 2021, the Parliament approved further amendments to the structure of government, the result of which was that MARDE was again split and reorganized into three ministries: for agriculture (MAFI), environment, and infrastructure and regional development.

The Government of the Republic of Moldova considers DRR and protection of the country's economic development from natural hazards to be among its priorities.

According to the Law No. 271 (of 9 November 1994), civil protection includes the leadership, management authorities, the National Network for Laboratory Observation and Control (RNOCL) in respect of the state of the environment and potentially dangerous facilities, human resources and equipment for eliminating the effects of disasters, and the training system for civil protection. Civil protection has branches in all territorial administrative units and it comprises all sectors of the national economy, its organization being mandatory. The responsibility for preparedness of civil protection authorities lies with the Government of the Republic of Moldova, ministries, departments, local public authorities, and enterprises. According to civil protection legislation (Law No. 271 of 9 November 1994), the specialized central public authorities are obliged to ensure, during peace or war, the protection of the population, of material goods and cultural values, to limit and to eliminate the consequences of disasters. The direct management of civil protection is exercised by the General Inspectorate for Emergency Situations (GIES) which is subordinated to the Ministry of Internal Affairs (MIA).

Civil protection management is exercised by the heads of ministries and other central public authorities either in person, or by civil protection commissions, divisions and sections. The commissions, divisions and sections are the main administrative civil protection authorities. In ministries, other central public authorities, businesses, commissions shall be established for exceptional situations from among management and employees without release from their basic jobs. The organizational structure and the numbers of commission members shall be established by the respective public authorities. The leaders of commissions, and divisions at all levels, are obliged to submit timely and objective reports, in the manner established by Law on Civil Protection (No. 271 of 9 November 1994), about all the cases of disasters, their causes, their effects and the measures taken to eliminate the effects. At the same time, the leaders of central and local public authorities, the decision makers of enterprises, regardless of the type of property and the organizational and legal form, must take the necessary actions to organize training in civil protection and to carry out public awareness to share knowledge in the field of civil protection.

The operational management of the forces and facilities for civil protection in carrying out rescue works of national or local significance at the level of facility is done by the GIES, by the leaders of the local public authorities, and by managers of enterprises. All the forces and facilities allocated for eliminating the consequences of disasters are subordinated to the manager of the rescue works, regardless of department hierarchy. Nobody in responsible positions is entitled to intervene in the actions of the manager of the rescue works or to cancel the orders and the provisions for the operation of civil protection forces and facilities. The **Ministry of Agriculture and Food Industry** (MAFI, previously MARDE) organizes and coordinates the control works of **radioactive and heavy metal contamination of the soil**, agricultural plantations, raw materials and agrifood products. It ensures

the rational capitalization of agricultural production from the contaminated territories; **performs sanitary–veterinary, agrochemical and other prophylactic measures**, able to reduce the damage caused by calamities, damage and catastrophes; processes and provides information on the estimation of exceptional situations of a natural and ecological nature in the process of agricultural production.

The Ministry of Agriculture and Food Industry (MAFI) must submit the following information: on loss of agricultural production as a result of natural and biological disasters; on progress and results of eliminating consequences of disasters. Some regulatory acts are not harmonized with each other. Thus, Decision No. 908 of 5 November 2014 provides for the endowment of the units of the GIES with intervention tools, but it is not specified how line ministries (including MAFI) shall ensure implementation of relief and other operations in case of disasters (Law No. 271 of 9 November 1994).

National Agency for Food Safety (ANSA) is providing information on the emergence of epizootic and epiphytic events.

In Law No. 267 of 9 November 1994 on **protection against fires**, including wildfires and forest fires, the obligations of central and local public authorities are stated. Thus, ministries and other central public authorities reporting to the government shall:

- develop organizational, prevention and technical-scientific measures to ensure protection against fires;
- train scientific research and design organizations in solving problems related to the protection of facilities against fires;
- ensure investigation of the inflammatory and explosive properties of substances, materials, devices and installations manufactured and used in production, according to universal standards;
- ensure inclusion of fire protection regulations in standards, technical conditions, norms, rules and guidelines, control how they are observed when designing, constructing, reconstructing and using a facility; and
- ensure the training and re-training of specialists in the field of fire protection.

Observations on environmental pollution with radioactive, toxic and bacteriological substances are carried out by the RNOCL, which includes: (i) the sanitary–hygienic and anti-epidemic centres and institutions of the Ministry of Health; (ii) the network of stations and posts of the Environmental Agency; (iii) agrochemical laboratories, plant protection stations under MAFI; (iv) veterinary laboratories of the Food Safety Agency.

The main institutions involved in DRR activities include (GFDRR, 2019, updated by author, 2021):

- National Commission for Emergency Situations (managing major emergencies, established in 2001);
- General Inspectorate for Emergency Situations (responsible for disaster prevention, response, relief, and recovery, established in 2003);
- Ministry of Agriculture and Food Industry with subordinated agencies:
    - Service for Active Influence on Hydrometeorological Process;
    - Agency for Intervention and Payments in Agriculture (AIPA);
- Ministry of Environment:
    - State Hydrometeorological Service (providing daily and seven-day forecasts for disaster preparedness;
    - Apele Moldovei (Moldova Water) agency;
    - Moldsilva agency (Forest agency);
    - Agency for Geology and Mineral Resources;
- National Agency for Food Safety (ANSA);
- Public Services Agency;
- Agency for Land Relations and Cadastre;
- Academy of Sciences of the Republic of Moldova; and
- local public authorities.

However, the National Bureau of Statistics (NBS) is not involved in DRR and, for example, does not have a role in damage and loss assessments after disasters.

The Regulation of the National Commission for the implementation and realization of the commitments under the UNFCCC and of the mechanisms and commitments of the Kyoto Protocol (Government Decision No. 1574 of 26 November 2003) stipulates the following tasks of the Commission, among others:

- coordination at the national and international level of the activities on the implementation of the commitments under the UNFCCC and of mechanisms and commitments of the Kyoto Protocol;
- elaboration and implementation of policies and strategies focused on realization of the activities for stopping, abatement of the phenomena on climate change, adaptation and mitigation of the impact of climate-change phenomena on the socioeconomic aspects, human health, ecosystems and natural resources;
- elaboration and presentation for examination and approval of the legislative acts on the implementation of the commitments under the UNFCCC and the mechanisms and commitments of the Kyoto Protocol;
- elaboration of the programmes on realization and supervision of the mode of implementation in the Republic of Moldova of investment or technical assistance projects within the framework of the Clean Development Mechanism (CDM) of the Kyoto Protocol of the UNFCCC;
- coordination of the process of technical expertise of the project proposals providing for implementation in the Republic of Moldova within the framework of the CDM of the Kyoto Protocol of the UNFCCC;
- coordination of the process of selection and approval of the projects which have to be implemented in the Republic of Moldova within the framework of the Kyoto protocol of the UNFCCC;
- certification of the selected projects for implementation at the UNFCCC Secretariat;
- coordination of the process of negotiation of the conditions for trading the quota of certificated GHG emissions reductions;
- coordination of the process of certification of the quota or GHG emissions reductions for each project separately.

The institutional responsibilities for natural hazard risk mitigation, monitoring, emergency response and recover is in Table 4.

Table 4. Institutional responsibilities for natural hazard risk mitigation, monitoring, emergency response and recovery

Institution	Subordinated subdivisions	Main responsibilities
National (headed by prime minister) and local (headed by mayors) Commissions on Emergency Situations	Governmental Commission on Emergency Situations	– preparing recommendations on emergency planning and preparedness, development of national/local policies and legislation; institutional strengthening, budgeting, etc.; – elaborating and coordinating of urgent measures and actions in case of emergency situations; – organizing and coordinating post-recovery activities; – reviewing of the status of preparedness to emergency situations.
	Local Commissions on Emergency Situations	
Ministry of Agriculture and Food Industry	Special Service for Active Influence on Hydrometeorological Processes	– monitoring of heavy rain and hail; – crops anti-hail protection; – stimulation of precipitation; – fog dispersion.
	Institute of Pedology, Agro-chemistry and Soil Protection "Nicolae Dimo" (partially subordinated also to the Academy of Sciences)	– conducting soil investigations; – preparing methodologies and methods for preventing land degradation and soil improvements (including gullies erosion, landslides and surface erosion); – preparing national programmes and action plans in the domain; – extension of best agricultural practices on soil conservation through training and demonstrational activities.

Institution	Subordinated subdivisions	Main responsibilities
Ministry of Environment	Agency Apele Moldovei	– developing water policy, programmes and action plans; – implementing flood protection measures and projects; – elaboration of urgent measures in case of flooding; – implementing irrigation and drainage projects; – water reservoirs and water courses dams and dykes' safety control; – participating in liquidation of relevant natural hazards consequences; – monitoring of the surface water resources, including the water volume and level.
	State Hydrometeorological Service	– weather and natural hazards monitoring, meteorological (droughts, hail, frost, heavy rain, strong wind, etc.), hydrological (flooding), agrometeorological forecasts; – natural hazards warning; – dissemination of hydrometeorological information among key stakeholders; – maintaining of National Fund of hydrometeorological data.
	State forestry agency Moldsilva Forestry Design and Research Institute Territorial Forest Enterprises	– developing national forestry policy, legislation, guiding materials, programmes and action plans in the forestry sector; – preparing forestry management plans; – designing afforestation and forestry biodiversity improvement projects; – implementing on the ground afforestation and other forestry activities, including afforestation of agricultural field protective belts.
	Agency for Geology and Mineral Resources / State Enterprise Moldovan Hydro-geological Expedition	– underground water resources monitoring (quality and water level); – monitoring of dangerous geological processes (landslides, gullies), including mapping, and forecast; – monitoring of earthquakes (on geodynamic indicators); – maintaining of the National Geological Archive.
	Inspectorate for Environment Protection	– ecological control and enforcement, including implementation of preventive land degradation measures and action plans.
Ministry of Internal Affairs	Department of Exceptional Situations and its territorial subdivisions	– national legislation, policy and programmes development in the area of emergency response and mitigation of natural and man-made hazards; – emergency response planning and implementation; – search and rescue; – developing and operating warning systems; – emergency preparedness and training; – post-disaster recovery and reconstruction; – monitoring of radioactivity safety; – disaster damage assessment.
Ministry of Education, Culture and Research	Institute of Geography and Ecology (partially subordinated also to the Academy of Sciences)	– mapping of climate conditions and dangerous geological processes; – micro-zoning studies.
Agency for Land Relations and Cadastre (subordinated to the GoM)	Commission for evaluation and selection of investment projects for the implementation of the Land Improvement Programme for ensuring sustainable management of soil resources for the years 2021–2025	– responsible for the evaluation and final selection of land improvement investment projects for financing that correspond to the requirements of the regulation for the conditions and procedure for granting pre-payments for land improvement investment projects, approved by Government Decision no. 985/2020, for the implementation of the Land Improvement Programme in order to ensure the sustainable management of soil resources for 2021–2025, approved by Government Decision no. 864/2020.
Public Services Agency (subordinated to the GoM)		– coordinate and organize activities aimed at ensuring the implementation of public policies in the information technology, state record-keeping and the state information resources.
National Food Safety Agency (subordinated to the GoM)		– implementing state policy in the field of regulation and control for food safety, sanitary–veterinary, animal health, plants protection and phytosanitary quarantine, seed control, quality of primary products, food products and forage.
Academy of Sciences (subordinated to the GoM)	Institute of Geology and Seismology Institute of Geography and Ecology	– monitoring of seismic activity; developing seismic maps; vulnerability assessment; maps design; developing seismic, landslides and gullies erosion mapping methodologies; dangerous geological processes mapping (gullies and landslides); carrying out micro-zonation studies; – development of methodologies for micro-climatic zoning.

Institution	Subordinated subdivisions	Main responsibilities
Municipal Design Institutes	Iprocom – Municipal Design Institute; Urban Project – Design Institute on Regional Development and Physical; Planning Cercon – Design Institute on Construction State Inspection in Construction	– anti-landslides design in urban and rural areas; – design of storm sewage projects in localities; – seismic risk mitigation legislation and regulation in construction; – developing national standards in construction; – regional and urban planning; – construction inspection and building-code enforcement.
Local public authorities	Rayon councils Village administrations (primarias)	– hazards records; – emergency situations preparedness planning and training; – planning and coordinating post-disaster recovery activities; – public warning and public awareness; – hazards reporting to central authorities.
Insurance companies		– life insurance; – construction insurance; – crop insurance.
State and private economic enterprises		– emergency situations mitigation and preparedness planning and implementation; staff training; implementing post-disaster recovery activities.
Civil society/NGOs		– public awareness; training and education; information dissemination; – developing public initiatives in the domain; – scientific and field research; – public participation in mitigating and recovery activities.

The **National Commission for Emergency Situations** is a national multisectoral body responsible for policy development and planning for crisis preparedness, mitigation and response. According to Decision No. 1340 of 4 December 2001, the Commission for Emergency Situations shall consist of:

1. Prime Minister – President of the Commission
2. Deputy prime ministers – vice-presidents of the Commission
3. Minister for Internal Affairs – Vice-President of the Commission
4. Head of the General Inspectorate for Emergency Situations of the Ministry of Internal Affairs – Vice-President of the Commission
5. Secretary General of the Government
6. Minister of Economy
7. Minister of Finance
8. Minister of Agriculture and Food Industry
9. Minister of Environment
10. Minister of Education and Research
11. Minister of Culture
12. Minister of Health
13. Minister of Labour and Social Protection
14. Minister of Justice
15. Minister of Defence
16. Director General of the Land Relations and Cadastre Agency
17. Director General of the Material Reserves Agency
18. Director of Moldsilva Agency
19. Director of the National Anticorruption Center
20. Prosecutor General
21. Director of the Information and Security Service
22. President of the Academy of Sciences of the Republic of Moldova
23. Governor of the Autonomous Territorial Unit Gagauzia (Gagauz-Yeri)
24. Deputy Head of the General Directorate for Strategic Planning and Mobilization Reserves of the General Inspectorate for Emergency Situations of the Ministry of Internal Affairs - Secretary of the Commission
25. Director General of the National Agency for Regulation in Energy sector
26. Director of the Single National Emergency Call Service 112
27. Chairman of the Board of Directors of Moldovagaz Joint Stock Company
28. General Manager of the State Enterprise Moldelectrica.

The head of the commission is the prime minister; the deputy head is the director of the GIES. Overall responsibility for disaster management lies with MIA, while the implementation function lies with the GIES, which is a MIA subordinate agency. District and local emergency commissions have a similar structure and include heads of local governments and all relevant public services. The commission meets regularly on a semi-annual basis. In the event of an emergency situation, members are immediately notified and meet to evaluate the threat to the population, economy, and infrastructure, and make relevant decisions. Parallel to this structure are district and local-level commissions for disaster management, comprised of local authorities, line ministries, and GIES staff.

In order to solve certain tasks for protection of the population and the territory against disasters, the central specialized public authorities, and other central public authorities, shall establish subcommittees and working groups with appropriate specialisation. In risk conditions or upon the occurrence of disasters or in order to eliminate their consequences, the operation of the commission is done by the Management Centre for Emergency Situations, established by the GIES. Upon the request of the GIES, the central specialized bodies of public authorities, and other central public authorities, institutions, and organizations, will dispatch representatives to the Management Centre for Emergency Situations to carry out activities for cooperation, consultation, and exchange of information throughout the duration of the deployment for such works (Decision No. 1340 of 4 December 2001 on the Commission for Emergency Situations). Thus MAFI, and other public institutions that focus on agriculture and the rural sector in the Republic of Moldova, have the possibility to include aspects that they consider important in strategies, policies and plans as related to disasters.

The commission operates on the basis of an annual plan for preparedness of civil protection (governmental decisions No. 1092 of 19 December 2017; No. 1272 of 26 December 2018). MARDE (currently MAFI) is included in some, but not all, measures covered by the Civil Protection Plan of the Republic of Moldova in case of disasters. In 2020, MARDE was only included in the training of the institutions of the RNOCL. Instead, training is foreseen for members of district and municipal emergency situations commissions, for people responsible for civil protection and defence against fires of city halls, and for persons responsible for civil protection in companies and institutions, and owners of accumulation lakes and ponds (following the Governmental Decision on timetable plan on preparedness measures of the civil protection).

Disaster management functions are divided among several ministries and state departments, local public authorities, and economic entities. Although overall direction is provided by the National Commission for Emergency Situations, and vertical lines of authority within the system in most instances work adequately, there is little feedback back up the chain of command, and horizontal linkages among many institutions appear to be inadequate in many instances. There is a need to clarify roles and responsibilities for strategic oversight, planning, coordination and implementation of mitigation and response measures for all forms of natural hazard.

A multidisciplinary, multisectoral and multistakeholder national platform for DRR does not exist. The working group of the European Union-funded Programme for Prevention, Preparedness and Response to Natural and Man-made Disasters in the Eastern Partnership Countries (PPRD East 2) has facilitated the constitutions of interministerial working groups composed by national authorities involved in flood risk management, and these working groups were instrumental in facilitating the process of adopting legal changes and developing a policy brief toward alignment with the European Union Floods Directive. The Republic of Moldova working groups were established but not by governmental order, as was the case in Armenia and Ukraine.

In addition, there is a separate commission focusing on climate change, the National Commission on Climate Change. It was established under the Climate Change Coordinating Mechanism and approved by the government in 2020, with the aim to serve as an interinstitutional body for coordinating and promoting the measures and actions necessary for the unitary application of the provisions of the UNFCCC and of the Paris Agreement (EU4climate, 2021). The commission is chaired by the minister of agriculture, and it consists of 17 members: ten representatives of central and local public administration authorities, and seven representatives of education and scientific institutions, NGOs and the private sector (Moldpres, 2020).

The **General Inspectorate for Emergency Situations (GIES)** represents an organizational unit within MIA and oversees disaster prevention, response, relief, and recovery. The GIES was focused mostly on emergency response/relief, but PPRD East 2 developed its capacities on prevention, mitigation and preparedness. According to the legislation, the GIES shall implement state policy in the area of civil protection, fire protection, first aid, prevention and elimination of consequences of emergencies and hazards, safe conduct of nuclear

and radiological activities, in order to ensure the safety of the population, property and the environment by implementing uniform and integrated measures aimed at reducing the risks of hazards and emergency situations. The GIES includes both military personnel and civilians who have responsibility for general preparedness. The **Civil Protection Forces** also includes subunits, militarized civil protection units, the division of the Service for Rescue and Fire Protection, specialized units, special institutions and organizations. The direct management of the Civil Protection Forces, aimed at eliminating the effects of disasters, is done by the General Staff of the Civil Protection Forces of the GIES. The specialized units of ministries and departments, aimed at exercising permanent control over the state of the environment, potentially dangerous facilities of the national economy and at eliminating effects of disasters, act according to the provisions of the respective ministries and departments, which are responsible for the state of preparedness of the above-mentioned units to fulfil the tasks allocated to them. Within MAFI, the following departments have links with the GIES: Plant Protection and Food Safety of Vegetal Origin Products and Department of Veterinary Medicine and Food Safety of Animal Origin Products.

The rapid dispatch service of the GIES is the main body that carries out management and coordination of works for territorial dispatch services in cities (towns) and districts on collection, primary processing, generalization and submission to the government of the information on technological, natural and ecological disasters. The rapid dispatch service of the civil protection unit of the city (town) or of the district includes the operational civil protection service of the district and the dispatch service of special units of respective communities, such as: district police commissariats; healthcare units; facilities subject to chemical, accident and fire risks; Moldtelecom (state telephone and communication entity) offices; energy surveillance and electricity networks; the director of Joint Stock Company Apa-canal (water supply); gas networks; heat producing networks; mayor's offices of villages (communes).

Territorial authorities include the Regional Division for Coordination and Guidance of Interventions; search and rescue, for ensuring fire safety at strategically significant facilities; Republican Training Centre; Urban and Extra Urban Reserve Command Service. The intervention subdivisions of the GIES have been established in all district-level territorial administrative units and they are deployed relatively uniformly and proportionally in 36 locations out of 1 681 communities in the Republic of Moldova (a total of 62 subdivisions). The GIES has 2 467 staff.

Local public authorities are involved in coordination with the GIES and other local departments, as well as mobilizing local funds and other resources for relief and recovery operations. In addition, they are charged with emergency planning with the GIES, as well as planning and zoning and construction codes for mitigation of flooding, landslides, earthquakes, and subsurface flooding. MAFI does not have local departments. There are Food and Agriculture departments at the district level, which collaborate with MAFI, however, they are subordinated and are financed by district Executive Committees.

The leaders of public authorities and branch management authorities, public organizations and companies (such as owners of water basins, water users associations, and owners of storage facilities), whose duties include prevention and elimination of consequences of major accidents, calamities, disasters, natural and ecological disasters, epidemics, epizootics and epiphytotics, are personally responsible for collecting, processing and rapid supply of official information on disaster issues to stakeholders. District councils have sections for agriculture that are responsible for use of land and agricultural products. Their activity is oriented towards the increase of efficiency of agricultural products, including support for land consolidation. An important direction in their activity is support for farmers in use of market mechanisms. Local authorities employ cadastre engineers, who deal with land disputes, conduct anti-sliding works and other activities related to the use of land and soil. However, local authorities do not have sufficient capacities to perform their duties relating to the planning and implementation of initiatives for agriculture sector development. Busy agendas, insufficiently qualified personnel, and limited technical and financial resources, are barriers to mainstreaming climate change in the policy and decision-making agendas. In general, the disaster response capacity at district and local levels is very weak and therefore support from the central government level is required to enhance disaster response, as well as DRR-related capacities.

The GIES has to prioritize its daily activities by substantially limiting the continuous training component as well as the initial training one. Thus, the logistics for the teaching process, as well as the considerable reduction of the practical training sessions, has a negative impact on the process of preparedness and maintenance of the

operational capacity of the GIES. A lack of decent accommodation, scarce teaching equipment and materials, as well as a lack of specially fitted rooms and spaces, limit the increase of the operational capacity of the GIES, and affect the safety of interventions. The organization and implementation of joint interventions with other emergency services (police, ambulance) is based on general legal and regulatory provisions, but not on a dedicated legal framework.

The **Ministry of Agriculture and Food Industry** is the state authority responsible for the development and promotion of policies and strategies in the following areas: agriculture; food production; food safety. The main responsibilities of the ministry are: to develop and promote policies, normative acts in the areas of its competence; collaboration, according to the national legislation, with foreign institutions in its areas of competence; examination and approval of draft normative acts elaborated by other public administration authorities and sent for examination; elaborating and presenting budget proposals in its areas of competence, elaborating the annual activity plan, as well as annual monitoring of implementation degree by generating and publishing reports; organizing the planning, execution, financial accounting and budget reporting systems within the ministry and, as necessary, within the subordinated institutions; coordination and monitoring of administrative authorities activities, of the subordinated decentralized public services and of the public institutions in which it represents a founder. The ministry collects data from all over the country concerning damage to agriculture by natural hazards. It also promotes crop insurance against natural hazards.

Several MAFI divisions (veterinary medicine and animal origin food safety policy, plant protection and plant origin food safety policy) and services (science, education and rural extension service soil and underground protection) are to a greater or lesser extent related to DRR or disaster risk management. However, they perform their own activities and there is weak harmonization among them. Regarding the risks posed to agriculture from drought, ongoing MAFI activities relate to its commitment to the improvement of irrigation systems and soil erosion control, and are supported by development partners.

On behalf of the Government of the Republic of Moldova, MARDE (currently MAFI) was in charge of implementation of the Sendai Framework for DRR and international environment treaties to which the Republic is party. In 2017, as part of government reforms, the Ministry of Construction and Regional Development was renamed the Ministry of Agriculture, Regional Development and Environment (MARDE), absorbing also MAFI and the Ministry of Environment. In 2021, MARDE was again split and reorganized into three ministries – for agriculture (MAFI), environment, and infrastructure and regional development.

The **Agency for Geology and Mineral Resources of the Ministry of Environment** is responsible for state policy in the field of geological research, rational use and protection of the subsoil, exploration, monitoring, and mapping of mineral wealth, landslides, and groundwater level.

The **Special Service for Active Influence on Hydrometeorological Processes**, and the **Agency for Intervention and Payments in Agriculture** (AIPA), **Apele Moldovei agency** (Moldova Water), **Moldsilva agency** (Forest Agency) and the **State Hydrometeorological Service**, are responsible for disaster risk management and described below.

The Special Service for Active Influence on Hydrometeorological Processes, established in 1964 and employing a total of 1 169 people, organizes and implements work aimed at active influence on clouds in order to reduce the damage caused by hail. The basic tasks of the service are: state regulation in the field of active influence on hydrometeorological and other geophysical processes; development of technology and methodology documentation, monitoring in the field of active influence on hydrometeorological and other geophysical processes; department-level control over compliance with requirements of standards, regulations and norms related to active influence on clouds; and implementation of works to combat hail. The special units are basic divisions that carry out hail protection works directly on specific areas of the territory, in different districts. The structure of each unit includes groups that carry out works of active influence on clouds with hail danger. The number of missile points in each special unit is determined by the hail protection area and by the tactical-technical capabilities of the anti-hail missiles.

The **AIPA** is an administrative authority under MAFI tasked to manage financial resources to support agricultural producers, monitoring of funds distribution, and quantitative and qualitative evaluation of the impact of support measures to farmers by the state. It is responsible for the efficient management of the National

Agricultural and Rural Development Fund, in the following areas:

- investments in agricultural holdings;
- investments in the processing and marketing of agricultural products;
- investments in physical infrastructure and rural services;
- advanced subsidies for start-ups; and
- direct payments in supporting agriculture and the rural environment.

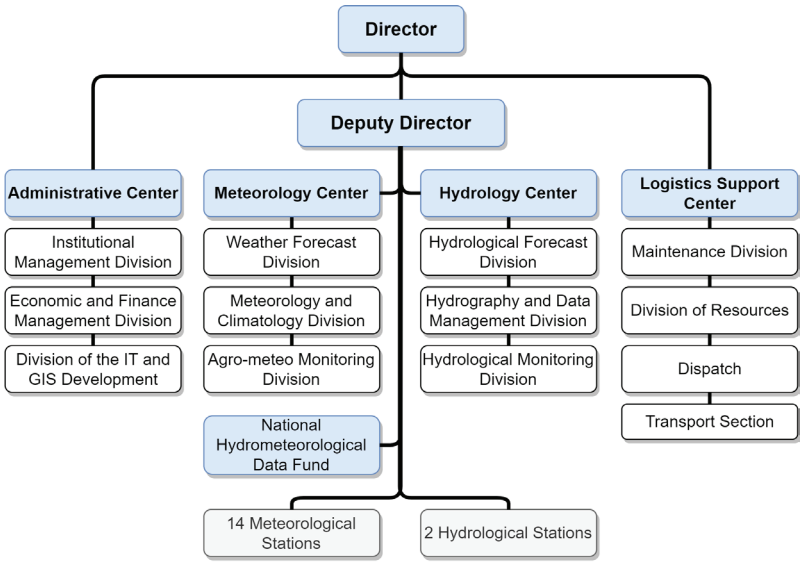
The agency is responsible for subsidizing insurance premiums for the insurance of crops and perennial plantations against any risk or group of risks in compliance with the list of eligible risks and eligible agricultural crops validated by the Commission for Emergency Situations.

The agency **Apele Moldovei (Moldovan Water)** is the administrative authority within the Ministry of Environment responsible for planning of water distribution, mitigation of flooding and waterlogging, the provision of irrigation and drainage services, and evaluation of water use and water rights, as well as developing national water policy. It is responsible for prevention and rehabilitation of areas that are at risk or have been flooded. It is unclear whether responsibility for management of drainage systems to prevent sub-flooding lies with local governments or with Apele Moldovei.

The agency **Moldsilva (forest agency**) is a state institution within the Ministry of Environment responsible for forestry policy development, and monitoring and management of state forestry resources. This includes the establishment of new forests, management, protection, preservation of forests and wildlife and biodiversity conservation throughout the country, research and monitoring of forest ecosystems and the rehabilitation of degraded and eroded farmland via afforestation programmes. According to the Forest Code, Moldsilva has the authority to develop, approve and assess forest management plans, while the Ministry of Environment has an oversight role on forest protection and use, though it lacks staff to fulfil effectively its mandate. Moldsilva carries out afforestation works to stabilize landslides and prevent erosion, as well as overall management of the national forest estate.

The **State Hydrometeorological Service** (SHS) is a national institution under the subordination of the Ministry of Environment. It monitors, forecasts and issues warnings related to meteorological, hydrological, and agrometeorological hazards. The meteorological department operates and maintains the system of posts and stations and issues public forecasts, including hazardous meteorological and hydrological phenomena (according to Law no. 1536-XIII of 25 February 1998 on hydrometeorological activity). Organizational chart of the SHS is presented on Figure 8.

Figure 8. Organizational chart of the State Hydrometeorological Service



Source: based on SHS **(State Hydrometeorological Service).** 2022. *Organizational chart of the State Hydrometeorological Service.* Cited 22 May 2022. http://www.meteo.md/index.php/despre-noi/organigrama/

The tasks of the SHS include:

- monitoring of the environment in order to protect the population from dangerous weather events, to prevent or reduce the damage that may be caused by such events;
- meeting the needs of the population, national economy and defence, as well as those of public authorities, in terms of weather information;
- setting up and managing the National Hydrometeorological Data Fund, necessary for the weather hydrometeorological justification of the design, building and use of various social–economic facilities and for the elaboration of long-term development strategies for the national economy; systematic analysis and synthesis of meteorological, agrometeorological and hydrological conditions, as well as information regarding the degree of environmental pollution in the country, ensuring development and publishing of routine data and awareness-building materials;
- carrying out scientific research in the field of hydrometeorology;
- maintaining, together with the interested bodies of ministries and departments, state records on water resources according to the quantitative indicators and data on water use according to a single system; maintaining the water cadastre;
- participating in the work of the state and department-level commissions to investigate consequences of natural calamities, disasters and accidents caused by dangerous weather events and pollution of air, water and soil;
- providing the observation network with devices and equipment that allow for collection, processing, and dissemination of weather-related information;
- development of regulatory documents and methodologies to regulate weather-related activity in accordance with international norms;
- ensuring compliance with meteorology and standardization regulations, exercising the internal metrology supervision of measurement devices; and
- issuing permits to economic agents to authorize opening of department-level weather stations and posts and exercising control over their activity.

The service includes:

- an observation network consisting of meteorological, hydrological, aerological, aviation-meteorological, agrometeorological and other stations and specialized posts, as well as hydrometeorology centres; and
- the National Hydrometeorological Data Fund.

The Environmental Agency conducts observations of environmental pollution and its consequences in terms of chemical, physical, hydrobiological and radioactive parameters and analysis of obtained data.

The **Agrometeorological Monitoring Centre** is part of the SHS. It conducts agrometeorological monitoring and provides information on agrometeorological conditions, soil state, humidity, phenology and agricultural productivity to various actors, including government, research institutions, and industry. Observations are collected through a network of stations distributed across the country – in total, there are 18 meteorological stations and 20 agrometeorological posts (Starchenko, 2017).[11] The centre provides forecasts on the harvest of the main crops one to three months in advance. Forecasted crops include wheat, maize, sunflowers, and sugar beet. The centre provides the following types of agrometeorological information (SHS, 2019):

- Analysis of the agrometeorological conditions for a week, ten days, month, season (three months), and year.
- Description of the phenomena dangerous for crops (drought and hot dry wind, frost during vegetation periods, hail, rain, strong wind); state of the soil and snow cover on fields in winter, for example the depth of freezing and thawing of the soil, soil temperature, height and density of the snow cover.
- Dynamics of the accumulation of amounts of the active and effective air temperature.
- Forecast of the soil moisture reserves at the beginning of the spring field works.
- Forecasts of the onset dates of the flowering fruit crops and grapes.

[11] The stations are equipped with all necessary equipment and staff and they provide full data on monitoring. The posts are less equipped, with less staff, and the volume of work is much less.

- Forecasts of the onset dates of the crop development phases.
- Information about the conditions of winter crops, fruit crops, and grapes.
- Data on rain and soil moisture reserves.

The main tasks of the National Hydrometeorological Data Fund are to:

- collect, maintain, organize and keep record of observation and hydrometeorological research materials, including departmental organizations data, both from the Republic of Moldova and abroad;
- carry out state registration of departmental hydrometeorological stations and posts;
- develop, based on hydrometeorological observations data, registers, catalogues, and guidelines relevant to SHS activity.

The National Hydrometeorological Data Fund has been storing historical data of meteorological observations since 1886. These data are used to analyse weather patterns across the country and to estimate climate evolution over the period of instrumental observations. The National Hydrometeorological Data Fund is systematized and permanently supplemented with hydrometeorological observations data and relevant scientific research material. The climate database generated from meteorological observations contains the following parameters:

- atmospheric pressure (at the station and sea level);
- air temperature (average, maximum, minimum);
- air humidity (partial pressure, relative humidity, dew point deficit);
- wind (direction and speed);
- meteorological visibility;
- precipitation;
- nebulosity (cloud type and height);
- soil surface temperature (average, maximum, minimum);
- soil temperature at depth on vegetation-free sectors (at 5 cm, 10 cm, 15 cm and 20 cm depth);
- soil temperature at depth on vegetation-covered sectors (at 20 cm, 40 cm, 80 cm, 120 cm, 160 cm, 240 cm and 320 cm depth);
- snow layer (height, density, water content);
- atmospheric phenomena;
- water level in rivers; and
- water flows and the thickness of the ice layer on water basins.

Meteorological data is processed by PERSONA MIS and PERSONA MIP software that processes information in accordance with WMO recommendations and requirements. The climate database is built by using the CLICOM climate data processing system. Weather data from the new automated stations (ADASA, Spain) is automatically classified as two different kinds of weather station tables (TMS and TMP tables) and also as monthly meteorological reports.

The SHS is actively involved in the implementation of the World Climate Program, the World Program of Climate Applications and Services, the Program for Hydrology and Water Resources, organized under WMO, as well as in the activity of the Intergovernmental Panel on Climate Change (IPCC). The SHS became a member of the EUMETNET (EMMA/METEOALARM an OPERA)[12],[13] as of 1 January 2016.

The **National Agency for Food Safety** (ANSA) is an independent administrative authority responsible for implementing state policy in the field of regulation and control of food safety, sanitary-veterinary, animal health, plant protection and phytosanitary quarantine, seed control, quality of primary products, food products and forage. It was established in 2013 based on the merger and reorganization of several institutions with control and supervision functions in the field of food safety. It is constantly informed of the phytosanitary situation of agricultural crops and animals on a national scale and to adopt an appropriate strategy when required to prevent and control plant diseases. In order to organize cooperation with other national authorities, ANSA has concluded a series of joint administrative acts with other agencies and public institutions on exchange of information, implementation of joint actions, and so on.

[12] European Multi service Meteorological Awareness.
[13] Radar programme of EUMETNET.

The **Agency of Land Relations and Cadastre of the Republic of Moldova** (ALRC) is the central specialized authority subordinated to the Government of the Republic of Moldova responsible for developing state policies in the field of land relations and territorial organization, improvement of degraded land, cadastre and real estate assessment, cartography, geoinformatics, photogrammetry, gravimetry, technical prospecting. It is positioned as the national coordinator of the National Spatial Data Infrastructure. All available spatial data (orthophoto images, digital relief model, basic digital maps, etc.) are made public through the thematic geoportal https://geodata.gov.md/. The ALRC owns and manages the INDS *(Infrastructura Naţională de Date Spaţiale)* geoportal and the thematic geoportals that provide free public access to spatial data, namely the geoportal of the national spatial data infrastructure, http://www.inds.gov.md/, and the geoportal of the National Geospatial Data Fund, https://geoportal.md/.

The **State Enterprise Institute INGEOCAD** is the leader in the field of geodesic, engineering–geological and cartographic activities. The main tasks of the institute are: execution of the complex of geodesic and engineering–geodesic works; cartographic and photogrammetric works for providing users with maps at different scales, with various thematic destinations; execution of cadastral works; delimitation and demarcation of the state border. In the field of cartography, the institute achieved the following results – electronic map of Chisinau; digital topographic map of the Republic of Moldova at a scale of 1:200 000; administrative territorial map of the Republic of Moldova; scheme plans of Chisinau, Balti, Orhei, Comrat towns; road map of the Republic of Moldova at a scale of 1:250 000. Through ALRC in cooperation with the European Association of Cartography and Cadastre Agencies, Eurographics, INGEOCAD participates in the development and updating of pan-European digital maps such as EuroRegional Map 1:250 000, Euro Global Map 1:1 000 000, EuroDEM.

Among the achievements of INGEOCAD are the following:

- Implementation of technologies for use of unmanned aerial vehicles (drones) for aerial photography and mapping of the territory for detecting territories and crop areas affected by drought, disease, erosion in agriculture; detection of forest areas affected by disease, fires, illegal logging; monitoring evolution of disasters (flooding, fires, leaks of toxic substances, etc.), assessing damage, environmental impact.
- Development of geographical information systems (GIS), including development of network services for spatial data users; creation of spatial data sets managed by the company – orthophotography, elevation, reference data systems, geographical grid systems, geographical designation, base maps; increasing the technological and technical capacity.

The **Public Services Agency** has the mission to coordinate and organize the activities aimed at ensuring the implementation of public policies in its areas of competence. The competence areas of the agency are the following:

- Information technology, state record-keeping and the state information resources, including the creation, exploitation and registration of state information resources, state information systems, state record of population, transport means and drivers, as well as the production of strict accounting forms and state emblems.
- The state registration of civil status documents and the possession of the national archive fund.
- The creation and maintenance of the real estate cadastre, other information systems and registers in the field, execution of cadastral and real estate evaluation works, administration of the real estate cadastre central data bank, state registration of real estate and ownership rights thereof.
- The regulation through licensing of entrepreneurial activity in accordance with the legislation.

The **Academy of Sciences of the Republic of Moldova** (ASM) organizes scientific research (natural and social sciences, including on DRR) in the field of improvement and development of a national system for monitoring, mapping of areas susceptible to disaster, and proposes scientific measures, including to mitigate impacts on agriculture. The Republic of Moldova has a number of research and academic institutions dealing with climate, soil, agriculture, irrigation, forest protection issues, including the Institute of Ecology and Geography, Institute of Geology and Seismology, Institute of Pedology, Agrochemistry and Soil Protection N. Dimo, Institute for Plant Protection and Ecological Agriculture, Research Institute of Field Crops Selectia, Institute of Horticulture, State Agrarian University of the Republic of Moldova, Institute of Forest Research and Planning, State University of the Republic of Moldova, and Tiraspol State University.

Agriculture extension services are developed through a network of non-state institutions and farmer organizations. Extension services are offered by the National Agency for Rural Development (ACSA); the Federation of Agricultural Producers from the Republic of Moldova (FARM); the National Farmers Federation of the Republic of Moldova (NFFM), and the UniAgroProject. Farmer advisory services provide ad hoc consultations, seminars, and training on a wide range of topics (such as agriculture technologies, fertilizer and pesticide use), but to a much lesser extent on DRR and climate-change adaptation issues such as irrigation management, and conservation agriculture. There are multiple issues faced by the extension services that hinder their performance and limit the amount of help they can provide, due to the limited number of extension specialists, ageing extension specialists with limited IT skills, insufficient financial investment in agricultural training centres and facilities; and limited knowledge of DRR and climate-change adaptation in agriculture.

Organizations in the field of agriculture and rural development have united under an institutional umbrella – the **National Network for Rural Development in the Republic of Moldova**. The meeting for the establishment of the network took place in 2018. Within the network, facilitation and strengthening of participation in political dialogue in the national agro–rural context is ensured. Stakeholders will have the opportunity to communicate with national authorities on agro–rural policy and propose initiatives for improved performance of the agriculture and rural development sector, and to develop common positions between local actors and their representative bodies. The network will act as a bridge between public authorities and representatives of local stakeholders, but will also strengthen the capacity of member organizations to provide feedback to the administration on the situation in the rural sector. The network involves both the private sector and civil society, as well as the central and local public authorities. The network has ten regional platforms in the country. Among the members are FARM, the NFFM, and UniAgroProtect.

Agroenvironmental NGOs have an essential role in the training of trainers and farmers on water, soil, forest and biodiversity protection, sustainable agriculture, environmental protection, and climate-change issues. These organizations include BIOS, BIOTICA, Cutezatorul, EcoContact, Ecological Movement of the Republic of Moldova, EcoTiras, National Environmental Center, and ProRural Invest.

Agro TV Moldova is the only television channel with dedicated programmes on agriculture and rural development, and to a lesser extent on DRR and climate-change adaptation.

There is a lack of a sound institutional framework and coordinated approaches between central and local government for handling disaster preparedness and mitigation (UNISDR and World Bank, 2008). This is one of the main reasons for the low efficiency of actions. The local institutions responsible for the use of land and water resources, such as water user associations for irrigation and others, are not part of the institutions included in DRR activities, which reduces the efficiency of actions intended to reduce the risks of agricultural disasters at local level.

There is a lack of clarity regarding the roles and responsibilities of the Ministry of Environment as the national focal point responsible for the Sendai Framework activities, and MIA, which is responsible for the development of the NSDRM. At present, the Republic of Moldova does not have a national platform for DRR, which would bring all relevant stakeholders from various sectors together and would facilitate interinstitutional coordination, collaboration and communication to advance its national commitment to reduce disaster risks as a member of the Sendai Framework for DRR 2015–2030.

Virtually all agencies involved in disaster management experience a lack of financial resources to procure and properly maintain relevant equipment that currently is mostly obsolete, and to develop and implement programmes and plans toward prevention, mitigation and response to natural hazards. Taking into account the impact of disasters on the national economy and their increasing frequency, as well as the state of the institutional framework, it is necessary to apply a participatory approach and to involve all relevant organizations in the development and implementation of the National Strategy for Disaster Risk Management 2021–2030, which is carried out by UNDP and UNDRR.

Early warning systems in the agriculture sector

Early warning systems (EWS) are a key tool that can be used to reduce the damage that results from natural hazards on agriculture. It is very important that alerts are disseminated through various media, but these warnings also have to be adequately received and understood so that all interested stakeholders, especially farmers and local public authorities, are aware and know what to do, so that the damage can be reduced.

The early warning structure for hydrometeorology in the Republic of Moldova is focused around three main components: (i) the monitoring of the network of surface hydrological and meteorological automatic stations; (ii) the satellite and internet components of the WMO-Global Telecommunication System; and (iii) the analysis and forecast centre based at the SHS meteorological forecasting centres at all the stations. The SHS issues warnings on weather-related hazards. The GIES assists with dissemination of these, as they may entail mobilization for possible intervention and relief effort where needed. Communication among agencies generally happens via standard means such as telephone, fax, and mobile phone.

The National Meteorological System reproduces, on a countrywide level, the global meteorological system. It is of a complex nature and ensures recording, transmission and processing of meteorological information, according to internal needs, directives and agreements of the WMO and other bilateral treaties and conventions to which the Republic of Moldova is party. The information obtained from monitoring is used for meteorological, agrometeorological, and water and soil pollution assessments, for warning on hydrometeorological disaster phenomena, for the assessment of climate change in the Republic of Moldova, and for supplementing the National Hydrometeorological Database.

The SHS terrestrial monitoring network includes 118 hydrometeorological stations and posts. Observation of meteorological, hydrological and agrometeorological parameters is carried out in a non-stop regime at stations and posts. The permanent observation points form the network and are equipped with the same type of equipment and operate in accordance with the international classical method. The placement of hydrometeorological stations and posts on the territory of the Republic of Moldova is in line with the international requirements contained in the WMO Global Observation System Manual. The number of weather stations located on the territory of the country is close to optimal density and is in line with international standards. However, considering that the Republic of Moldova is a country with a high risk of extreme events, the density of the meteorological network is considered to be slightly below optimum.

The SHS meteorological observation network includes 18 meteorological stations, 15 agrometeorological stations, and 32 weather mini-stations. The results of meteorological observations received at stations in accordance with the WMO Guidelines include more than 80 measurements, recordings and visual features of different meteorological dimensions. They form the basis of meteorological data banks of all types and destinations, and are used for the development of hydrometeorological forecasts, providing consumers with the information on actual meteorological observations in the observation points, notifications and warnings on dangerous phenomena and natural hazards, as well as for describing the local meteorological regime and climate.

Semi-automatic stations with software called SAIM Pogoda and produced by a manufacturer called Vaisala were installed at 14 weather stations from 2004 to 2008. They measure air temperature and humidity, atmospheric pressure, wind speed and direction, soil temperature up to 5 cm depth, and transmit promptly the operational information in non-stop automatic mode. Other meteorological parameters are measured by using classical equipment. The national meteorological network was modernized in 2016. New automated weather stations produced in Spain by a manufacturer called ADASA have been installed at 14 weather stations, measuring all the basic meteorological characteristics, as well as the amount of precipitation. Actinometric observations

(direct, diffuse and summary solar radiation, radiation balance and the underlying surface albedo) are carried out at the meteorological station in Chisinau. In 2016, the automatic actinometric complex was installed to measure all solar radiation components. 32 automatic weather stations were installed the same year in different districts of the country, measuring air temperature and humidity, the temperature of the soil at a depth of 5 cm, as well as the amount of rain. Every three hours the basic meteorological information, encoded in SYNOP[14] telegrams, is collected by the Communication and Information Technology Centre. These data are submitted to the Regional Meteorological Centre (in Moscow) to be distributed within the global and regional exchange among WMO member countries. Monthly meteorological information obtained at the four stations and encoded in "climate"[15] telegrams is transmitted to the Regional Meteorological Centre, Deutscher Wetterdienst (DWD, German Meteorological Service) and World Climate Data Centre (Asheville, North Carolina, United States). These data are further used by WMO to prepare monthly climatologic reports and climate modelling in relevant scientific research. Information on the occurrence of dangerous meteorological phenomena or natural hazards, encoded as "WAREP" (the code WAREP is designed for transmission of warnings about hazardous weather phenomena), is promptly transmitted through the Telecommunications and Information Technologies Centre (Chisinau) to the meteorological forecasting centres at all the stations.

In 2010, within the framework of the regional EUMETSAT Project on Data Access for Western Balkan, Eastern European and Caucasian Countries (DAWBEE), the National Meteorological Forecasting Centre was equipped with the DAWBEE station. This station receives and visualizes data by satellite, which allows monitoring of the state of the atmosphere, evolution of cloud systems, parameters of moisture fields, and meteorological phenomena, in quasi real time. The SHS was strengthened in 2013 with severe-weather forecasting capacity by the World Bank Disaster and Climate Risk Management Project (DCRMP), which improved the SHS capacity to monitor weather and issue early warnings of weather-related hazards by providing timely and accurate hydrometeorological forecasts and services. Thus, they developed an end-to-end multi-hazard EWS, which established the forecast and warning system that links data via communications to the forecasting centre as well as to users so that when the forecast centre issues warnings, they reach the person in the flood plain in time to take protective actions.

Another activity in the framework of the DCRMP project was to improve early warning/nowcasting capabilities. Nowcasting is a best-practices procedure of using the latest real-time data, information and model products to issue high-impact short-fused weather warnings designed to save lives from approaching severe weather or flash flooding. This was accomplished by the acquisition of dual polarization Doppler radar technology for localized forecasts; installation of a flash flood modelling system; installation of a meteorological workstation; automation of the existing hydromet-observation system; development of plans for seasonal/climate forecasts. The SHS has a modern laboratory for equipment calibration. In 2016, the installation of the Data Processing, Processing, Editing and Automated Data Production System was completed in the SYNERGIE and METEOFACTORY forecasting process together with Meteo France International. The global observations network (GCOS) includes Chisinau weather station, its data being used for global information exchange. At regional level, data from all stations of the national network are used. Data on adverse meteorological phenomena observed across the country each year are transmitted and included in the WMO Bulletin for Region VI (SHS, 2019; World Bank, 2017).

The following types of communication are used to collect data from the observation network and receive synoptic information:

- internet (data from meteorological stations), at 14 out of 18 stations, 3G modems ensuring a speed of 4.7 Mb/s are installed;
- since 2016, data from the new meteorological stations are transmitted directly (via GSM) to the server installed in the SHS (Chisinau);
- telegraph (data from stations) – Telex Alpha telegraph modem and the corresponding software is installed at the telecommunication centre; this set fully replaces the telegraph and allows receipt of the telegram directly on the computer, and with the possibility of editing it;
- telephone (in case other communication fails);

[14] Surface synoptic observations, a numerical code called FM-12 by the WMO, used for reporting weather observations made by manned and automated weather stations.
[15] A code for reporting monthly climatological data assembled at land-based meteorological surface observation sites to data centres.

- a complex meteorological multi-satellite MITRA, connected to a satellite communication channel that allows receipt of satellite images, maps, data distributed in the form of a meteo-message, as well as operational information;
- a direct channel for transmitting information from the Doppler DWSR-3501C meteorological radar, located on the territory of Chisinau international airport; and
- direct channel to the Regional Meteorological Centre of the WMO (Moscow), using the designed UniMas hardware and software set intended to perform the message switching function; UniMas receives and transmits meteorological data through a direct link channel.

The National Hydrological Monitoring Network (NHMN) has been established with the aim to monitor the situation of surface water on the territory of the Republic of Moldova. It consists of two stations and 54 hydrological posts, 31 in the Dniester river basin, 24 in the Prut river, Danube and Black Sea basins. Daily observations of water level, rain, water and air temperature, water turbidity, seasonal observations of ice formation phenomena, ice thickness, measurements of water flow, are carried out at hydrological posts. Special programmes provide for studies on regional characteristics of the hydrologic regime of water bodies, identification of zonal factors and economic activity impact, development and spreading of the natural hydrological hazardous phenomena, taking into account assurance of national economic organizations. The NHMN provides the information needed to make operational decisions on preventing dangerous hydrological phenomena, water management, as well as development of the river basins' management plan. The NHMN supports the provision of coherent and operational hydrological data for the development of hydrological forecasts, as well as the annual data needed for the development of the Hydrological Directory. Five automatic hydrologic stations were installed under the project Surface Water Monitoring and Flood Prevention on the River Raut in 2006–2008, supported by the Government of the Czech Republic. In 2010–2012, also with the support of the Government of the Czech Republic, 11 automatic hydrologic stations were installed on the river Prut. In 2011, the SHS installed a web server that receives data from automatic hydrologic stations using GPRS and satellite communications. Eight automatic hydrologic stations were installed in 2013 in the framework of the Millennium Challenge Corporation Project, Irrigation Sector Reform, an automated system of monitoring water resources in the Dniester river basin. Another eight automatic hydrologic stations were installed in the Dniester river basin in 2014, under the project Climate Risks and Disaster Management in the Republic of Moldova.

Hydrological information is shared on a regional level between the Danube river basin (DANUBE-HYCOS) and Black Sea (BLACKSEA-HYCOS) states. Long-term intergovernmental agreements and programmes with neighbouring countries, Ukraine and Romania, are of particular importance. These agreements and programmes provide for sharing hydrologic operational information and monitoring of the state of water resources in the Dniester and Prut border rivers.

The Environmental Agency has taken over responsibilities from SHS and presently carries out systematic ecological monitoring of the quality of the environment components (surface water, air, soil, sediments, rain, ambient dose rate of γ-radiation, etc.) through the monitoring network covering the entire territory of the Republic of Moldova. The national environmental quality monitoring system was established in 1960 and systematic observations started in 1980, having the following priority objectives: monitoring of the quality of the environment components and determining the level of pollution; detection of extremely high pollution of surface waters, air and soil; prevention and mitigation of adverse effects on the environment and population by using emergency warning systems; emergency warning of decision makers about the level of environmental pollution; building systematic awareness of civil society about the quality of the environment. Currently, the national monitoring system contributes to solving the most pressing issues related to the quality of the environment, mainstreaming environmental aspects in economic sectors, and promotion of sustainable development. The Environmental Component Monitoring Network includes 72 posts (surface water quality), 19 stations (monitoring of air pollution and radioactivity of the environment), and 37 sections (soil monitoring).

The SHS website, http://www.meteo.md/, contains data on current weather, agrometeorological, hydro-meteorological and weather forecasts, different maps, satellite images and other meteorological and hydrological information, as well as information on environmental quality.

There was an interesting example of cooperation between the SHS and the National Agency for Rural Development (ACSA) in the framework of the World Bank-funded DCRMP in 2012–2014. If the SHS identified potentially hazardous conditions (frosts, high and low temperature, heavy rain, and so on), it published a

warning on its site. Within five minutes, ACSA was forwarding this warning to its regional and local consultants (O'Connell and Kiparisov, 2018). The farmers were then warned by regional and local consultants through SMS and, in case they had subscribed to a special contract to receive such information, also through mobile communication. The following information from the SHS was provided to MARDE (currently MAFI) and ACSA for further dissemination to farmers: weather warnings, hydrological alerts, environmental quality alerts, weather forecast for the next 24 hours and next seven days, decade weather assessment and soil moisture reserves, and meteorological forecasts (SHS, 2019).

The agency (ACSA) developed the Agricultural Marketing Information System (AMIS in English, SIMA in Romanian) in the framework of the DCRMP, where ACSA was selected to provide services, and SIMA was modified in order to include early warning and an online communication platform (PACT). Thus, ACSA disseminated meteorological information through the SIMA-PACT system during the project implementation period, 2012–2015. The goal of the SIMA-PACT system was to provide information related to agricultural business, marketing services and markets to interested parties, including all public information from the SHS. The agency (ACSA) signed a contract with GSM providers ORANGE, MoldCELL, and UNITE, in order to provide the above information to interested parties via mobile telephone. In 2012, ACSA tested this option through 100 subscribers of the above-mentioned companies. Beneficiaries were asked to fill in a user profile, and ACSA provided five packages for the duration of the project, including:

- *Alerts*, which is mainly for local public authorities;
- *Professional*, which is for farmers and is devised depending on their interests – annual farm crops, vegetables, orchards, vineyards;
- *Informational*, mainly for MAFI and district executive committees;
- *Special*, mainly for the food-processing industry; and
- *Extension*, which is mainly for the ACSA network.

Between 2012 and 2017, SIMA served 1 195 subscribed users (SMS services – weather warnings, hydrological alerts, environmental quality alerts, weekly market prices and weather forecast for the next 24 hours and next 7 days) and over 23 000 customers registered with SIMA-AMIS (online access – decade weather assessment and soil moisture reserves, and meteorological forecasts). Just one example of the potential aniticipatory effect of SIMA's activities could be the weather warning from 10 October 2014. The SHS issued a weather warning regarding the worsening weather conditions (rain, sleet, wind intensification), notification of which was sent out in real time via SIMA to 996 farmers and local public authorities (SMS service) and duplicated via the SIMA-PACT newsletter. Thus, farmers and local public authorities had at least 12 to 14 hours to respond to the bad weather conditions – ensuring access to food for animals in the immediate vicinity of farms, sheltering agricultural products harvested from the field, equipping means of transport, and so on.

The costs of the packages were as follows – alerts cost about USD 12, the professional package USD 73, informational USD 20, special USD 40, and extension USD 12, which were subsidized through the project. Individual users and organizations bought the packages. When users (in particular farmers) negotiated the contract, they were able to reduce the costs by excluding some of the package. Small farmers considered the price too high, while 240 large farmers bought automatic agrometeorological stations. On the other hand, 90 percent of the cost of the service went to the mobile phone companies and only 10 percent to ACSA, which did not cover the costs incurred by them. The initiative therefore did not achieve any continuity (A. Fală, personal communication, 2020).

Market information

One of the main problems for Moldovan producers and processors is a lack of market information. This results from poor links from primary producers to end markets and poor communication down the value chain. Growers are fragmented and do not have long-term relationships with traders (the actors in the value chain that have the most market information). Producers require information on varieties, colours, size, weight, and plant protection practices required in end markets. They also need information on the markets in which Moldovan produce can likely be more competitive, taking into account market demand and competitors.

The structure of how Moldovan agricultural produce is marketed, and lack of market information, also impedes the sector's competitiveness. The large majority of farmers sell their produce at the farm gate, which limits their choices and market power. A World Bank horticulture study found that "in 2012, for example, only a third of the total fruit marketed and a fifth of the vegetables were bought by enterprises and organizations that collect and process agricultural produce" (World Bank, 2015c). The prices typically paid at the farm gate are enough to provide a positive margin to the farmer, but not much more than that, thus limiting the profits that farmers could use to invest in improvements. Producers that do not sell directly at the farm gate usually go to open-air wholesale markets, which may also provide limited opportunities and low market power for producers. Typically, only the largest producers sell to traders in wholesale or export markets. At times, the largest producers may also export directly.

AgraVista is an online information portal in the Republic of Moldova that delivers specialized analytical information on high-value products (including crop and livestock products) to guide agricultural producers towards attractive and competitive markets (www.agravista.md). It includes: daily news and comments on the market; wholesale prices on domestic and foreign markets (Poland, Romania, Ukraine, the Russian Federation); analytical information on market trends, marketing studies; commercial calls for bids, and bids; a database on companies; AgraVista electronic newsletter; information about exhibitions, conferences, thematic forums. Every year, AgraVista is accessed by over 100 000 unique users from over 100 countries, which includes farmers, private companies and associations, although the majority is from the Republic of Moldova. The information is distributed through thematic electronic subscriptions. Partnerships with 26 international systems (APK-Inform, Fruit Inform, the Republic of Moldova Chamber of Commerce and Industry, Foundation for Promotion of Small and Medium Enterprises from Galati, Romania, the Regional Fund for Entrepreneurship Support of Odessa Region, CNFA, Agra Informa) ensures a flow of information, which is rapid and dynamic. It focuses on trends and fluctuations of international markets. AgraVista is a product of the Federation of Agricultural Producers from the Republic of Moldova (FARM) that inputs and provides information on the connection between the business environment and agricultural producers. At present, FARM provides the extension services instead of ACSA. Beneficiaries of this agricultural portal can place ads on offers of produce or calls for such offers, and view quantities and commercial prices. There is also vast information on agricultural legislation, analyses and comments on trends of agricultural markets, export terms and conditions, as well as certification requirements.

Within the USAID 2016–2021 project High Value Agriculture Activity (HVAA) in the Republic of Moldova, guidelines were developed – Developing an Online Sales Channel for Producers and Offline Outlets. This manual describes all the stages of launching one's own online business-to-consumer (B2C) sales channel, from search of customers to logistics, and recommending ready-to-sell products to existing companies. The manual describes different methods of organizing each stage of online sales, so that companies with different resources, budgets and teams can benefit and obtain additional profit from the online sale of their products (Agrobiznes.md, 2020). Moldovan growers and exporters need deeper market information in order to compete on the regional markets.

Challenges for improving and developing early warning systems

The SIMA-PACT system worked very well in 2011–2015 when it was supported by a World Bank project. Until 2020, the system is still operational. It was connected to the SHS and provided meteorological, hydrological and environmental quality warnings, description of hazards, impact modalities and damage, weather characteristics and agrometeorological forecast related agricultural crops by stage of growth and season. Unfortunately, the beneficiaries did not want to pay for such services and currently ACSA provides the services only to its own subsidiaries in territories and to a few farmers. Currently, mobile phone companies provide free information on weather hazards, but nobody gives the farmers any advice on what to do in such conditions. The agency (ACSA) had a data exchange agreement with the Civil Protection Agency and with the SHS (A. Fală, personal communication, 2020). In the current conditions, at least two communication channels (national and regional mass media and all mobile phone operators) provide real time information and weather forecasts and alerts. Based on these considerations, only the Cell Broadcast Service can be actual for earthquakes or technogenic situations with a short reaction time.

The SHS provides meteorological, agrometeorological and hydrological information to central and local public authorities, the national economy and the population of the Republic of Moldova based on the Annual Hydrometeorological Service Scheme. Since 2018, the call for provision of extension services within MARDE (currently MAFI) has been awarded to FARM. The SHS does not have direct cooperation with FARM. There is no relevant budget line in agriculture for the SHS, so currently the official extension service of MAFI does not provide meteorological information to farmers.

Considering the occurrence of hydrometeorological hazards in the Republic of Moldova, the country requires consolidation of long-range forecasting for hydrometeorological information. Numerical modelling software for issuing weather and hydrology forecasts, modelling software, as well as spare parts for existing equipment, are necessary. Financial constraints limit the country's implementation of systematic approaches to detailed risk assessment, mitigation measure preparation, and development of EWS. Consolidation of institutional and legal backgrounds, such as the development of a national strategy for mitigation of hydrometeorological hazards risk, needs to be in place for the country as a proactive step towards disaster preparedness and mitigation. Considering the small size of the country, regional cooperation is very important for disaster preparedness and mitigation. The SHS is also facing the following problems:

- Maintenance of equipment (repair, calibration, verification, compliance with standards), but also accreditation services according to the standards of the quality management system.
- Updating, developing and acquiring new software, developing new products for consumers.
- Restoring aerological observations, performing bathometric measurements.
- Establishment of two hydrological stations on two water basins (Prut river and Nistru river).
- High fluctuation of SHS staff due to low and demotivational salaries.
- Lack of faculties for professional training of meteorologists and hydrologists in Moldovan universities.

There is an urgent need to solve the above-mentioned problems in order to collect and disseminate EWS information and take the necessary DRR and climate-change adaptation measures.

A number of recommendations to overcome these challenges were proposed in the Final Report of the subcomponent C1, Early Awareness and Communication Platform integrated with the Agricultural Marketing Information System (ATMOS-AMIS). These particularly include:

- For government and the National Regulatory Agency for Electronic Communications and Information Technology of the Republic of Moldova (ANRCETI), to develop a regulatory mechanism

or supplement laws and regulations on the activity of mobile operators in the country, for developing and supporting Cell Broadcast Service.

- For the government and ANRCETI, to develop a regulator mechanism of obligating mobile operators to invest in new equipment capable of relaying a larger number of SMS and MMS warnings than is possible now.
- To integrate the SHS radar and radars of Special Service for Active Influence on Hydrometeorological Processes in a unique system for early identification of risk of hail and giving primacy to the SHS for notifying about precise locations to local public authorities and economic agents.
- To unify and use a unique nomenclature for codification of risks from different types of natural and human-made hazards, based on the coding as after weather as well as by location.
- To develop and propose for approval by the government a decision to create the legal framework and the allocation of financial resources (either from the consolidated budget, or the local public authorities) for payment for telecommunication real-time dispatch of alerts regarding disaster risks through mobile operators.
- To connect the service phones of responsible persons or equip with special automatic alarm devices and voice message information (offices) to issue orange and red weather codes.
- To develop further the Forecasting Diseases and Pests interface by establishing a network of automated forecasting warning stations with software for issuing notifications to inform farmers, which would bring added value and more relevant financial sustainability to ATMOS-AMIS.
- To develop projects for interconnection and integration with regional marketing systems, in order to facilitate access to information in the field of agro-operative information from potential European Union markets.
- To develop specialized training (lasting three to four days) for members of regional commissions for observation and evaluation of damage caused by natural disasters, to provide instructions and inform their members about the methodologies for attesting the force majeure and for assessing the degree of damage and injury to sectors and crops by natural hazards.

Agrometeorology services for the agriculture sector

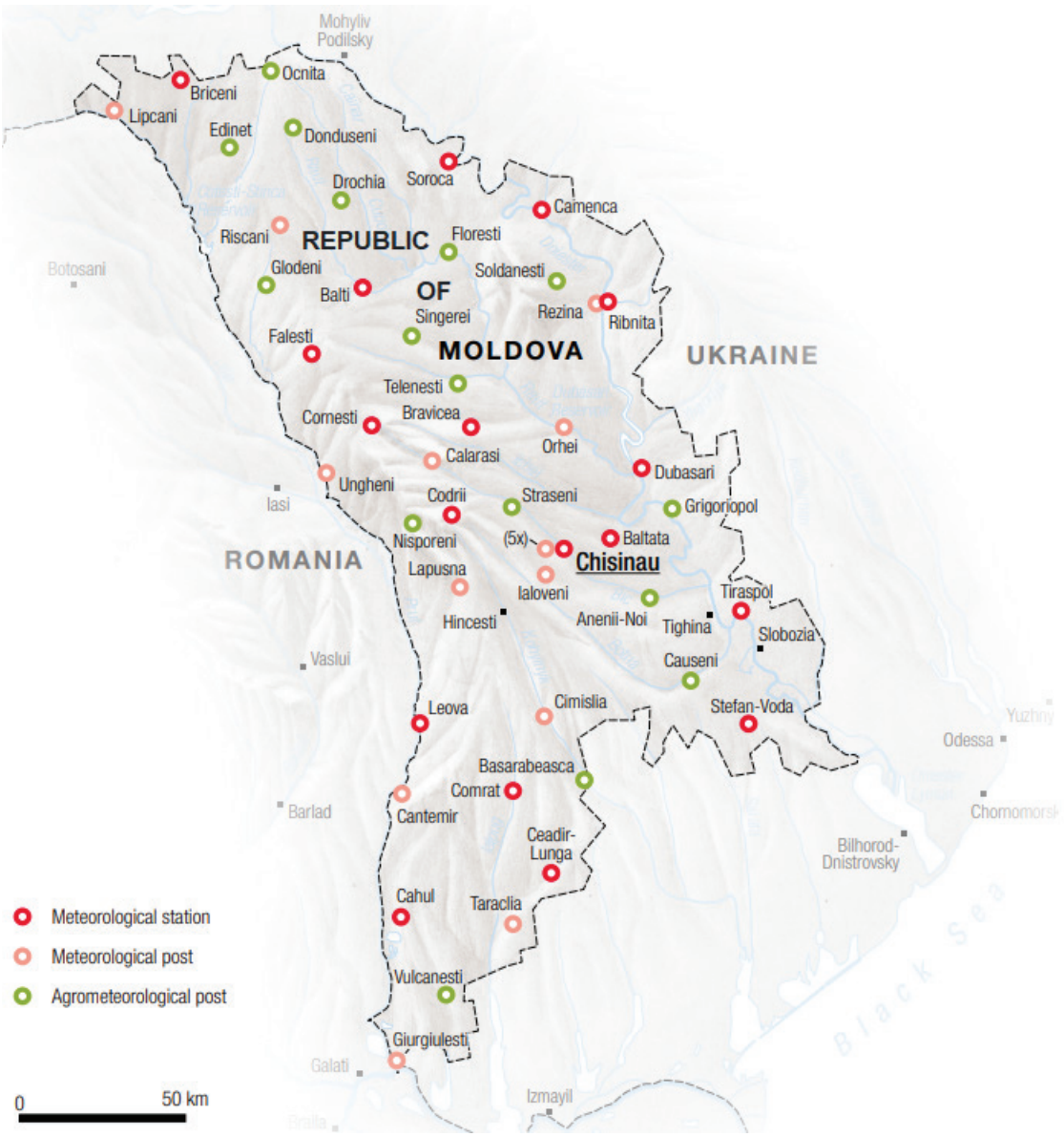
Agrometeorological monitoring is a system of observations of agrometeorological conditions, soil condition and moisture reserves in the soil, agricultural crops development, and productivity rate. The operational information received serves as a basis for the estimation of the weather conditions and their effect on the state and productivity of agricultural crops, modelling of the production process and projection of agricultural crops growth, development and yields, as well as development of agrometeorological recommendations for making operational and optimal decisions by agricultural producers. At present, agrometeorological monitoring is done at 13 meteorological stations and 15 agrometeorological posts in the Republic of Moldova (Figure 9). At meteorological stations and agrometeorological posts within the National Observation Network, observations are carried out by the following parameters – soil temperature in farmland; soil moisture up to a depth of 100 cm; observations and measurements on the soil condition and the snow layer during the cold period (depth of soil freezing, depth of soil thawing); observations on the thickness and density of the snow cover on farmland during the winter period; agricultural crop development phases; determining crop production inputs. The SHS also monitors soil drought. Observations of complex meteorological elements are made at the same stations and posts.

In 2016, the agrometeorological network was upgraded with new equipment for determining soil moisture (Delta-T). Delta-T Profile Probe PR2/6 in combination with the HH2 Moisture Meter reader are used to measure soil moisture. This device measures the volumetric moisture content in soil, the accuracy being ± 0.04 m3.m-3 (4 percent). The Probe PR2/6 model used in the Republic of Moldova allows measuring soil moisture at six levels – 10 cm, 20 cm, 30 cm, 40 cm, 60 cm, 100 cm. The data collected as a result of agrometeorological monitoring is used for the drafting of agrometeorological prognoses (future crop yield forecasts), for assessing the influence of meteorological conditions on the growth, development and formation of the crop yields during the vegetation period, the state of crops during hibernation. The main crop (autumn wheat, corn, sunflowers, sugar beet) yields are projected in advance from one to three months, which allows an assessment of the expected production situation in the country in advance. Agrometeorological monitoring is performed to provide information to the government, the National Bank, agricultural associations, farmers, and others.

All agrometeorological information is available on the web page of the SHS. Some services are free, while others are provided at a cost, according to Government Resolution No. 330 of 3 April 2006 “on approval of the lists of paid and free services provided by the State Hydrometeorological Service and the procedure for the use of special funds State Hydrometeorological Service”. Paid services particularly cover specialized meteorological information, actinometric data, aerological data, agrometeorological information (such as soil temperature, soil moisture, depth of freezing and thawing of the soil, phenological observations, crop productivity, crop yield structure, the state of agricultural crops), and hydrological information. The SHS provides some agrometeorological information for a fee, which varies from USD 2 to USD 10 (according to Government Decision No. 330), on a list of services to be provided by the SHS free of charge and for a fee, and on the use of SHS special funds.

Starting in 2010, the SHS established a four-colour scale, which represents the graduated risk of forecasted dangerous hazards. On the SHS website (www.meteo.md), the “Alerts” section describes in detail the risks and recommendations for each code for all dangerous hazards, mentioned above, which are possible on the territory of the Republic of Moldova. The weather stations cooperate with local public authorities and provide to them information upon request. The SHS informs the recipients by developing specialized daily, weekly, fortnightly, monthly, quarterly, and biannual forecasts, as well as annual reports of a more detailed nature. Farms receive information from the SHS through the SHS website and the media, or the SHS provides specialist information upon request.

Figure 9. National network of agrometeorological monitoring



NOTE: The boundaries and names shown and the designations used on these map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries.
Source: **Zoï Environment Network.** 2019. *Concept and action plan for Climate Services in the Republic of Moldova.* https://zoinet.org/wp-content/uploads/2018/01/Concept-Action-Moldova-WEB.pdf

The following agrometeorological parameters are monitored and measured at 14 meteorological stations, 13 meteorological posts, and 15 agrometeorological posts (SHS, 2019):

1. Soil temperature in agricultural fields:
   - at the depth of the tillering node;
   - arable layer at a depth of 5 cm; and
   - arable layer at a depth of 10 cm.

2. Soil moisture:
   - instrumental in layer 0-20 cm;
   - instrumental in layer 0-50 cm;
   - instrumental in the layer 0-100 cm; and
   - top layers of soil.

3. Conditions of the soil and snow cover in the winter period:
    - soil freezing depth;
    - soil thawing depth; and
    - height and density of snow cover in wintering crop fields.

4. Development of crops phases.

5. Conditions of crops:
    - crop density;
    - plant height;
    - growth of tubers and potato tops;
    - root growth in sugar beet and forage swede; and
    - growth of perennial, annual seeded herbs and grass mixtures.

6. Elements of crop productivity.

7. Crop structure of agricultural crops.

8. Inspection of wintering crops:
    - autumn survey of winter crops and perennial grasses;
    - spring survey of winter crops and perennial grasses;
    - ripening of wood of fruit crops and grapes in autumn;
    - viability of winter crops and perennial grasses in winter; and
    - viability of branches of fruit crops and grapes.

9. Observations of crop damage by adverse meteorological phenomena, agricultural pests and diseases:
    - damage to crops from various factors during active vegetation of plants;
    - monitoring of the moisture content of grain and straw and the germination of grain during harvesting of grain crops; and
    - assessment of the extent of weed spreading.

10. Observations on the conduct of field work.

11. General visual assessment of the status of crops.

12. Quantitative assessment of the status of crops.

However, the SHS does not provide actionable agricultural advice to farmers on management and prevention measures, mitigation or preparation for certain natural hazards in order to reduce the adverse impacts, such as on what to plant (types, species, varieties), or when to plant, or by supporting informed decision making.

Collected agrometeorological data is published in yearbooks (since 1955) and agroclimatic guidelines. Hydrometeo Services has started to digitalize the agrometeorological data that will be conducted gradually. The availability of such information results in an increase in agricultural production as it supports more rational distribution of agricultural enterprises and introduction of best practices, taking into account changing conditions (SHS, 2019). The main users of the data and information provided by the Agrometeorological Monitoring Centre include (SHS, 2019):

- central and local public authorities;
- agricultural organizations: associations, farmers and individual producers of agricultural products;
- Service of Civil Protection and Emergencies;
- National Agency for Rural Development (ACSA);
- forestry agency Moldsilva;
- insurance companies;
- research institutions;
- ecological organizations; and
- population through mass media, web page (http://www.meteo.md/).

The rationale for the organization of anti-hail works in the Republic of Moldova was based on the considerable and systematic hail-related losses in the agriculture sector. According to data of the Institute of Scientific Research in the field of economics and Organization of Agricultural Production, over the 1955–1981 period, an area of 257 300 ha of farmland (12 100 ha of every 100 000 ha) was affected annually. In some regions, the area affected by hailstorms was in excess of 25 000 ha per 100 000 ha. The annual economic damage from hailstorms, prior to the beginning of the organization of hail suppression activities, was between USD 80 million and USD 100 million (Abshaev and Safarov, 1991). The experimental works carried out over the 1964–1967 period, using the missile method, showed effectiveness and opportunity in implementation of hail protection in the Republic of Moldova, with its extension to regions where hail events were more frequent. In 1990, an area of 2.5 million ha, or 70 percent of the territory, was subjected to hail protection (Annex IV). The economic downfall of the Republic of Moldova at the end of the 1990s meant that the anti-hail works were practically stopped. Thus, in 2000–2001, no hail protection works were carried out in the country. The losses caused by hail for the above-mentioned period were in excess of MDL 400 million, although hail processes were of low intensity. The estimated enormous damage has shown repeatedly the need to restore and improve hail protection infrastructure. Starting in 2002, restoration works were started for anti-hail infrastructure. In 2020, the protected territory was 1.665 million ha. A total of 132 missile points are involved in the technological works, which are subordinated to 12 special units (Edinet, Soroca, Falesti, Floresti, Singerei, Cornesti, Calarasi, Hincesti, Cimișlia, Ceadir Lunga, Cahul, Ștefan Voda). The technological process includes nine specialized radars of the MRL-5 type, equipped with an ASU-MRL set of software packages, which are incorporated in a corporate IT network. The time of accumulation, processing and transmission of radiolocation information is up to three minutes. Anti-hail missiles of the ALAZANI-6 type (Russian production) and Loza-2 (Bulgarian production) with an effective radius of about 10 km are used in the operational work (SSAIHP, 2021).

During the 1981–2006 period, about 54 anti-hail projects were implemented across the world, some of which are still ongoing, covering an area of over 90 million ha, including 40 million ha in China, 8 million ha in France, 6 million ha in the United States of America, 2.8 million ha in Spain, 2.5 million ha in the Republic of Moldova (currently 1.6 million ha), 2.4 million ha in the Russian Federation, 1.75 million ha in Bulgaria, 1 million ha in Canada, and 0.5 million ha in Greece. Romania plans to increase its hail protection area to 2 million ha. According to Krauss (2009), in the state of Alberta in Canada, in addition to agricultural crops, the social sector is also protected, using crystallization reagents to remove hail. Such projects are financed by insurance companies. During the protection period, the insurance ratio was 43 percent, compared with the pre-protection payments (SSAIHP, 2021).

Specialized weather forecasts are widely used by the Antihail Service of the Republic of Moldova serving for operational planning of anti-hail operations. They include the following methods (or types) of forecast: forecast of the synoptic situation; analysis of the thermodynamic condition of the atmosphere at the time of maximum development of convection; forecast of development of cumulus clouds, showers, thunderstorms, hail, squall winds; forecast in a mesoregion of the development of hail clouds; forecast of hailstorm intensity; forecast of hailstorm type. Many of these activities are conducted by the special weather forecasters group that is part of the Department of Active Influence of the Antihail Service, although some of them also fall under the auspices of the SHS. Better integration of the above tasks with the SHS could strengthen the hydrometeorological capacity in the country (FAO and WMO, 2018).

Systematic hydrometeorological observations made in the Republic of Moldova over the past 60 to 110 years allows us to summarize the climate data, and to study complex adverse weather conditions. This is needed to successfully combat the negative effects of adverse weather conditions, identify solutions to environmental issues, and ensure sustainable management of the environment. The results of the hydrologic observations are published in places such as the Annual Data on the Regime and Surface Water Resources, State Waters Cadastre of the Republic of Moldova, and Multiannual Characteristics Guide.

Scientific research is also conducted under regional hydrometeorological programmes. Based on regional climate monitoring, the research is focused on the natural and anthropogenic influence on the climate of the Republic of Moldova. Such research fosters climate-change forecasts for the country; and makes it possible to calculate changes in the basic features of air temperature and precipitation. Risks and vulnerability for agricultural industries are assessed in the context of climate change, and adaptation measures for agriculture are identified.

The Department Research Informational Technologies and Geographic Information Systems of the SHS conducts research in hydrometeorology, including ensuring methodological and scientific support to the SHS subdivisions. The staff of the department process and interpret meteorological and hydrological information, including by using GIS. The department focuses on:

- development of scientific materials and methodologies in the SHS activity domains;
- development of scientific publications in the SHS activity domains;
- keeping record of new scientific and practical achievements in the GIS domain;
- mapping materials for forecasts development, analysis of certain hydrometeorological actions or factors;
- mapping materials for the SHS web page;
- digital land use maps, updated on the basis of satellite images;
- spatial maps and different thematic maps;
- thematically dedicated GIS databases;
- GIS info-planes derived products (surfaces of basins and sub-basins, median altitude of sub-basins, afforested areas, afforestation coefficient, and so on);
- altimetric digital model of land and derived products (slopes, expositions, altitudinal levels, topographic profiles, and so on);
- flooding, drought hazard and risk maps, and so on;
- flood risk model in major large and small riverbeds;
- maps with delimitated areas affected by flooding, drought;
- estimates of water reserves in snow layers, volumetrically expressed as median water layer for basins of interest in terms of hydraulic energy and water supply;
- agrometeorological and biophysical parameters of vegetal coverage derived from satellite data (soil surface temperature, actual evaporation, foliar index, biomass, spatial structure, vegetation indices, and so on);
- accidental pollution risk modelling in major riverbeds of large rivers; and
- methodology guidance for use of GIS technologies in the spatial analysis of hydrometeorological phenomena and processes and projections thereof.

Flooding on transboundary rivers, the Nistru and Prut, is relatively easy to forecast because such flooding usually originates in heavy storm rain or snowmelt events in the Carpathian mountains.

The research related to measures suited to non-irrigated areas susceptible to drought are carried out in research institutions. There are some hard-copy MAFI guidelines that are published and available to farmers and extension officers on risk mitigation actions in agriculture related to irrigation, soil erosion, plant protection, drought-resistant varieties, agrotechnical measures that improve soil moisture retention, such as minimum tillage and maintaining vegetative cover, and optimization of sowing and planting times. However, they are developed by researchers who have used scientific terminology and are difficult for farmers to understand. The ongoing World Bank and International Fund for Agricultural Development (IFAD) projects focus on some of these issues.

Challenges for improving and developing agrometeorology services

The Ministry of Agriculture and Food Industry (MAFI) has been considering upgrading and extending the Special Service for Active Influence on Hydrometeorological Process, in which it proposes to increase the protected areas, mainly in the southern part of the Republic of Moldova. So far, the financial resources have not been identified, but MAFI aims to reduce the expenses for maintenance of anti-hail stations, which are estimated at approximately MDL 80 million (USD 4.5 million) per year. In case of installing an automated online system, the costs of maintaining the stations will be reduced by half, and the number of employees could be reduced to 100 people (Report.md, 2016). In reality, this idea has not been implemented successfully, given the considerable cost of the proposed automated anti-hail launchers (about EUR 20 000 per launcher), the insecure management software for guiding the installations, many critical issues related to the quality of devices (as components of the launchers), and the need for essential changes to existing technology. The above-described reasons show that it is impossible to implement automated rocket launchers with existing technology. Currently, the annual cost of protecting one hectare of land from hail in the Republic of Moldova is EUR 3 to EUR 3.50, in the Russian Federation from USD 3 to USD 4, in Serbia and North Macedonia from EUR 3 to EUR 4, and in Romania from EUR 9 to EUR 20 (SSAIHP, 2021).

Abshaev and Malkarova compared more than 50 years of data on crop losses with losses before hail suppression in Azerbaijan, Armenia, Georgia, Northern Caucasus, Ukraine, the Republic of Moldova, Tajikistan and Uzbekistan, where anti-hail rocket systems have been applied. They found that average losses were reduced by between 70 percent and 90 percent in protected areas, depending on the given year and region (Abshaev and Malkarova, 2006). A review of hail suppression activities in the Russian Federation mentions that the efficiency of hail suppression projects there averaged about 87 percent in recent years (Makitov *et al.*, 2017). The efficiency evaluation of the hail suppression project in the Northern Caucasus was carried out according to a technique based on the comparative analysis of the hail damage in the protected area before and during the seeding operations, considering the hail activity of each region is changing from year to year. The authors concluded that hail damage in the protected territory is reduced by 7.7 times in comparison to average values before the beginning of the suppression project. These projects all use rocket technologies to disseminate silver iodide. Similar claims of success have been made in other eastern European programmes. However, it is difficult to assess these claims independently because of the lack of data that support the claims. Most of these claims are based on crop losses and often not conducted by an independent entity unrelated to the hail suppression activities. Although the results seem questionable, from a quantitative perspective it seems to indicate that cloud seeding with silver iodide tends to decrease the potential for severe damaging hail (FAO and WMO, 2018).

The benefits of this technology are not clear. A 2007 World Bank report referred to a US National Academy of Sciences study and to a statement of the WMO Working Group on Physics and Chemistry of Clouds and Weather Modification Research Program. The US National Academy of Sciences study concluded that "there was no scientifically credible evidence that hail can be suppressed." A lack of knowledge and the difficulty of observing the details of a large hailstorm makes it difficult to target observations or to design experiments that can detect induced changes. The WMO working group, in its statement on weather modification in the same report (Word Bank, 2007), notes with regard to hail suppression that evaluation of the results has proved difficult. For those countries currently operating weather modification programmes, the US National Academy of Sciences study recommends that "the decision of whether to implement or continue an operational program is a matter of cost-benefit risk management." Unfortunately, in the Republic of Moldova as elsewhere, there is a lack of reliable estimates of the economic benefits of the anti-hail rocket programme. Hence, a convincing cost–benefit analysis has not been possible. "Given the current level of knowledge about the effectiveness of the anti-hail missile system, it was recommended that the Republic of Moldova refrains from further investment in expanding the system," the 2007 World Bank report states. In spite of the above-mentioned recommendations, the Republic of Moldova continues to invest in expanding the anti-hail missile programme.

There is a lack of local equipment for monitoring climate-related factors and issuing irrigation forecasts, and a lack of equipment for monitoring the condition of dams and irrigation facilities.

Disaster risk reduction in the agriculture sector

Disaster risk assessment

The disaster risk assessment (DRA) is one of the most important baseline documents of comprehensive disaster risk management. Disaster risk assessment methodologies exist at the national and local levels, but they are focused on specific types of disaster. Its compatibility with the European Union DRA Guidelines is only partial, thus further elaboration and updating of the methodology is needed in order to achieve full compliance. The GIES has the responsibility to assess only fire-related risks based on the methodology for the investigation of fires cases (2006) updated in 2022 (MIA and GIES, 2022), while the assessment of other risks is distributed among other governmental institutions that are responsible also for their update. Assessments of flooding (Cazac and Boian, 2008), drought (SHS, 2012) and soil erosion risks (Ministry of Environment and Territory Development, 2000) were developed by MARDE, while the analyses of possible emergency situations at the level of district, municipalities, Autonomous Territorial Unit of Gagauzia, and the impact on population, economy and environment (GIES, 2015) are developed by the central and local public authorities. The GIES prepared a DRA draft project in 2019 (PPRD East, 2019), which is focused on legal and institutional reform, but also on extensive capacity development of all national institutions responsible for disaster risk assessment. The draft project includes: identifying the roles and responsibilities in the risk assessment process, developing a multisector DRA coordinating body on the national level, developing governmental scientific single risk assessment working bodies, DRA capacity development at the national level, developing the necessary DRA tools at the national level, performing the first assessment for the initially selected ten disaster risks, smart disaster risk management capacity development (learning about the DRA results and how to use them as the basis for future DRR), drafting a lessons learned and DRA system on the local level document, and raising public risk awareness.

Spatial planning and scenario studies including hazard mitigation are strongly improved by the use of geographical information technology. Unfortunately, GIS technology is scattered over different institutes. The scenario studies related to climate change are developed by the Institute of Ecology and Geography together with the Climate Change Office within the Ministry of Environment, while the hazard mitigation is developed by the research institutions and agencies in respective fields of activity, such as the ALRC, Apele Moldovei agency, the SHS, the Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo" (ICPA), Institute of Ecology and Geography of the ASM, and the Institute of Forest Research and Planning.

Apele Moldovei agency identifies the flood risk areas and develops flood maps. Countrywide monitoring of landslides and ground waters is carried out by the state enterprise Hydro-Geological Expedition, together with the Agency for Geology and Mineral Resources, and the Institute of Geology and Seismology of the ASM.

Soil erosion monitoring is carried out by the ICPA; forest monitoring by the Institute of Forest Research and Planning. The ICPA developed landslide and soil erosion, hazard maps that is very useful for local governments to reduce landslide and soil erosion effects through land-use policies and zoning and construction regulations.

The Climate Change office of the Ministry of Environment and other research institutions and universities perform climate-change modelling and research with reference to the influence of climate change on agriculture, water and forestry, which contribute to disaster risk assessment, DRR and climate-change adaptation.

A series of publications reflecting different aspects of drought and soil erosion control are published with the contribution of the Field Crops Research Institute Selection, the ICPA, the Institute of Ecology and Geography, and the Institute of Plants Genetics and Physiology of the ASM (Andries and Filipciuc, 2016; Boincean and Dent, 2020; Institute of Ecology and Geography, 2020; Kharchuk, 2020).

Technical assistance offered by the PPRD East 2 programme to the GIES, Ministry of Environment and Apele Moldovei focused on aligning disaster risk assessment approaches and systems that existed in partner countries, including the Republic of Moldova, to the European Union disaster risk assessment good practice based on the European Union Risk Assessment and Mapping Guidelines for Disaster Management. The assessment confirmed that there is a lot of information available, there are specific risk assessment experts, but the cooperation with scientists is limited and response planning documents are related to hazard (and not risk) assessments. There is no comprehensive risk assessment in the country. Different institutions use different methodologies, criteria and data to determine possible consequences of disasters in agriculture and there is not one united disaster risk assessment document that would make risk comparable and risk levels determined at national level. The focus is more on preparedness and much less on DRR, including for agriculture.

The PPRD East 2 programme proposed a different, holistic approach and a comprehensive DRA, one that includes cooperation of all sectors and is used as a baseline for disaster risk management and general development as such. Introducing this approach included a change from reactive to proactive, including a paradigm change from a system focused on responding after a disaster happened to a system focused on DRR – focused on analysing the factors of risk, vulnerabilities and resilience of societies, and then reducing the risks through knowledge-based investments. Only after these steps are accomplished, focus should be placed on preparedness for the remaining risks and on responding to a potential disaster. This approach requires a certain amount of raising awareness and changes in the organizational systems (PPRD East, 2019). The PPRD East 2 defined steps that needed to be taken to include systematic DRA into national regulations and practices. The aim of these steps was to ensure that the national DRA document, once developed, becomes a baseline for future smart decision making, and provides managers with all information needed to make their planning and financing decisions in the future. There are a few prerequisites for this kind of approach to a multisectoral risk assessment:

- a national focal point is a prerequisite needed at the national level to coordinate, motivate and guide all sectors in developing a risk assessment; and
- active involvement of all sectors is needed to make DRA a national effort, to use all available data and knowledge, and to share responsibility for risk assessment and risk management at a later stage. National interinstitutional working groups are a mechanism to ensure this.

Unfortunately, proposed approaches have not been implemented. A national DRA document has not been prepared yet, however, there are sectoral assessments that are part of policy documents, such as the Climate Change Adaptation Strategy until 2020 (2014, updated in 2019), the Concept for the reform of the national system for the management, prevention and reduction of the consequences of floods (2018), and modelling water erosion in the Middle Prut Plain as a support for sustainable development planning (Castravet, 2018).

Preparedness and emergency action plans

The emergency commissions and the GIES create **emergency preparedness and response plans** for a period of five years, which are discussed, regularly updated, and ratified in its meetings. Emergency planning at the district and local levels is updated on an annual basis, based upon public consultations and data collected by the authorities. There are also a number of sector plans; however, not all agencies are involved in the planning process and thus there is a lack of intersectoral linkages.

The plans include a programme for consolidating the rescue and fire service in rural localities for the period 2013–2020 (GoM, 2013, updated in 2015); plans for the management of wetlands under the Ramsar Convention: for the Unguri-Holosnita and for the Lower Dniester sites (2014); Guide for preparing drought management plans, their development and implementation in the context of the European Union Water Framework Directive as part of the river basin management plans (Global Water Partnership in Central and Eastern Europe, 2015); incorporation of climate-change adaptation measures in the strategic documents of the Republic of Moldova; simplified user guide (ADA/UNDP, 2016); the National Plan for training forces and means to eliminate the consequences of exceptional situations and fires (GoM, 2017), flood risk management plans for the Dniester, Danube-Prut and the Black Sea river basin districts for the period 2020–2025 (GoM, 2020b).

In accordance with the Government Decision No. 1076 of 16 November 2010, in case of an emergency, a special commission is to be established. The commission shall consist of representatives of ministries and state authorities, in accordance with Government Decision No. 1340 of 4 December 2001 on Commission for Emergency Situations in the Republic of Moldova and Government Decision No. 1076. The members of the commission (including MAFI) are responsible for collecting information and assessing the consequences within the scope of their competence. The results of the assessment are to be submitted on paper to the GIES using the standard reporting template defined by the Decree of GIES manager No. 139 – eight different reporting templates were developed for various types of disasters: on transport accident (disaster); explosion, danger of explosion; detection of ammunition (explosive substances); chemical damage (radiative); technogenic accident; the emergency situation caused by natural hazards; the exceptional biological-social situation; fire. The GISCUIT IT platform for generating emergency data was developed within the GIES in 2013.[16] It includes for example data on number and total damage (without specification per sector) of the impact of storms, heavy rain, flooding, landslides, drought, epidemics and epizootics (contagious diseases of animals and livestock, mass poisoning of animals and livestock, mass perish of wild animals, agricultural plants attack by pests and diseases), extremely cold winters, late spring or early autumn frost, fires, including wildfires. It is used to show spatial representation of data and the generation of disaster statistics in the form of spreadsheets. GIES registers the data on the platform on the base of the reports received by the commission. The current database comprises data in electronic format since 2013, while historical data exist since 1997. The GIES updates the GISCUIT IT platform.

[16] GISCUIT is a web mapping platform built on powerful, cutting-edge, open-source geospatial components. The goal is to make it as easy as possible to build more secure, reliable and modern web GIS applications. GISCUIT allows users to visualize, share, edit and analyse geospatial data. It has a powerful web-based administrator panel with features like data import, layer styling, user management, permissions management, publishing data and more. It is compliant with the Open Geospatial Consortium standards.

Post-disaster needs assessment in the agriculture sector and food systems

There is currently no systematic post-disaster needs assessment, which includes damage and losses assessment, undertaken for the agriculture sector in the Republic of Moldova. When a disaster occurs, MAFI reacts depending on the type of disaster. The commission in charge for assessing the damage and losses caused by natural hazards includes the following members: representatives of the GIES, District Agriculture and Food Division, local public authorities, head of the enterprise/farm, and insurance company (in case the production is insured). There is a methodology for assessing the damage and losses to agriculture and the reports are submitted to MAFI (MARDE and Chamber of Commerce and Industry, 2020). However, due to the fact that the majority of farmers do not have insurance, they do not receive payments for losses in agricultural production (I. Sirbu, personal communication, 2020). Some activities related to damage and loss assessment have been conducted within the "Comprehensive crop assessment and design of the sustainable drought response" project (TCP/MOL/3802/C1), for instance, training for MAFI and collection of some information in the context of assessment of the impact of the 2020 drought on the plant and animal sector.

In terms of the assessment, the total area of the respective crop (ha or m^2 for greenhouses), damaged area (ha or m^2 for greenhouses), level of damage (percentage), average yield for the last three years (tonnes/ha), compromised (lost) production (tonnes), the estimated value of compromised (lost) production (MDL), are assessed. With regard to livestock, the evaluation is conducted by experts from ANSA and the following data is collected: livestock in heads of cattle, their weight (tonnes), estimated value of the damage (MDL).

The assessment procedure is initiated by the submission of an application/request for compensation by an economic agent (MARDE and Chamber of Commerce and Industry, 2020). Based on the received application, the commission goes to the field to check on the case. On the other hand, there is an operational regulation for each water basin.[17] The local staff of the agency constantly monitors the situation and if the SHS sends them a flood alert, the local staff notifies the agency, and the agency, in turn, notifies the GIES. In addition, every large water basin has both equipment and materials against flooding prepared in advance. In case the flood protection infrastructure is deteriorated, the expertise is provided by a licensed engineer (A. Coronovschi, personal communication, 2020).

Assessment of hail suppression efficiency in the Republic of Moldova is carried out by comparing losses from hail in years with hail suppression, and years with no suppression. This data was collected from government agencies and onsite inspections of plant and crop damage and the relevant area of damage after each hail event. The analyses of the assessment were conducted by a special commission consisting of representatives from agricultural bodies, insurance companies, Antihail Service of the Republic of Moldova, and local and regional administrative bodies (FAO and WMO, 2018). The assessment includes:

- radar real-time assessment of seeding efficiency on each individual hail cloud during real-time seeding in order to make a decision on terminating or continuation of seeding;
- assessment of the damage during the period of seeding for the purpose of determining the potential level of prevented damage as a result of cloud seeding for each hailstorm;
- assessment of the physical efficiency of seeding for an anti-hail season (one year) or the longer-term period for the purpose of determining the potential extent of reduction of losses from hail due to cloud seeding;
- assessment of potential economic impact of seeding during the season or a longer-term period;
- assessment of potential statistical significance of the seeding effect at a certain confidence level; and
- assessment of ecological safety of seeding technology.

[17] Decision of the Government of the Republic of Moldova no. 1202 of 08.11.2001 regarding some measures to regulate the use of water basins (https://www.legis.md/cautare/getResults?doc_id=85497&lang=ro). Decision of the Government of the Republic of Moldova no. 51 of 16.01.2007 regarding some measures to improve the activity of the fishing branch and to regulate the way ponds are used (https://www.legis.md/cautare/getResults?doc_id=62207&lang=ro).

There are some methodologies for calculating disaster damage and loss in agriculture, such as soil erosion loss, which were developed by the ICPA. Most damage and losses are borne by individuals (usually the rural poor) as compensation is rarely made, with the following three exceptions: a) in case of an earthquake, the government mobilizes exceptional funds for partial compensation of physical and indirect losses; b) a reserve fund is set aside annually by the central and local government, and managed by the GIES, to provide disaster relief for localized exceptional events (flooding, extreme climatic events) – usually agriculture is one of the sectors that receives emergency support. These funds only partly compensate for losses and are in the range of USD 6 million to USD 10 million from the national budget (in 2018, USD 8.1 million) and 2 percent of local budgets; c) an insurance programme in rural areas to cover these risks.

In 2018, the anti-hail system received USD 2.04 million, while the second-largest budget in the agriculture sector was obtained by the Agency for Land Relations and Cadastre, amounting to USD 1.4 million, including for land use and increasing soil fertility, policies and management in the field of geodesy, cartography and cadastre, and geoinformatics. The third was the SHS, which received USD 1.27 million, and the fourth was MARDE (currently MAFI) together with Apele Moldovei agency, which received USD 1.07 million for irrigation and drainage systems. There is also a small special budget line for climate-change mitigation and adaptation which in 2018 amounted to USD 0.08 million. For activities related to DRA and DRR, such as Environmental Quality Monitoring, as well as including those related to the agriculture sector, USD 0.58 million was allocated.

In addition to agency budgets, there exists a reserve fund managed by the Ministry of Finance on behalf of the government, used for emergency interventions by all concerned agencies (though not to cover investment costs, such as installation and equipment costs for the establishment of dams).

The reserve fund contains up to 2 percent of the national budget. It is non-accumulating and replenished by annual appropriations. The allocation can be augmented by transfers from other budget lines in case of a widespread disaster. The main part of the reserve fund goes to compensate losses emanating from natural hazards. However, ANSA received USD 6 427 967 in 2018 for damage and losses caused by biological hazards (Republic of Moldova, 2017).

The mainstreaming of climate-change issues into policy initiatives in agriculture and rural development is still relatively new. Most strategies and action plans were not correlated with the financial resources available. Over-optimistic estimates of donor support and insufficient appreciation of potential risk factors affected implementation. Despite progress on adaptation and mitigation policy initiatives, including for agriculture, there is room for enhanced multisectoral and multilevel (national-regional-local) cooperation in decision making, as well as for improved targeting, making sure that disaster, climate and environmental challenges are prioritized (World Bank and CIAT, 2016).

Agricultural insurance

The agriculture sector is vulnerable to natural hazards. Risk transfer represents an effective mechanism for managing the hardship resulting from climate risks by means of risk mitigation measures. Adequately designed risk transfer mechanisms even have the potential to generate incentives for individuals as well as the collective to engage actively in risk reduction. Agricultural insurance in various forms must become part of the farming sector's risk management strategy, along with an appropriate and diversified crop mix and more efficient use of water and other resources. Better and more widespread agricultural insurance, including weather-indexed insurance, must be developed. It will reduce the risk of lending and therefore, lower the cost of borrowing. Properly combined with the financial sector, it will also provide the means to compensate people for losses due to disasters, and lower the burden on all segments of the economy. FAO, other institutions (World Bank, IMF) and donor agencies have expressed their readiness to respond to the government for any technical assistance in this area (FAO and WFP, 2007; FAO, 2019; World Bank, 2020).

The Moldovan agricultural insurance scheme is heavily subsidized by the government. Premium subsidies compensate for the risk of drought, hail, flooding, storms, and frost, as well as the forced slaughter of animals and poultry. The subsidized goods include sugar beet, corn, sunflowers, tobacco, vegetables, wheat, fall rape, barley, vines, orchards, grapes, fruit crops and animals. Besides subsidizing agricultural insurance premiums, the Moldovan government also provides ex-post disaster assistance. In 2008, for instance, the government allocated MDL 15.3 million (around USD 1.49 million) to compensate any type of farmland owner for crop losses due to a flood that affected 4 832 ha of farmland. However, besides being expensive for the state, ex-post disaster relief also leads to poor incentives as it does not encourage individuals to engage in risk reduction and prevention.

In 2017, there were nine companies with licences to provide agricultural insurance, but high market share was covered by two to three companies that have experts. Market penetration is 2 percent to 3 percent of total acreage, quite low (it reached 4.5 percent when subsidies amounted to 80 percent). Subsidies for agricultural insurance account for roughly 1 percent of total agricultural subsidies. Premium rates are high, for example, 5 percent to 6 percent premiums for hail, 1.5 percent to 3 percent for frost, 7 percent to 9 percent for drought, if insured separately. Loss assessment is done by insurance company experts onsite with the participation of local authorities. Re-insurance is provided by international re-insurers, and there is no obligation for re-insurance by law. There is no regulation on triggers and deductibles by law, it is negotiated between insurer and insured; no regulation on bonus-malus system; no compulsory insurance for all fields with the same crop foreseen. Insurance is a precondition for receiving government subsidies for livestock. Thus, the Republic of Moldova has a subsidized, private system of single and multirisk agricultural insurance with a low penetration rate (GET Moldova, 2018).

Agricultural insurance is a viable long-term mechanism; however, due to high costs, and imperfect insurance packages, it requires state support, by granting subsidies to insurance premiums. A list of risks is approved for subsidized insurance plant production, horticulture, viticulture and animal husbandry: (i) winter frosts, early autumn frosts and late spring frosts; (ii) torrential rain; (iii) flooding (river overflows); (iv) crop flattening and blowing away of seeds; (v) burning of cereal crops; (vi) excessive drought (which caused a decrease in yield of over 30 percent); (vii) hail; (viii) loss of animals, birds, bee hives due to disease, storm, hail, flooding, excessive cold, trauma; (ix) necessary slaughter of animals, birds, bee hives, according to the orders of the National Agency for Food Safety. The same documents include the list of agricultural crops and species of animals and birds for which insurance premiums are subsidized from the National Fund for the Development of Agriculture and Rural Areas (NFDARA). They are as follows:

- Sugar beet, sunflowers, corn, soybeans, vegetables, potatoes and tobacco.
- Wheat, barley and spring and autumn rapeseed.
- Perennial plantations (vineyards, orchards, nurseries for vineyards and orchards, as well as grape and fruit harvest).
- Animals (cows, chickens, pigs, sheep and goats), beehives and birds.

A grant applicant can be any legal or natural person registered in the due manner who submits an application to request financial resources from NFDARA, in accordance with the criteria set forth in the support measures, as stated in the regulatory framework. Insurance premiums may be subsidized in case of insuring the harvest of agricultural crops and perennial plantations against any risk or group of risks from the list of eligible risks and eligible agricultural crops. The amount of subsidy is determined on the basis of the insurance premiums calculated according to insurance tariffs provided in Special Conditions for ensuring the production risks in agriculture and it amounts to 50 percent of their value for all agricultural producers. The maximum amount of subsidy shall be determined taking into account the insurance premiums calculated in accordance with the insurance tariffs provided for in Special Conditions for insuring production risks in agriculture:

1. For field crops (except sugar beet):
    a. for areas up to 300 ha – the ceiling is MDL 400 000;
    b. for areas from 301 to 500 ha – the ceiling is MDL 500 000;
    c. for areas from 501 to 1 000 ha – the ceiling is MDL 1 million;
    d. for areas of over 1 000 ha – the ceiling is MDL 1.5 million;

2. For sugar beet:
    a. for areas up to 200 ha – the ceiling is MDL 400 000;
    b. for areas from 201 to 300 ha – the ceiling is MDL 500 000;
    c. for areas from 301 to 400 ha – the ceiling is MDL 700 000;
    d. for areas over 400 ha – the ceiling is MDL 1.0 million;

3. For perennial plantations (vineyards and orchards):
    a. for areas up to 100 ha – the ceiling is MDL 400 000;
    b. for areas from 101 to 300 ha – the ceiling is MDL 1 million;
    c. for areas over 300 ha – the ceiling is MDL 1.5 million; and
    d. for livestock farms – MDL 400 000.

The AIPA shall subsidize insurance premiums for the insurance of crops and perennial plantations against any risk or group of risks in compliance with the list of eligible risks and eligible agricultural crops. Annex V introduced the allocated funds for insurance premiums in agriculture and the compensation paid by insurance companies from the perspective of the subsidy process.

From the financial sources of NFDARA, subsidies are allocated annually for insurance premiums. While during the years 2012–2013 the value of subsidies for insurance of risks in agriculture reached about MDL 40 million (USD 3.2 million) per year, or more than 9 percent of the value of the subsidy fund, over the last three years they have decreased and show a lower percentage share of total grants requested. For example, in 2017, 80 applications worth only MDL 4.5 million (USD 225 500) were authorized, which represents only 0.6 percent of the subsidy fund. In 2019, the value of subsidies for such purposes increased, reaching MDL 5.7 million (USD 285 750), while the share of the total was 0.5 percent (Tables 5, 6 and 7).

Table 5. Number of applications received by the Agency for Intervention and Payments in Agriculture

Year	Submitted applications	Approved applications	Number of insured companies	Subsidy amount requested (MDL)	Subsidy amount approved (MDL)
2017	83	80	98	4 510 273	4 474 949
2018	122	119	146	7 459 283	7 409 531
2019	84	73	103	5 640 599	4 925 801

Source: D. Cosalic, personal communication, 2020.

Table 6. Insured agricultural crops, 2017–2019

Insured agricultural crops, ha	2017	2018	2019
Sugar beet	264.0	130.0	229.0
Sunflowers	425.0	731.3	213.0
Corn	81.5	246.0	110.0
Wheat	2 924.0	2 627.0	1 886.6
Autumn barley and rape	951.0	2 753.0	395.1
Perennial plantations	1 081.0	1 248.7	542.1
Soybean	160.0	0	0
Vegetables and tobacco	24.0	16.2	15.0
Total insured land, ha	**5 910.5**	**7 752.2**	**3 390.7**

Source: D. Cosalic, personal communication, 2020.

Table 7. Insured livestock, 2017–2019

Insured livestock	birds	bovines	swine	sheep	goats
2017	193 060	568	1 203	605	0
2018	0	512	557	2 325	92
2019	0	936	472	1 050	0

Source: D. Cosalic, personal communication, 2020.

In 2017, the AIPA allocated MDL 15.5 million (USD 755 800) to reduce the consequences of late frost in the spring of 2016. Most of the fundings went to large enterprises with low inclusion of small- and medium-sized farms in existing subsidy scheme programmes. In 2019, the AIPA convened a meeting with both associations of various producers and insurance companies accredited by MARDE in order to discuss the problems faced by the stakeholders of the insurance process. During the meeting several problems were identified, which were faced by both farmers and insurance companies, which have led to reducing the process of risk insurance in agriculture and less people applying. In particular, the regulatory framework in the field does not regulate the scope of subjects, insurance relations, the beneficiaries of insurance, which can be both commercial banks that lend to farmers and providers of goods and services (for example suppliers of plant protection products, seed suppliers, agricultural services, and transport).

Law No. 183 of 11 September 2020 on subsidy insurance of production risks in agriculture provides for promoting farmers' access to insurance in agriculture against risks specific to agricultural activities: excessive drought, hail, flooding, torrential rain, attacks by pests, diseases or diseases in livestock, defending farmers' interests in the insurance process, creating opportunities for ensuring crop quality, expanding the list of objects and risks covered by subsidized insurance, promoting farmers' access to loans by granting the possibility of insurance premium payment by the insurance beneficiary. The law provides for the possibility of paying the insurance premium in more than two instalments, which will reduce the financial burden on the insured agricultural producer. Subsidizing insurance premiums in agriculture will be done from the National Fund for Development of Agriculture and Rural Environment. The share of subsidy will be established on the basis of insurance premiums calculated according to special conditions for insurance of production risks in agriculture and it will amount to 70 percent of their value, if the cumulative value of subsidies for subsidized insurance authorized for payment in the year prior to the year of insurance contract is up to 6 percent of the fund's size. The insured amount for the yield of agricultural production is the product of the projected average yield per hectare and the anticipated sales price of the crop, if the parties do not agree on a lower level of insured amount. The average projected yield per hectare is calculated as the average production of the crop to be insured, obtained by the agricultural producer in three of the last five years, excluding the year in which the largest harvest was obtained and the year in which the smallest crop was obtained. At the same time, upon request by the insurer, the insured person or the AIPA, the parties are to recalculate the projected yield if, due to factors other than those against which it was insured, it is found that the yield will be either less than 75 percent of the forecast or higher by more than 50 percent of the forecast. According to the law, the insurance premium is established in accordance with the basic rates applied to the insured amount and it includes the overhead expenses of the insurer, which may not be more than 15 percent of the value of the premiums subscribed under the contract.

Currently, the insurance market in the Republic of Moldova is almost eight times lower (0.8 percent of GDP) than the global average (6.1 percent). Farmers in the Republic of Moldova do not insure themselves, because the agricultural insurance market is a form of dispossession of farmers' money and does not provide insurance against climate risks. The insurance market experienced a slight boom in 2006–2015, during which the government granted up to 80 percent of subsidies for insurance premiums. However, the farmers did not want to insure themselves, due to their experience in 2011–2015, when farmers paid MDL 173 million insurance premiums, but received back only MDL 27.9 million, or 16 percent of the amount paid. The rest of the money went, for the most part, in an unknown direction. After such an experience, instead of insuring themselves, farmers wait for the government to offer them compensation after disasters. The schemes for withdrawing money from insurance include: paid commissions, preferential contracts with "friends", loans offered to "friends", purchases at exaggerated prices and sales at disappointing prices. These issues need to be investigated by the parliament and parliamentary committees which have competence in this area (IDIS Viitorul, 2020).

The Republic of Moldova operates a hail prevention service, using a system of ground-based rockets and radar stations. There is a relationship between hail insurance and hail prevention. Irrespective of the future scope of the hail prevention service in the Republic of Moldova, there is a positive opportunity for a hail insurance product in the Republic of Moldova, to be offered by private insurers. Thus, the private sector should be encouraged to insure against localized threats using traditional products.

Challenges and recommendations for improving disaster risk reduction in agriculture

Disaster risk reduction in agriculture is a challenge for the Republic of Moldova. Political will can impact DRR preparedness, through its prioritization at national and sector levels. However, the development of an efficient DRR in agriculture is impacted by the frequent government reorganization and restructuring processes. For example, as part of 2017 reform, the ministries of agriculture and environment and regional development merged into a single entity with increased roles, less staff and institutional memory. A reorganization of functions was also made for subordinated agencies. New institutions were created, such as the Environment Agency that took competences from the Hydrometeo Service. This caused delays in DRR management, and related decision-making processes.

Disaster risk assessment

There is a necessity to upgrade the monitoring capabilities of the Agency for Geology and Mineral Resources (AGRM) and relevant research institutions and to focus on active landslides that pose a substantial risk, as well as an effective system for information transfer. Monitoring, early warning, and prognosis should be done in coordination with the SHS and the GIES, as there is a close correlation between fall and winter precipitation, groundwater levels, and the area of active landslides.

There are national action plans towards stabilizing landslide and erosion hazards. However, within the programme for conservation and increase of soil fertility for the period 2011–2020, that was around 15 percent of the total number of programme actions. To implement the programme, only USD 5.5 million was allocated rather than USD 12.5 million. These gaps need to be closed by either prioritizing what to do first, by whom and where, or by increasing investment levels. The programme tended to set ambitious targets – reducing soil erosion to zero and applying rates of fertilizer that entirely make up for losses. As a result, the costs of such programmes become very high, whereas a prioritized stratification is preferable. The benefits of investment in erosion control measures are usually slow to materialize, do not always benefit the communities involved in soil protection and afforestation measures, and are relatively cost intensive. For these reasons, erosion-control programmes should carefully involve the participation of communities, which may be compensated for direct losses due to the measures adopted (for example, when afforestation replaces pasture or cropped areas). Interventions should as much as possible bring tangible financial benefits, such as afforestation with productive trees (World Bank, 2007; Ciubotaru, 2019).

There is a need for a national-level spatial planning capability, where GIS and remote sensing infrastructure is concentrated to improve hazard risk mapping and spatially explicit land-use planning. Within the ALRC there is National Infrastructure Geoportal of Spatial Data that contains baseline geospatial data. On the other hand, it would be advisable to share services, responsibilities and training opportunities with the other relevant institutes. Greater coordination is also required in data sharing and management. It is often difficult even for government agencies to acquire data from one another. Data sets are at variance with one another, as methods of acquisition and classification sometimes differ.

It is necessary to have the political will to continue the sustainable disaster risk assessment development process initiated in PPRD East 2. It is necessary to:

- have a clear division of roles and responsibilities in the risk assessment process;
- develop a multisector disaster risk assessment coordinating body at the national level;
- develop governmental–scientific single risk assessment working bodies;

- develop disaster risk assessment capacity at the national level;
- develop the necessary disaster risk assessment tools at the national level;
- perform the assessment for the selected disaster risks, smart disaster risk management capacity development;
- draft lessons learned and raise public risk awareness.

Preparedness and emergency action plans

There are about 3 500 small ponds and reservoirs that were constructed for irrigation, flood regulation and fishing. The dams were not constructed in accordance with existing standards. Many of the dams are vulnerable to collapse during flooding. There is a need to develop and implement a dam safety and enhancement action plan, with a focus on the potential failure of small dams and reservoirs following heavy rain and high runoff events. Stabilizing and maintaining small dams and reservoirs could, in addition, contribute toward drought mitigation and the potential for adding value through small-scale irrigation operations.

Unfortunately, there is no effective interaction for DRR actions among national institutions and agencies that have responsibilities related to civil protection and disaster management. The interaction is hindered by insufficient resources and an unstable political framework, including the fact that at the national level there are no regulatory documents to define the obligation of all state (and non-state) entities to interact and coordinate activities in the framework of DRR. The main state authority for such purpose is the Commission for Emergency Situations, which is operational in case of emergencies. Certain isolated activities to reduce the risk of disasters is certainly carried out in the country, but it is sectoral in nature. For this reason, adoption of a strategy at the level of parliament will contribute to the effective planning and implementation of such activities.

An Institutional Capacity Assessment (ICA) was carried out by the Climate Change Office of the Ministry of Environment and the consultants of the ADA/UNDP project titled Supporting Moldova's National Climate Change Adaptation Planning Process during 2014 in seven priority sectors, including agriculture, water resources and forestry (MARDE and UNEP, 2018). The assessment focused on overall organizational performance and functioning capabilities of the sectors, and identified the sectors' needs in relation to climate-change adaptation capacity development. The main impediments to addressing climate change through the agriculture, water, forestry and the regional development sectors are presented in Table 8. During the ICA, the level of cooperation between institutions was identified as not being strong enough and requiring further strengthening. The Republic of Moldova has yet to put in place a coordinating mechanism to address climate-related challenges; however, efforts are being made to conceptualize and operationalize it. While the government provides for clear lines of communication and authority within individual institutions and agencies, cross-sectoral coordination of information and strategies is not strong. In addition, the existing national government's organizational structure exhibits duplication and policy gaps as well as programmatic fragmentation. These impediments represent a major constraint on the ability of the national government to link environment and development strategies with climate-change impacts. Efforts should move toward more coordinated and integrated approaches to climate-change adaptation. Improving horizontal (cross-sectoral or agency) as well as vertical (between national, local government and communities) integration and coordination is crucial to development of more systematic responses to climate-change problems.

The main systemic-level impediments to the effective use of multilevel and multisector climate-change coordination mechanisms to address climate-change impacts and strengthen adaptive responses are:

- absence of an overarching national climate-driven mandate for coordination of national strategies and priorities;
- limited number of national climate-change policies and strategies and limited references to them make coordination difficult, ad hoc and project driven; and
- limited use of criteria and indicators to guide and monitor the work of coordination teams.

A link between climate-change coordinating mechanisms and other national coordinating mechanisms has yet to be established. The key priorities by sector identified during the ADA/UNDP assessment are:

- Agriculture – rehabilitation/modernization of centralized irrigation systems and drainage infrastructure will make a major contribution to increasing current productivity and mitigating future climate impacts. These are expected to have good rates of return as long as they can be combined with successful institutional capacity development for management of irrigation systems. Other options include small-scale on-farm irrigation systems, soil management and climate risk management technologies (for example, anti-hail nets), and the potential for changes in crop mix towards perennial crops (grapes and fruit trees), which will be more resilient to climate change.
- Forests – ecological rehabilitation and expansion of forests and forest belts are expected to have high returns on suitable land, and to have a high poverty and gender impact. Restoration of degraded forests and pastureland also promotes agricultural productivity through improved watershed function and protection from harsh weather.
- Human health – although there is uncertainty around the scale of climate-related health impacts, modest investments in heat warning systems and public health campaigns are expected to have high returns.
- Water – improvement in municipal supply systems to reduce losses,and building a small-scale storage reservoir on the lower Nistru river, present immediate, modest investment opportunities with high returns. In the coming decades, larger-scale storage infrastructure will be needed. The ideal size and timing of these requires more analysis, and the institutional capacity to effectively manage a variety of water investments would also need to be strengthened.
- Flood control – a substantial set of structural and non-structural measures for flood control is expected to provide substantial economic returns from the reduction of damage and loss.
- Disaster risk management – a set of modest investments is expected to provide key gains for public safety as well as substantial economic returns, that is, improvements to emergency prevention and preparedness, including training facilities, new emergency command centres in the north and south, and improving emergency response capabilities.

Post disaster needs assessment

At the moment, there is no systematic pre- and post-disaster baselines for the agriculture sector, which as a result do not allow for making comparisons between the pre-disaster and post-disaster conditions and situations. However, some reference data exist. For example, reference data for flood risk areas are at the SHS (A. Coronovschi, personal communication, 2020). The National Bureau of Statistics (NBS) does not collect data on disasters.

The tables used for the collection of the baseline data are not prescribed. Data validation to ensure the integrity of the data collected and avoid double-counting is not performed in the Republic of Moldova due to a lack of technical capacities and resources. A clear methodology for the validation of the damage and losses is not available. The NBS has the basic functions to collect, process and disseminate statistical data about the country's demographic, social, economic and ecological state. However, they do not collect data on disasters and DRR measures.

Agriculture insurance

There are different reasons for the low participation rate in agricultural insurance. First of all, farmers do not fully understand insurance, there is a lack of knowledge and financial education; they consider risk premiums too high (vicious circle with low participation); they mistrust insurance companies, and do not agree with loss assessments; they complain about excessive bureaucracy, and the large number of documents required. At the same time, the legal framework is underdeveloped and outdated; there is no transparent regulation of contract provisions such as deductibles, triggers, indemnities; there is no regulation of re-insurance. In terms of issues in practical implementation: disaster relief payments undermine incentives for participation in agricultural insurance; there is a lack of a solid statistical basis at the state level (yields levels, loss histories); yields systematically undervalued in official statistics (also due to underreporting, crops partly sold on the grey market); there are delays in payment of indemnities (GET Moldova, 2018).

In order to improve the regulatory framework, MAFI together with stakeholders, in the process of subsidizing risks in agriculture, has developed a law about subsidized insurance in the agriculture sector (2020) that reflects medium-term actions to boost the role of insurance in agriculture.

Table 8. Main impediments to addressing climate change through the agriculture, water, forestry, and regional development sectors

Gap analysis	Sectors			
	Agriculture	Water	Forestry	Regional development
At the systemic level	• Limited link between policy, functional programming and budgeting; • limited coordination between ministries and subordinate organizations and limited coordination between industry and research institutions; • lack of access to financial resources and distortions caused by underdeveloped capital markets which also inhibits private investments; • inadequate resource base that is used inefficiently and leads to high resource costs; • insufficient incentives to develop and use climate-resilient and sustainable technologies for soil conservation combined with neglected agricultural externalities (pollution, degradation, etc.); • lack of professional institutions to promote sustainable markets and the lack of research into the development and adoption of technology systems adapted to climate change; • insufficient trained personnel experienced in the use and management of new technologies; • lack of a coherent economic policies (poor correlation between tax policy and tax regime); • macro-economic conditions (high inflation and price fluctuations, instability of the national currency and exchange rate, balance of payments and economic growth, small market size) that affects subsidies, import duties and creates market distortions; • poorly developed logistics and supply system; • limited ability to update and upgrade old and degraded infrastructure.	• Lack of appropriate sectoral legislation; • absence of clarity in jurisdiction and functions between agencies leading to limited implementation in areas where the mandates of different ministries and agencies overlap; • need to streamline sectoral policies and agencies to reduce duplication of mandates and activities; • lack of a clearly defined interagency coordination mechanism; • absence of a coordinated system for monitoring the sector and for assessing/responding to risks; • limited link between policy, functional programming and budgeting; • limited ability to identify internal capacity development needs. • limited ability to update and upgrade old and degraded infrastructure; • limited capacity to provide access to a clean drinking water supply to the rural population.	• Overlapping powers between the agencies that coordinate the development of forestry related policies and their lack of collaboration; • lack of a clearly defined cross-sectoral mechanism for coordination functional authorities; • limited integration of adaptation measures in the development plans of enterprises, national and sectoral plans due to lack of regulatory framework that addresses climate change; • lack of climate adaptation target requirements in the legislative documents; • limited financial and institutional capacity to improve governance and implementation capacity; • limited ability to conduct economic analysis of costs and benefits of climate adaptation interventions to support increased adoption of new approaches; • limited methodologies for climate impact measurement of related policies, plans and available financial resources.	• Lack of a clearly defined cross-sectoral mechanism for coordination and impact measurement of adaptation related policies, available financial resources and project implementation; • need to complete regional development legislation and related legal reform that will ensure the ministry's ability to establish priorities; • limited ability to identify capacity development needs of regional development institutions and local authorities responsible for implementation; • need to streamline sectoral policies and agencies to reduce duplication of mandates and activities; • focus on sectoral project selection at both the national and regional levels instead of opting for a strategic approach.

Gap analysis	Sectors			
	Agriculture	**Water**	**Forestry**	**Regional development**
At the organizational level	• Lack of prioritization of issues (and policy-based budgeting); • inefficient and outdated management structures; • limited oversight of programmes; • poor information and knowledge dissemination about new technologies that leads to undeveloped infrastructure to support small projects and a perception that new technologies and systems are risky; • lack of highly qualified personnel; • limited technical knowledge and the absence of a programme to train officials on climate change and climate-change adaptation issues.	• Lack of prioritization of issues (and policy-based budgeting); • limited oversight of programmes; • limited technical knowledge and the absence of a programme to train officials on climate change and climate-change adaptation issues.	• Shortage of highly qualified scientists specializing in forestry and a large number of employees with poor forestry education; • degradation of the training of highly qualified specialists in forestry and forestry research field; • limited ability to provide training and exchange of experiences with other forestry organizations on best practices and techniques to reduce forest vulnerabilities; • insufficient administrative capacity.	• Limited ability to transition to a strategic approach that will drive both strategic criteria and project selection at both the national and regional levels in pursuit to achievement of stated climate-related goals; • limited ability to identify capacity development needs of regional development institutions and local authorities responsible for implementation; • limited climate-related technical skills, knowledge in regional development institutions and local authorities.

Source: **MARDE (Ministry of Agriculture, Regional Development and Environment) & UNEP (United Nations Environment Programme).** 2018. *Fourth National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change.* Chisinau. http://www.clima.md/lib.php?l=ro&idc=81&

Conclusions and recommendations

The vulnerability of the Republic of Moldova to climate change is highlighted in multiple documents, such as the fourth National Communication to the UNFCCC, along with projections on how agriculture will be specifically impacted by it in the near future, due to the expected increase in and severity of extreme weather events. Considering the country's increasing levels of vulnerability to multiple natural hazards, including flooding, drought, soil erosion, landslides, hail and frost, an effective DRR system needs to be in place in order to mitigate such risks, especially with regard to the significant impacts that these hazards can have on the agriculture sector.

Legislation and policy

The Republic of Moldova has established a legal and institutional framework that is focused on DRR. It is on its way to transition from an emergency response-oriented approach towards a more proactive DRR approach. The Law on Civil Protection establishes the GIES as the designated national authority and provides clear roles and responsibilities for the office of the president, parliament, and key ministries. Responsibilities for initial emergency response to all major hazards lies with the GIES. Protocols exist for the issuance of water-related hazard warnings from Ministry of Environment agencies, following which the GIES communicates and coordinates with its own and other central, regional and local civil defence agencies as appropriate for prevention, mitigation, rescue and relief operations.

The country's legislation covers mostly human-induced disasters; the legal framework for disasters caused by natural hazards is less developed. The disaster management system is mostly response-oriented. The legislation covers in good detail the responsibility and rights of responders from the service as well as citizens and NGO volunteers. Less attention is devoted by the legislation to prevention measure such as systematic risk assessment, EWS, emergency plans, land-use planning and information for the public. The Republic of Moldova has sectoral legislation and standards for emergency classification and damage assessment; and modern and up-to-date IT systems for recording disaster data. Most legal and regulatory documents do not link climate change, disaster risks and proposed measures together. There are only a few laws that use the terms forecast, warning, prevention, reduction, and disaster preparedness.

Although DRR is referenced in many policies and strategies, it is necessary to further mainstream it into the national and sectoral political framework. The Republic of Moldova has drafted a National Strategy for Disaster Risk Management, and an Action Plan for implementing the NSDRM, but these have not been adopted. However, it is included in the government's Action Plan for 2020–2023.

In terms of mainstreaming DRR into country's plans, policies and strategies and harmonization with European Union legislation, international conventions and agreements, DRR is taken more into account in recent documents. The National Strategy for Agriculture and Rural Development of 2014–2020 recognizes the increased risk of extreme weather events and climate change is considered as a threat to the sector. Climate-change adaptation is one of the main objectives; however, only a few measures are included to achieve it.

The Republic of Moldova has initiated important efforts to mainstream climate-change adaptation into national and subnational planning processes; particularly, the NAP-1 process was advanced through the implementation of the project Supporting Moldova's National Climate Change Adaptation Planning Process, implemented from 2013 to 2017 with financial support provided by the ADA and implemented by UNDP (known as National Adaptation Planning Process in the Republic of Moldova 1 – NAP-1). Building on this project, the GCF approved two NAP readiness proposals submitted by UNDP (NAP 2) and FAO (the Agriculture Sector Adaptation

Planning Process, Ag. SAP). These proposals aim to kickstart country's second NAP cycle, to address the remaining barriers identified under the NAP-1 process and provide sector-specific support for mainstreaming adaptation in agriculture.

Policy recommendations include:

- Develop a risk-reduction action plan for rural livelihoods in the Republic of Moldova through a participatory process, leading to revising legislative mandates and regulatory frameworks to assure harmonization and linkage of capacities to mitigate key risks and to ensure synergy of the actions.
- Consult with national stakeholders on the benefit of having intersectoral actions for DRR and preparedness, especially taking into account vulnerable people, based on lessons learned from other past hazards (drought, torrential rain with hail, flooding) and linked to and within the context of the COVID-19 outbreak in 2020 in the agriculture sector.

Institutional framework

The institutional framework as well as DRR coordination mechanisms are currently in place. The main institutions involved in DRR activities include: the National Commission for Emergency Situations, the GIES, Ministry of Environment with subordinated agencies, MAFI, ANSA, PSA, ALRC, ASM, local public authorities. The direct management of civil protection is exercised by the GIES subordinated to MIA. There is a lack of clarity regarding the roles and responsibilities of the Ministry of Environment, as the national focal point for Sendai Framework activities, and MIA, which is responsible for the development of the NSDRM. At present, the Republic of Moldova does not yet have a national platform for DRR, which would bring all relevant stakeholders from various sectors together and would facilitate interinstitutional coordination, collaboration and communication to advance its national commitment to reduce disaster risks as a member of the Sendai Framework for DRR 2015–2030. The activities of MAFI regarding the drought risks to agriculture are related to improving irrigation systems and soil erosion control.

Practically all agencies involved in disaster management experience a lack of financial resources to procure and properly maintain relevant equipment that currently is mostly obsolete, and to develop and implement programmes and plans toward prevention, mitigation and response to natural hazards.

The experience related to the COVID-19 pandemic, drought and flooding in 2020, shows that the Republic of Moldova is not prepared to reduce the impact of hazards in agriculture within the context of pandemic crises.

Recommendations for improvement of the institutional framework and coordination mechanisms include:

- Establish a national platform for DRR to advance the national commitment to reduce disaster risk and enhance the institutional coordination, collaboration and communication on DRR actions.
- Clearly outline the roles and responsibilities of all relevant stakeholders in DRR, climate-change adaptation and laws, strategies, plans and policies, along with expected actions. In particular, clarify the roles and responsibilities of the Ministry of Environment as the national focal point responsible for Sendai Framework activities, and MIA, responsible for the development of the NSDRM.
  Involve all the local institutions responsible for managing natural resources, such as Water Users Associations for Irrigation, in DRR planning and implementation in order to prevent and combat the consequences of agricultural disasters.
- Strengthen the coordination and collaboration of disaster risk reduction/management and climate-change adaptation activities, in particular for agriculture.
- Establish a working group and clarify roles and responsibilities across line ministries and other relevant organizations regarding risk assessment and mapping, especially for the agriculture sector.
- Enhance capacities and cooperation with institutions which are involved in the development of GIS database and mapping in order to enhance risk and vulnerability mapping as well as the use of GIS and risk mapping by the line ministries and subordinated institutions at local, national and regional levels.
- Create a national ecological network and promote organic agricultural practices, which are among the main MAFI priorities, disseminate information and knowledge as well as exchange of experiences in this field, and create ecological production networks in relation to agricultural emergency

management at local and national levels, which eliminates the use of chemicals in production and, ultimately, prevents degradation and chemical pollution of the natural environment, which provokes agricultural disasters.

- Encourage synergy and harmonization of actions between focal points and working groups of the Sendai Framework, UNFCCC, UNCCD and United Nations Convention on Biological Diversity, which will contribute to join efforts in the development and implementation of DRR and climate-change adaptation policies and actions in agriculture. In order to avoid duplications while significant gaps still remain uncovered and being systemic in advancing with climate action, it is necessary to promote synergy and coherence in adaptation planning. Thus, different focal points of international donors and United Nations organizations should collaborate in promoting synergy and complementarity of climate action – UNFCCC, GCF, GEF, Adaptation Fund focal points and local country offices of FAO, UNDP, and the International Organization for Migration (IOM) have to collaborate more closely with the government and actively participate in donor coordination meetings addressing the gaps and needs stated by the government. During coordination committee meetings with regard to climate change, the government has to present the plan and emphasize the gaps while donor and United Nations organizations have to provide responses according to needs. There are country programmes of each donor/resource partner organization that should be developed in close coordination with the government and donor community to provide efficient climate-response corresponding needs.
- Increase communication and coordination between involved ministries and parties for carrying out full assessments of risks at national, regional and local levels, as well as development and implementation of DRR and climate-change adaptation actions. This includes reinforcing the role of the National Commission for climate change. In addition, the agriculture sector needs an adaptation planning governance and effective coordination mechanism. The Sectoral Work Group represented by the key agriculture stakeholders, has a key role and shall secure the required knowledge, expertise and skills throughout the process and promote cooperation among stakeholders.
- Focus the institutional capacity improvements on identifying seeds for drought-tolerant varieties and temperature-tolerant livestock breeds on the international market for adoption in the Republic of Moldova.
- Train farmers in efficient use of water and to make use of weather forecast and market information.

Early warning

The State Hydrometeorological Service (SHS) provides meteorological, agrometeorological and hydrological information to central and local public authorities, the national economy and the population of the Republic of Moldova. The SHS issues warnings on weather-related hazards. The GIES assists with dissemination of these, as they may entail mobilization for possible intervention and relief effort where needed. However, there is no relevant budget line in agriculture for the SHS, and thus currently the official extension service of MAFI does not provide meteorological information to farmers.

The following recommendations are proposed to strengthen the existing EWS:

- Reinforce national capacity and update operational systems on the extensive data collection, processing, analysis, prediction capability and dissemination, ensuring with required budgeting in order to have complete and reliable information on food market, agricultural commodity, land, labour, material and technical services, investments, information and scientific support. Publish the information and materials on the MAFI and FARM websites.
- Develop user-friendly and effective systems for farmers and agrifood supply chain operators to access early warning information with clear recommendations for certain hazards that may lead to disasters and may further adversely impact food security, income and livelihoods.
- Adapt the existing FAO Global Information and Early Warning System (GIEWS) food price tool and other tools and indicators for climate monitoring and agricultural forecast at national level and harmonize it with the existing information systems.
- Promote good international scientific practice in order to create a radiolocation system for early warning about torrential rain, hailstorms, strong winds, flooding, and so on.
- Carry out an analysis of regional and global trends of market prices and the availability of basic products, taking into account the emergencies in the agriculture sector, for providing a price forecast and early warning.

- Build capacity of MAFI and extension service staff in the GIEWS and the UN WFP Alert for Price Spikes (ALPS) tool, to analyse observed price deviations and forecast seasonal prices and provide recommendations.
- Develop an effective system or mechanism for collecting the feedback of users on forecast and early warning products, particularly considering engaging the agricultural user at early stages of the climate services framework. To ensure a higher uptake of the information, users need be part of the codesign, codevelopment and coproduction of climate and agrometeorology services.
- Strengthen the agricultural extension and emergency warning capacities on the identification and dissemination of risk mitigation measures adapted to frost-, hail- and storm-vulnerable regions, appropriate to the lead time the SHS could provide.
- Enhance GIS database capacity that will help to link and improve mapping of all types of risks and vulnerabilities, in particular for the agriculture sector.

Agrometeorology services

Agrometeorological monitoring is performed to provide information to the government, the National Bank, agricultural associations, farmers and others. The SHS informs the recipients by developing specialized daily, weekly, fortnightly, monthly, and quarterly forecasts, as well as annual reports of a more detailed nature. Farmers receive information from the SHS through the SHS website and the media, or the SHS provides specialist information upon request on a contractual basis for a fee. The country's existing agrometeorology services are facing the following challenge – there is a lack of local equipment for monitoring climate-related factors and issuing irrigation forecasts, as well as a lack of equipment for monitoring the condition of dams and irrigation facilities.

Recommendations for improvement of agrometeorology services include:

- Provide agricultural activity guidance based on the crop calendar; provide regular agrometeorology bulletins.
- Develop and implement mobile applications for distribution of agrometeorological information, including warnings.
- Connect with agricultural extension service for the dissemination of meteorology forecasts to farmers, especially on extreme events.
- Develop plant and animal pest and disease forecasts linked to weather warning alerts.
- MAFI to take lead responsibility to coordinate the implementation of prevention, mitigation and preparedness activities regarding natural hazards in agriculture, such as frost, hail, drought and flooding; develop weekly bulletins and dissemination system preparedness for response and agricultural damage mitigation.

Disaster risk reduction in agriculture

Risk assessment and DRR actions planning is currently hindered by a lack of clarity regarding the roles and responsibilities of line ministries and other stakeholders involved in DRR. There are no comprehensive risk assessments in the country apart from climate risk analyses conducted in 2000, 2009, 2013 and 2018 in the framework of preparation of the National Communications to the UNFCCC. Different institutions use different methodologies, criteria, and data to determine possible consequences of disasters in agriculture, and there is not one united disaster risk assessment document that would make data comparable and risk levels determined at the national level. The focus is more on preparedness and much less on disaster risk reduction, including for agriculture. Hazard mapping and the application of GIS technologies are also increasingly being used in the Republic of Moldova. The limited use of and capacity to use these technologies across line ministries and related organizations reduces the identification of hazards and vulnerable areas where potential disaster risk could be addressed, including for the Moldovan agriculture sector.

Overall, although there are clear improvements being made regarding the implementation of DRR in agriculture in the Republic of Moldova, there is still a long way to go before effective mainstreaming and implementation of DRR in agriculture takes place. It is necessary to have a clear division of roles and responsibilities in the risk assessment process, developing a multisector disaster risk assessment coordinating body at the national level, developing governmental–scientific single risk assessment working bodies, developing disaster risk assessment

capacity at the national level, developing the necessary disaster risk assessment tools at the national level, performing the assessment for the selected disaster risks, smart disaster risk management capacity development, drafting lessons learned, and raising public risk awareness.

The following recommendations are proposed for the improvement of the DRR system with a holistic approach to ensure effective mainstreaming and implementation of DRR in agriculture:

- Develop a standardized national risk assessment framework for all potential hazards in agriculture, including preparation of national risk maps, updating existing methodologies for comprehensive assessments of disaster damage and losses caused by natural hazards, and improve risk management in agricultural systems.
- Align the country's post-disaster damage and losses evaluation and compensation methodology with international standards for conducting post-disaster needs assessments, especially for the agriculture sector.
- Study the possibility to use modern technologies (approved by WMO) related to the artificial increase in precipitation.
- Establish a database, which systematically collects historical hazard data by sector, including data on agriculture by commodity at subnational level, update the database regularly and improve interinstitutional coordination for accessing the database. The NBS could play a substantial role in data collection and processing on disasters and DRR measures.
- Enhance knowledge and strengthen awareness and capacities of the relevant national organizations on DRR by providing training on data collection, analysis and management.
- Develop and disseminate guidelines with agricultural measures that help to reduce the adverse impacts of natural hazards, such as drought, frost, hail, which can also reduce the magnitude of long-term degradation processes, such as soil erosion and landslides. Enhance farmers' access to knowledge and information about new crop varieties and livestock breeds, as well as on agriculture-related DRR and climate-change adaptation practices and technologies.
- Enhance the capacity of local communities in undertaking climate risk assessment and identifying prevention measures. Encourage a bottom–up approach and use of participatory tools with the engagement of local public authorities, local NGOs and local private-sector representatives in identifying local level risks and response measures.
- Strengthen the DRR and management capacities and knowledge of the agricultural extension network and agroenvironmental organizations.
- Restructure the insurance system in agriculture towards a stable economic system that is secure from possible risks in accordance with the systems that exist in advanced economies in order to ensure farmer support in case of natural disasters.
- Train and inform farmers and administration about the necessity for insurance of agricultural activities against natural hazards.
- Invest in data systems and support research and design of agricultural insurance products.
- Use best international practices in order to find a reliable mechanism acceptable by both farmers and insurance companies in order to spread risk and help farmers to mitigate the risks around agricultural damage and catastrophic losses that occur due to natural and biological disasters.
- Investigate and apply options for reforming crop insurance to decrease administration costs and improve affordability for smallholders.
- Analyse and identify options for tailoring the crop insurance system to smallholders' needs by improving affordability and providing crop insurance prior to investments instead of after.
- Introduce weather index-based insurance paired with other options and services for farmers.
- Include DRR, disaster preparedness information, and activities, into the curricula of primary and secondary schools, and agricultural institutions.

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Annexes

Annex I. List of interviewees

Nr.	Name	Organization
1.	Raisa Leon	Head of the Environmental Policy Implementation Directorate, Environmental Agency
2.	Nicolae Munteanu	Chief Forest Engineer, Moldsilva agency
3.	Diana Cosalic	Head of the methodology and reporting service, The Agency for Intervention and Payments in Agriculture
4.	Grigore Gaina	Head of Consulting and Information Center of the National Farmers Federation of the Republic of Moldova (NFFM)
5.	Anatolie Fală	Programme Director, National Agency for Rural Development (ACSA)
6.	Alexandru Coronovschi	Associate Researcher, Land Reclamation Department, State Agrarian University
7.	Stefan Pertu	Farmer enterprise, Caracusenii Vechi village, Edinet district
8.	Lilian Mindov	Head of the Cadastre of Real Estate Division, Agency for Land Relations and Cadastre
9.	Valentin Sascov	Head of the Department of Extension, Rural Economic Development and Marketing of the NFFM
10.	Radu Cazacu	Deputy Director, Apele Moldovei Agency
11.	Lidia Treschilo	Chief of the Department of Meteorology, State Hydrometeorological Service
12.	Ion Sirbu	Chief of the Agricultural Department of the Hincesti Executive Committee
13.	Viorel Jardan	Director, Center Regional Development Agency
14.	Cristina Gheorghita	Senior Specialist of the Water and Air Resources Management Department of the Inspectorate for Environment Protection

Annex II. Summary of relevant legislation on disaster risk reduction and management, early warning systems, and agrometeorology services

Legislation/policies/plans	Main DRR provisions	Endorsement	Relation to agriculture
Governmental Decision (GD) No. 1340 of 4 December 2001 on The Commission for Emergency Situations of the Republic of Moldova	Establishes the Commission for Coordination of Civil Emergency and Crises	Updated in 2019	MARDE (currently MAFI) is a member of the commission. It includes the roles and responsibilities of the commission, including MARDE in prevention, preparedness, mitigation, and emergency response
Law No. 93 of 5 April 2007 on Organization, Function, Duties and Responsibilities of the Civil Emergency Service	Provide framework for creation of the General Inspectorate for Emergency Situations	Updated in 2018	It outlines duties and responsibilities of the central specialized public authorities (including MARDE) and the local public authorities, the legal persons, regardless of the legal form of organization
GD No. 1146 of 13 November 2000 on approval of the Concept for civil protection development in the Republic of Moldova	Outlines the priority directions, the development mechanism and the stages of civil protection development	2000	Generic. It is focused on emergency response, prevention, mitigation and preparedness. Agriculture is not mentioned in this decision
GD No. 1076 of 16 November 2010 On classification of emergency situations and way to collect and submit information in the field of population and territory protection in emergency situations	Stipulates the role of the central and local public authorities in collection, processing and submission of information	2010	Generic, linked to the Law No. 271. It is related to the collection, processing and submission of disaster damage and losses data related to emergencies, including in agriculture
GD No. 862 of 18 December 2015 on Regulation on management of emergency funds of the Government	This decision outlines general rules for damage evaluation and compensation	2015	All agricultural products and equipment are subject to evaluation and compensation from state budget. Criteria which products and equipment can get compensation from the state and damage caused by which type of hazards are not specified
GD No. 908 of 5 November 2014 on Endowment of the units of the Service for Civil Protection and Emergency Situations under the Ministry of Internal Affairs with intervention tools	Provides norms of special forces and technical means for the units of the Service for Civil Protection and Emergency Situations	2014	Generic, linked to Law No. 93
GD No. 282 of 14 March 2005 on Regulation on training in the field of civil protection	Provides actions at different levels to organize training in civil protection area and to carry out public awareness to share knowledge in the field of civil protection	Updated in 2011	Generic, linked to Law No. 271
Law No. 271 of 9 November 1994 on Civil Protection	Regulates the planning and mitigation of civil protection in case of emergencies	Updated in 2017	Relates to prevention, mitigation and emergency response in all sectors, including agriculture

Legislation/policies/plans	Main DRR provisions	Endorsement	Relation to agriculture
GD No. 461 of 24 March 2008 on approval of the Regulation on the way of performing special services within the Service for Civil Protection and Emergency Situations	Establishes the way of enrolling in service and dismissing citizens hired on the basis of an individual employment contract, as well as other aspects related to the performance of works within the service	2019	Generic, linked to the Law No. 93
GD No. 202 of 14 March 2013 on approval of the program for strengthening the Rescue and Fire Protection Service in rural communities of the Republic of Moldova for the period 2013–2020	Provides for the strengthening of the system in order to have a functional system, which is modern and compatible with the European Union provisions in the area, by creating territorial stations for rescuers and firefighters, strengthening two to three communities, which will represent the primary intervention force until the arrival of the certified basic forces of the GIES	Updated in 2015	Generic, linked to Law No. 271
GD No. 67 of 23 January 2007 on Improvement of the activity for protection from fires	Approves the plan for providing special devices and modern equipment to units of the GIES for the years 2007–2011	2007	Generic, linked to Law No. 267
Law No. 267 of 9 November 1994 on Protection against fires	Establishes the organizational structure of fire corps and services to combat fires and regulates the involvement of fire corps during natural hazards	Updated in 2017	Generic. It includes prevention, mitigation and preparedness interventions/activities for any fire. The wild/forest fires are not mentioned, but assumed to be included. The roles and responsibilities of the central specialized public authorities and the local public authorities are mentioned. Forest-related organizations are not included
GD No. 1159 of 24 October 2007 on Technical Regulation General rules of protection against fires in the Republic of Moldova	This decision lays down provisions regarding development of guidelines on measures for fire protection that refer to central and local public authorities	2005	MARDE must submit the following information: on accidents in enterprises and their consequences, as related to accidents with a large number of victims, including deaths; on emergence of epizootic and epiphytic events; on loss of agricultural production as a result of disasters; on progress and results of eliminating consequences of disasters
GD No. 433 of 18 June 2012 on approval of the Regulation regarding flood protection dams	Stipulates that the central and local public authorities shall take the necessary measures to implement the provisions of this regulation and to ensure the development of the cadastral documentation regarding the delineation, building and registration of flood protection dams, as state property, along with adjacent land	Updated in 2019	MARDE is responsible for the control over the enforcement of this decision, linked to laws No. 272/2011
GD No. 952 of 15 October 1999 on protection of communities of the Republic of Moldova from geological processes	Approval of measures to protect communities from dangerous geological processes, floods and other natural hazards for the period 2006–2015	Updated in 2009	MARDE and Apele Moldovei Agency are responsible for the development of prevention, mitigation, and emergency response land protection measures against floods and soil erosion
Law No. 221 of 19 October 2007, on Sanitary-Veterinary Activity	Aims to protect and improve the health of animals, to protect the public health from the transmittance of diseases from animals and deal with animal health epidemics and disasters	Updated in 2018	Relates to prevention and emergency response actions taken in case of epidemics caused by animals and potential threats to public health

Legislation/policies/plans	Main DRR provisions	Endorsement	Relation to agriculture
Law No. 228 of 23 September 2010 on plant protection and phytosanitary quarantine	The purpose of this law is to strengthen the legal and institutional framework, to create adequate economic-legal conditions for the organization and conducting of plant protection and phytosanitary quarantine	Updated in 2018	The phytosanitary control authority shall ensure the training and certification, every two years, of the inspectors involved in activities of control, phytosanitary certification and laboratory expert evaluation according to the programmes coordinated with MARDE
Law No. 113 of 18 May 2012 on establishment of general principles and requirements of legislation in respect to food safety	Aims at achieving a high level of protection of human health and consumer interests in food safety, taking into account the diversity of food supply	Updated in 2019	MARDE will develop and propose for adoption regulatory provisions regarding measures and penalties applicable for infringement of the legislation on safety of food and feed. MARDE is a member of the network of Rapid Alert System
GD No. 404 of 6 April 2016 on approval of sanitary-veterinary provisions regarding establishment of the disease control and fighting measures in respect to certain transmissible forms of spongiform encephalopathy in livestock	Transposes the provisions of EC Regulation No. 999/2001 of the European Parliament and of the Council of the European Union	Updated in 2019	MARDE will develop guidelines specifying the applicable national measures and detailing the competences and responsibilities in case of confirmation of some illness cases, linked to laws No. 113 and 221
GD No. 698 of 25 August 2014 on approval of the sanitary-veterinary provisions regarding measures to combat foot-and-mouth disease partly	Transposes the Council Directive 2003/85/EC	Updated in 2019	Generic, linked to the laws No. 113 and 221
GD No. 771 of 16 October 2012 on approval of sanitary-veterinary rules regarding the African horse sickness	Comprises the rules which have been harmonized with the provisions of Council Directive 92/35	Updated in 2019	Generic, linked to the laws No. 113 and 221
GD No. 51 of 16 January 2013 on organization and operation of the National Agency for Food Safety (ANSA)	Establishes the mission, basic functions, main duties and general rights of ANSA	Updated in 2015	MARDE shall carry out, according to the effective legislation, the procedure of reorganization of the Agency for Sanitary-Veterinary Control and for Safety of Animal Products and of the General Inspectorate for Phytosanitary Surveillance and Seed Control, linked to laws No. 113 and 221
GD No. 1530 of 29 December 2007 on approval of veterinary sanitary provision regarding establishment of criteria for the programs for eradication and control of some animal diseases	This decision is in accordance with the provisions of the Action Plan for implementation of the European Union-Moldova Association Agreement on improving the food safety system for Moldovan consumers and facilitating trade by reforming and modernizing the sanitary sector	Updated in 2015	Generic, linked to the Law No. 221
GD No. 939 of 4 August 2008 on approval of sanitary-veterinary rules regarding measures for surveillance, control and fighting bird flu	Transposes the Directive 2005/94 / EC of the Council of Europe	Updated in 2017	The decision also refers to any domestic birds or other birds kept in captivity, officially recognized by MARDE as rare breeds, within the contingency plan, linked to Law No. 221
GD No. 356 of 31 May 2012 on approval of some regulatory acts regarding implementation of Law No. 228 on plant protection and plant protection quarantine	Transposes Annex I to the European Union Council Directive 2000/29/EC, as well as Regulation (EC) No. 690/2008 of the Commission	Updated in 2019	Generic, linked to Law No. 228
GD No. 1081 of 22 September 2008 on approval of the sanitary-veterinary provision regarding the establishment of the control and supervision rules related to some transmissible spongiform encephalopathies	This decision is harmonized with the provisions of Regulation (EC) No. 999/2001 of the European Parliament and of the Council of the European Community	Updated in 2016	The competent authorities are MARDE, ANSA and the Republican Veterinary Diagnostic Centre within the limits of their legal competences, linked to the Law No. 221

Legislation/policies/plans	Main DRR provisions	Endorsement	Relation to agriculture
GD No. 239 of 26 March 2009 on approval of the sanitary-veterinary provision regarding the health conditions of water animals and products and measures for prevention and control of certain diseases in water animals	Transposes the Directive of the Council of the European Union No. 2006/88/EC	Updated in 2016	The national reference laboratory must ensure a permanent and open dialogue with MARDE
GD No. 350 of 12 July 2001 on Sustainable Development Strategy for the Forestry Sector 2003–2020	The eco-protective function of forests is manifested more strongly only if the degree of the country afforestation exceeds 15 percent of a country's territory. According to the strategy it is planned to plant new forests on an area of 73 000 ha	2001	The direct contribution of the forestry sector to sustainable development will be achieved through two basic strategic directions: restoration and bio-ecoprotective potential of forests and areas with forest expansion. Specific objectives to achieve these strategic directions clearly account for climate risk: (i) mitigation of the destructive effect of temperature changes, drought and other negative climatic factors; (ii) reducing soil degradation by erosion; (iii) reducing and stopping the landslides; (iv) improving the quality of aquatic resources; (v) reducing the greenhouse gas emissions through carbon removals; (vi) conservation of biological diversity
Law No. 436 of 28 December 2006 on Local Public Administration	Regulates the organization and functioning of local government units	Updated in 2013	The municipalities have responsibilities regarding the implementation of measures to prevent and mitigate the consequences of natural hazards, disasters, fires, epidemics, epiphytotic and epizootics, including for the agriculture sector
GD No. 833 of 10 November 2011 on National Energy Efficiency Program 2011–2020	The global goals of the programme are as follows: a) reducing global primary energy consumption by 20 percent by 2020; b) increasing the share of renewable energy in the total energy mix from 6 percent in 2010 to 20 percent in 2020; c) increasing the share of biofuels to at least 10 percent of all fuels used in 2020; d) reduction of emissions of greenhouse gas emissions at least by 25 percent by 2020 compared to the base year 1990	Updated in 2018	Generic

Annex III. Use of disaster risk reduction, early warning systems, and agrometeorology services terminology in legislation/policies/plans

Legislation / policies / plans	DRR/management provisions				In agriculture sector
	prevention	preparedness	mitigation	emergency response	
Decision No. 1340 of 4 December 2001 on The Commission for Emergency Situations of the Republic of Moldova	+	+	–	+	+
Law No. 93 of 5 April 2007 on Organization, Function, Duties and Responsibilities of the Civil Emergency Service	+	+	+	+	–
Decision No. 1146 of 13 November 2000 on approval of the Concept for civil protection development in the Republic of Moldova	+	–	+	+	+
Decision No. 1076 of 16 November 2010 On classification of emergency situations and way to collect and submit information in the field of population and territory protection in emergency situations	–	+	–	–	–
Decision No. 862 of 18 December 2015 on Regulation on management of emergency funds of the Government	–	+	–	–	–
Decision No. 282 of 14 March 2005 on Regulation on training in the field of civil protection	+	–	–	+	–
Law No. 271 of 9 November 1994 on Civil Protection	+	–	+	+	–
Decision No. 461 of 24 March 2008 on approval of the Regulation on the way of performing special services within the Service for Civil Protection and Emergency Situations	–	–	–	+	–
Law No. 267 of 9 November 1994 on Protection against fires	+	–	+	+	+
Decision No. 1159 of 24 October 2007 on Technical Regulation General rules of protection against fires in the Republic of Moldova	+	+	–	+	–
Decision No. 409 of 4 June 2014 on National Strategy for Agricultural and Rural Development for the years 2014–2020	+	+	+	–	+
Decision No. 433 of 18 June 2012 on approval of the Regulation regarding flood protection dams	+	–	–	+	–
Decision No. 952 of 15 October 1999 on protection of communities of the Republic of Moldova from geological processes	+	–	+	+	–
Law No. 221 of 19 October 2007, on Sanitary-Veterinary Activity	+	–	–	–	+
The Law No. 228 of 23 September 2010 on plant protection and phytosanitary quarantine	+	+	+	+	+
Law No. 113 of 18 May 2012 on establishment of general principles and requirements of legislation in respect to food safety	+	–	+	+	+

Legislation / policies / plans	DRR/management provisions				In agriculture sector
	prevention	preparedness	mitigation	emergency response	
Decision No. 404 of 6 April 2016 on approval of sanitary-veterinary provisions regarding establishment of the disease control and fighting measures in respect to certain transmissible forms of spongiform encephalopathy in livestock	+	+	+	+	+
Decision No. 698 of 25 August 2014 on approval of the sanitary-veterinary provisions regarding measures to combat foot-and-mouth disease partly	+	+	+	+	+
Decision No. 771 of 16 October 2012 on approval of sanitary-veterinary rules regarding African horse sickness	+	–	+	+	+
Decision No. 51 of 16 January 2013 on organization and operation of the National Agency for Food Safety (ANSA)	+	+	+	+	
Decision No. 1530 of 29 December 2007 on approval of veterinary sanitary provision regarding establishment of criteria for the programmes for eradication and control of some animal diseases	+	+	–	+	+
Decision No. 939 of 4 August 2008 on approval of sanitary-veterinary rules regarding measures for surveillance, control and fighting bird flu	+	+	+	+	
Decision No. 356 of 31 May 2012 on approval of some regulatory acts regarding implementation of Law No. 228 on plant protection and plant protection quarantine	+	–	–	–	+
Decision No. 1081 of 22 September 2008 on approval of the sanitary-veterinary provision regarding the establishment of the control and supervision rules related to some transmissible spongiform encephalopathies	+	+	–	–	+
Decision No. 239 of 26 March 2009 on approval of the sanitary-veterinary provision regarding the health conditions of water animals and products and measures for prevention and control of certain diseases in water animals	+	–	+	–	+
Decision No. 350 of 12 July 2001 on Sustainable Development Strategy for the Forestry Sector 2003–2020	+	+	+	+	+
Law No. 436 of 28 December 2006 on Local Public Administration	+	–	+	–	–

Annex IV. Dynamics of anti-hail works in Republic of Moldova, 1967–2020

Years	Area, thousands of ha	Effectiveness of anti-hail works (%)	Years	Area, thousands of ha	Effectiveness of anti-hail works (%)
1967	100	88	1994	1 970	96
1968	170	92	1995	1 970	98
1969	210	97	1996	1 975	85
1970	230	100	1997	2 100	98
1971	230	93	1998	2 125	90
1972	360	94	1999	2 125	97
1973	430	88	2000	–	*
1974	500	86	2001	265	**
1975	600	95	2002	480	88
1976	730	89	2003	600	94
1977	800	91	2004	630	83
1978	890	73	2005	667	94
1979	1 000	92	2006	702	86
1980	1 180	90	2007	1 000	84
1981	1 325	97	2008	1 400	88
1982	1 430	98	2009	1 500	91
1983	1 670	96	2010	1 400	90
1984	1 960	82	2011	1 400	86
1985	2 220	94	2012	1 400	89
1986	2 260	94	2013	1 486	90
1987	2 320	96	2014	1 486	97
1988	2 360	97	2015	1 486	94
1989	2 430	95	2016	1 486	96
1990	2 490	98	2017	1 665	100
1991	2 060	94	2018	1 665	99
1992	1 730	95	2019	1 665	96
1993	1 970	87	2020	1 665	100

* In 2000, anti-hail works were not carried out.
** In 2001, the effectiveness of the anti-hail works was not calculated due to the short protection period (July–September).

Annex V. Allocated funds for insurance premiums in agriculture and compensation paid by insurance companies

Years	Premiums included in applications (MDL)		Compensation (MDL)	% of compensation
	Total	including subsidies		
2007	31 645 342	16 300 000	7 980 597	25.22
2008	44 99 344	27 200 000	13 134 152	29.19
2009	21 079 664	25 530 000	23 591 579	111.92
2010	40 585 192	16 500 000	17 267 546	42.55
2011	43 516 413	25 800 000	24 191 797	55.59
2012	74 581 695	37 800 000	100 201 309	134.35
2013	92 642 410	41 300 000	30 976 008	33.44
2014	58 287 440	22 760 583	6 723 119	11.53
2015	44 956 961	30 996 019	4 593 185	10.22
2016	18 254 076	9 092 308	12 695 877	69.55
2017	13 110 159	4 474 949	2 024 881	15.45
2018	10 263 315	7 409 531	2 647 604	25.80
TOTAL	**493 897 011**	**265 163 390**	**246 027 653**	**49.81**

Source: D. Cosalic, personal communication, 2020.

Annex VI. Programmes/projects related to disaster risk reduction, early warning systems, and agrometeorology services in the agriculture sector

Title of programme/project	Targeted countries	Funding agency/ies	Implementation agency/ies	Implementation period	Allocated budget	Main components/project aim
Rural Resilience Project	Republic of Moldova	IFAD	IFAD	2017–2023	USD 38.7 million	The project aims at providing an affordable and long-term source of funding to strengthen resilience to climate change in agriculture as well as the project is implementing climate resilience activities in agriculture.
Moldova Climate Adaptation Project	Republic of Moldova	World Bank	World Bank	2017–2023	USD 27.2 million	The project aims to enhance productivity and resilience through climate-smart forestry and agriculture in targeted landscapes as well as it focuses on strengthening national climate forecasting and disaster management systems.
Conservation Agriculture – Developing a Sustainable Soil Management System in Moldova	Republic of Moldova	The Government of Japan	2KR Project Implementation Unit	2017–2020	USD 4.8 million	This project focuses on promoting and implementing conservation agriculture practices in the Republic of Moldova.
Climate Resilience through Conservation Agriculture, Inclusive Rural Economic and Climate Resilience Programme (IRECR)	Republic of Moldova	GEF/ IFAD	IFAD	2014–2020	USD 64.5 million credit, USD 4.37 million grant component (GEF)	The objective of the project is to enhance adaptive capacity/resilience of rural farmers through sustainable land approaches. Currently the project development grant has been approved and the project is under development.
Livada Moldovei project	Republic of Moldova	EIB	Implementation Unit Livada Moldovei	2016–2020	USD 120 million credit	This project focuses on installing weather forecast stations, meteorological systems, irrigation, anti-frost systems and anti-hail systems in orchards, post-harvest technologies and development of support systems for vineyards plantations (PERGOLA system).

Title of programme/project	Targeted countries	Funding agency/ies	Implementation agency/ies	Implementation period	Allocated budget	Main components/project aim
Climate Resilience through Conservation Agriculture Inclusive Rural Economic and Climate Resilience Programme (IRECR)	Republic of Moldova	IFAD, DANIDA, GEF	IFAD	2014–2020	USD 46.5 million credit, including USD 4.37 million grant component (GEF)	The overall goal of the IRECR programme is to enhance the adaptive capacity of farmers to climate change through the promotion and expansion of resilient agricultural approaches. The project aims to demonstrate the adaptation potential of conservation agriculture and to support knowledge generation and pro-poor farmers' investments around sustainable agriculture systems and technologies leading to more resilient agricultural production.
Supporting Moldova's National Climate Change Adaptation Planning Process	Republic of Moldova	Government of Austria		2013–2017	EUR 1 million	The project offers support to the Republic of Moldova in i) putting in place its National Adaptation Plan (NAP) process, building upon existing development planning strategies and processes and contributing to the implementation of priority adaptation actions; ii) developing the institutional and policy frameworks for medium to long-term gender-sensitive adaptation planning and budgeting; iii) strengthening the institutional and technical capacities for iterative development of comprehensive NAP; iv) demonstrating adaptation interventions in priority sectors to catalyse replication and upscaling.
Clima-East Pilot project in Moldova Sustainable management of pastures and community forests in Moldova's first National Park Orhei	Republic of Moldova	European Union	UNDP	2013–2016	USD 0.69 million	The project promotes ecosystem-based climate change mitigation and adaptation and aims to demonstrate a natural resource management model in the pastures and forests of the Republic of Moldova. More specifically the project activities shall increase ecosystem's capacity to sequester carbon under pending climate risks, while at the same time retaining biodiversity and economic values.
Improvement in the management of pastures to reduce the impact of droughts on the livestock sector	Republic of Moldova	FAO	FAO	2012–2015	USD 0.43 million	The objective of the project is to increase the resilience and preparedness of small-scale farmers to natural hazards, to improve their capacity to mitigate these hazards, and to improve the response of the Ministry of Agriculture and Food Industry (MAFI). Outputs focus on the provision of substantive technical advice on DRR specific good practices in crop and livestock production to be made accessible to small-scale farmers, and also on reinforced capacity of MAFI.

Title of programme/project	Targeted countries	Funding agency/ies	Implementation agency/ies	Implementation period	Allocated budget	Main components/project aim
Agriculture Competitiveness Project	Republic of Moldova	World Bank, GEF	World Bank	2012–2017	USD 22 million, including USD 4.44 million from GEF	The development objectives of the project include: i) to enhance the competitiveness of the country's agrifood sector by supporting the modernization of the food safety management system; ii) to facilitate market access for farmers; iii) to mainstream agroenvironmental and sustainable land management practices; iv) to exchange information on climate change adaptation measures in agriculture with farmers, agricultural producers, local public authorities and other stakeholders.
Small Grants Programme of the Global Environment Facility (GEF SGP)	Republic of Moldova	GEF	UNDP	2012–2020	USD 1.65 million	The main objective of the small grants programme is to generate national and global environmental benefits and socioeconomic development opportunities through community-based initiatives and actions implemented by NGOs and community-based organizations in the areas of biodiversity conservation, climate-change mitigation, sustainable land management, protection of international waters, phase-out of Persistent Organic Pollutants (POPs) and chemicals management.
Improvement in the management of pastures to reduce the impact of droughts on the livestock sector	Republic of Moldova	FAO	FAO	2012–2015	USD 0.43 million	The overall expected impact of the project is: i) to increase the resilience and preparedness of small-scale farmers to natural hazards (mainly droughts and floods); ii) to improve their capacity to mitigate these hazards; and iii) to improve the response of MAFI (currently MARDE). Outputs will focus on provision of substantive technical advice on DRR specific good practices in crop agriculture and livestock production to be made accessible to small-scale farmers, and also on reinforced capacity of MARDE.
Moldova Disaster and Climate Risk Management Project (DCRMP)	Republic of Moldova	International Development Association (IDA)	World Bank	2010–2014	IDA – USD 10 million (credit) GFDRR technical assistance grant USD 0.1 million	The project development objective is to strengthen the State Hydrometeorological Service's ability to forecast severe weather, improve the capacity of the government to manage emergencies as well as coordinate disaster response among local units by establishing the Emergency Command Centre. It will also initiate activities for adaptation in agriculture. These objectives are expected to all contribute to an improved capacity of the Republic of Moldova to prepare for and respond to disasters.

Title of programme/project	Targeted countries	Funding agency/ies	Implementation agency/ies	Implementation period	Allocated budget	Main components/project aim
Transition to High Value Agriculture	Republic of Moldova	MCC	MCC / Millennium Challenge Account Moldova	2010–2015	USD 102 million	The project aims at increasing incomes in the rural areas by encouraging high value agriculture and catalysing investments into high value production, which included actions aiming to enhance water resource management based on river basin management, development and implementation of environmental and social management plans for all water users associations, which include conducting disaster risk assessments, protection against flooding and implementation other climate-change adaptation related measures.
Rural Investment and Services Project II (RISP II)	Republic of Moldova		Consolidated Agricultural Projects Management Unit (CAPMU)	2006–2013	Total USD 56.37 million, of which IDA USD 48.34 million Sweden USD 6.31 million Japan USD 1.72 million	To continue to foster the post-privatization growth in the agriculture and rural sectors of the Republic of Moldova by: (i) strengthening and expanding the rural advisory services; (ii) improving business skills of the to-be entrepreneurs and assisting with the legal registration of the new businesses; (iii) upgrading the financial sector environment through a range of risk management measures, such as supervision capacity building, and introduction of new lending instruments such as leasing; (iv) increase the commercial banking sector outreach into rural areas; and (v) developing a practical approach to reducing transaction costs in land markets.
Renewable Energy from Agricultural Waste Project	Republic of Moldova		Consolidated Agricultural Projects Management Unit (CAPMU)	2005–2008	USD 2.65 million	Addressing global climate change and reducing associated threats by achieving a reduction in GHG emissions through the promotion of renewable energy from biomass. In addition to achieving actual annual emissions reductions of 4 258 tonnes of CO_2 equivalent through greater efficiency and fuel switching from coal to straw biomass, the project has been instrumental in demonstrating social and economic benefits through the use of renewable energy, including decreased operating costs.
Moldova: Soil Conservation	Republic of Moldova	World Bank Prototype Carbon Fund / World Bank Prototype C	World Bank	2002–2022	USD 19 million	The Republic of Moldova soil conservation project is reforesting 19 768 ha of heavily eroded lands and degraded and unproductive pastures, through afforestation with tree and shrub species adapted to these adverse site conditions and providing urgently needed fuel wood and timber to rural people.

Title of programme/project	Targeted countries	Funding agency/ies	Implementation agency/ies	Implementation period	Allocated budget	Main components/project aim
Rural Investment and Services Project I (RISP I)	Republic of Moldova	IDA, SIDA	Consolidated Agricultural Projects Management Unit (CAPMU)	2002–2006	USD 19.69 million: IDA – USD 19.13 million; Sweden – USD 0.56 million	To foster the post-privatization growth in the agriculture and rural sectors of the Republic of Moldova by improving access of farmers and rural entrepreneurs to legal ownership status, know-how, knowledge and financial services, while building the capacity of the private and public institutions to ensure the sustainability of the activities.
Sustainable agriculture and improvement of rural settlements in Moldova	Republic of Moldova	Dutch foundations: CORDAID and NOVIB	NGO BIOS	2000–2006	USD 0.35 million	This project focuses on: i) the development of institutional capacities (including three pilot plots and three training centres in the south, centre and north of the country) to promote sustainable agriculture in the Republic of Moldova via the models developed through cooperation with farmers based on research of soil, water quality, biologic diversity; ii) the elaboration and implementation of community area development plans; iii) the provision of training in sustainable agriculture actions for trainers and students; iii) the provision of education to children in the preservation of natural resources.
Environmental policy and technology project for Moldova	Republic of Moldova	USAID	EPT Moldova	1995–1996	USD 2.5 million	The project is aimed at providing research and demonstrations of soil conservation actions; the undertaking of soil erosion and plant protection monitoring and evaluation; the provision of training, education and awareness-building actions for trainers and farmers in conservation agriculture, grants in the form of equipment.

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