Comprehensive analysis of the
disaster risk reduction system
for the agricultural sector in Armenia

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Abbreviations and acronyms

ADF	Agriculture Development Fund
ADS	Armenia Development Strategy
AMD	Armenian dram (national currency)
ANAU	Armenian National Agrarian University
CADRI	Capacity for Disaster Reduction Initiative
CIS	Commonwealth of Independent States
CJSC	Close Joint Stock Company
CRED	Centre for Research on the Epidemiology of Disasters
DRR	Disaster risk reduction
EMDAT	The International Disaster Database
ENPARD	European Neighbourhood Programme for Agriculture and Rural Development
EWS	Early warning systems
FAO	Food and Agriculture Organization of the United Nations
FMC	Forest Monitoring Centre
GDP	Gross domestic product
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographical information systems
HMC	Hydrometeorology and Monitoring Centre SNCO of the Ministry of Environment of Armenia
HMS	Hydromet Service (Service of Hydrometeorology and Active Influence on Atmospheric Phenomena SNCO of the Ministry of Emergency Situations of Armenia)
IFAD	International Fund for Rural Development
IPCC	Intergovernmental Panel on Climate Change
MoA	Ministry of Agriculture
MoD	Ministry of Defence
MoE	Ministry of Economy
MoF	Ministry of Finance
MoESCS	Ministry of Education, Science, Culture and Sport
MoENV	Ministry of Environment
MoES	Ministry of Emergency Situations
MTAI	Ministry of Territorial Administration and Infrastructure
NAP	National Adaptation Plan
NARMA	National Agricultural Risk Management Agency
NDO	MoES National Disaster Observatory
NGO	Non-governmental organization
SCRA	Statistical Committee of the Republic of Armenia
SDGs	Sustainable Development Goals
SNCO	State non-commercial organization
SOPs	Standard operating procedures
UNDP	United Nations Development Programme
UNISDR	United Nations International Strategy for Disaster Reduction
UNDRR	United Nations Office for Disaster Risk Reduction
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization

Executive summary

Natural and biological hazards. Armenia is a landlocked mountainous country in the southern part of the Caucasus region. It is located in a high-risk zone, and is therefore exposed to various natural, as well as biological, hazards. The World Bank considers Armenia among the 60 most disaster-prone countries in the world (Dilley, 2005). Among the most frequent and dangerous hazards that pose a risk to human lives and their livelihoods, are earthquakes, flooding, landslides, rock falls, mud flows, lightning, hailstorms, drought, and wildfires. For instance, the devastating earthquake of Spitak in 1988, which had a magnitude of 6.8, killed 25 000 people, left 515 000 homeless, and caused damage estimated at between USD 15 billion and USD 20 billion (GFDRR, 2009).

Due to the country's dry climate, the frequent occurrence of disasters, as well as environmental issues – including deforestation and desertification caused by human activities – Armenia is sensitive to the adverse impacts of climate change. Climate variability, including extreme weather events combined with a gradual rise in the average annual temperature and reduced precipitation, have contributed to the intensification of hydrometeorological hazards, which may adversely impact people, their livelihoods and all sectors of the Armenian economy. It is expected that with climate change, the average annual temperature will be 10.2 °C by 2100, which is 4.7 °C higher than the 1961–1991 baseline. There may be a 16.3 percent increase in annual precipitation by 2100, although during summers it is anticipated that there will be a significant decrease in rain – by 23 percent – compared with the 1961–1991 baseline (MNP and UNDP, 2015). The Armenian agricultural sector is one of the most vulnerable sectors to climate change. According to the projections of local and international experts, the inevitable rise in the number of hydrometeorological hazards will lead to an increased risk of soil erosion and loss of soil fertility, reduction of crop yields, water scarcity and lack of irrigation, damage of crops and livestock, and an increase in pests and infectious diseases (MNP and UNDP, 2009).

Agriculture and food security. Agriculture is an important sector for the Armenian economy. In 2017, the agricultural share of the country's gross domestic product (GDP) was 14 percent (SCRA, 2018a). It is estimated that around 2 043 800 ha, or 68.7 percent of the country's total land, is agricultural land – which is made up of arable land (446 000 ha), permanent crops (34 800 ha), grasslands (121 000 ha), pastures (1 050 800 ha), and other land area (391 200 ha). According to the 2014 agricultural census, there are a total of 361 064 farms, including 360 611 household-based farms, and 453 commercial farms (farms with legal status). The size of farms varies from *marz* to *marz* (province), depending on the region. The majority of the family-based farms, around 89 percent, has up to 3 ha, which indicates that for many families in rural areas, their own agricultural production is still the main source of food for their consumption and survival (SCRA, 2016a). An estimated 236 600 farms (74.5 percent) of family-based farms are male-headed, while 80 800 (25.5 percent) of them are female-headed (FAO, 2018).

Armenia remains vulnerable to changes in external markets and economies, which poses a risk to food availability, particularly in the event of an emergency. The country has a high degree of self-sufficiency in potatoes, fruit, grapes, vegetables, lamb, eggs and fish, and above-average self-sufficiency in beef, milk and milk products, and more recently in sugar, but it still has a low level of self-sufficiency in wheat, maize, legumes, vegetable oil, and other types of meat. This in turn indicates the vulnerability of the country with regard to foreign food markets and food-price fluctuations. According to the recent WFP report on Food Security and Vulnerability Assessment in Armenia, 15.3 percent of households in Armenia are food insecure (4 percent reported poor, and 11.3 percent borderline food consumption scores), with more than 40 percent of households facing difficulties to access food in markets due to a lack of financial resources (WFP, 2020).

Armenia is especially rich in fruit, berries and nuts, such as apricot, grape, peaches, apples, plums, pears, pomegranates, quinces, figs, walnuts, and other fruit. Agroecological conditions also permit the cultivation of different types of vegetables, including tomato, pepper, eggplant, cabbage, potato, cucumber, carrot, pumpkin, bean, garden radish, parsley, basil, coriander, mint, fennel, estragon, cress, cauliflower, lettuce, water melon,

melon, and peas. Winter wheat and spring barley are the dominant cereals. Maize is mainly grown for feed, and in the mountainous areas there is limited cultivation of rye and oats. *Medicago sativa, onobrychis viciifolia*, some clover, mangolds, and vetch are also grown as feed crops, while a small amount of tobacco is cultivated as an industrial crop. Cattle, pig, poultry, and sheep breeding are the most developed types of animal breeding, and the gross output of livestock is approximately half of total agricultural production.

Institutional framework for disaster risk reduction (DRR). After the Spitak earthquake in 1988, the government undertook significant measures towards the modernization and development of its national emergency management system (MoES, 2019a). Armenia has various national DRR and management-related legal and policy frameworks, where agriculture is mainstreamed, and DRR issues are reflected in sectoral policy instruments. Disaster risk reduction is considered one of the key components of the country's overall national disaster risk management system. The Ministry of Emergency Situations (MoES) leads and coordinates DRR and disaster risk management, including disaster preparedness and response activities. Its continuous improvement remains a high priority on the government agenda as it is viewed as one of the key contributors to the security and safety of the country. Following Armenia's commitments to the implementation of the Hyogo Framework for Action (UNISDR, 2005), the Sendai Framework for DRR (UNDRR, 2015), the Paris Agreement (UNFCCC, 2015), and Sustainable Development Goals (SDGs) (UN General Assembly, 2015), the Government of Armenia – along with enhancing its emergency response potential – has acknowledged that DRR and climate-change adaptation are priority directions for the country to build a resilient future. Consequently, the integration of DRR and climate-change adaptation into sector development planning has become a key strategic approach for the government that will require continuous improvement of the relevant legal and institutional frameworks.[1] For instance, the agricultural sector is not represented in the Inter-agency Operative Working Group (IOWG) on emergencies, which is chaired by MoES and focuses on the enhancement of national-level integrated DRR efforts and coordination. In addition, the Ministry of Economy (MoE), that is currently responsible for agriculture – due to recent dissolution of the Ministry of Agriculture (MoA) in the course of a major government restructuring – plays rather a secondary role, being mainly focused on emergency response rather than on risk reduction preventive measures.

Agrometeorological services. Since the government restructuring of 2019, Armenia's Hydromet Service (HMS) was transferred from MoES to the Ministry of Environment (MoENV), and is now called the **Hydrometeorology and Monitoring Centre (HMC) State Non Commercial Organization (SNCO).** It was merged with two other structures operating within the MoENV – the Forest Monitoring Centre (FMC), and the Environmental Monitoring and Information Centre (EMIC). The HMC covers the entire territory of Armenia, performing observation of hydrometeorological elements and events, such as the weather, climate, hydrological and geophysical observations. In addition, the HMC provides hydrometeorological services to decision makers and other beneficiaries (including the agricultural sector). Approximately 45 percent of stations of the HMC observation network possess 70-year old observation data, 80 percent of which is currently digitised. The provision of agrometeorology services is one of the HMC's key functions. The HMC meteorological database includes observation data on weather and climatic elements (temperature, precipitation, snow, solar radiation, elements of atmosphere vertical section, and so on), including metadata, as well as data on hydrometeorological and climatic risks. Its current telecommunication system operates through the World Meteorological Organization (WMO) and the e-platforms of their global information service centres, which collect, process and distribute data from the stations and satellites.

Being part of global observation network, the HMC contributes to the WMO information system, providing daily observations and monthly climate data, as well as five-day weather forecasts on a daily basis. Under the Commonwealth of Independent States Interstate Council on Hydrometeorology, the HMC exchanges data from 16 hydrometeorological stations with Commonwealth of Independent States national partner agencies. It also shares data from 32 stations with the Russian Federation's hydrometeorological services within the context of the bilateral cooperation programme on hydrometeorological forecasting. The HMC provides short-term weather forecasts (24-hour, five-day) based on its own data and by using global models obtained via the internet. It issues a 'hydrometeorological bulletin', which provides daily hydrological updates for rivers and lakes, but meteorological and agrometeorological information is not included yet.

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[1]This has been accomplished through the adoption of enabling policies, strategies, programmes and structures. More details are provided in the relevant sectors of this document.

Early warning systems (EWS). At present, Armenia does not have a proper EWS in place (Tammelin, 2012). There are government-adopted regulations which outline the warning procedures for emergencies (Government of Armenia, 2005a). In addition, there is the latest Government decree on the approval of regulations for state executive and self-governing bodies, organizations and the public, on warning and awareness in emergencies (Government of Armenia, 2017b). It describes the responsibilities of all actors involved and provides instructions for action, defines warning tools, and the meaning of different signs. However, these regulations refer to major disasters (for example, external military attack, including from the air, hazards such as the radiation and chemical, or dam collapse) for which particular national plans are available. It is the HMC that currently provides the initial information and triggers the activation of an early warning. This is an alert rather than a warning with presumed standard communication and operational procedures. As mentioned earlier, formally, a system with a systematic management procedure with clear distribution of roles and responsibilities, chain of management and decision-making procedures, does not exist. Upon receipt of the HMC's alert regarding potential hazards (received through the government's internal electronic communication), the agricultural authorities (MoE) proceed with informing the population regarding the required preventive measures to be undertaken. Both the HMC and MoE use the mass-media channels and messaging options to inform the organizations and general public. There is a price-monitoring system in Armenia conducted by the Statistical Committee of the Republic of Armenia (SCRA) and available on their website. However, a regular market monitoring and information system does not exist.

Disaster risk reduction in agriculture. At present, the agricultural sector, as one of the key DRR beneficiaries, is relatively passive and not substantially involved in DRR at the national level. Formally, however, it exists in all official policy, strategic and legal documents, with a defined role and function. In practice, it does its portion of the work, but it does so in isolation, and in a reactive way with respect to disasters that impact the agricultural sector. Disaster risk reduction and management, as a regular and systematized approach and framework with a set of management procedures, does not exist in the agricultural sector. There are elements of disaster risk management, which mainly refer to the traditional areas of protection, such as the prevention of plant and animal infectious diseases and epidemics, pest control and emergency response to the impacts of natural hazard-induced disasters. At the same time, the government has made a significant attempt to improve the effectiveness of use of natural resources, elimination of hazardous risks and protection of agricultural production through the application of modern technologies and approaches in agriculture, including the improvement and effectiveness of risk monitoring and assessment through modernization of HMC and agrometeorology services; introduction of agricultural insurance; planting of intensive orchards; promoting the construction of smart barns; introduction of modern irrigation systems; and improvement of anti-hail systems and wider use of anti-hail nets.

Programmes and projects related to DRR. Various UN agencies, including FAO, WFP, UNDP, as well as other international organizations such as GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit, the German agency for international cooperation), together with key national institutions, are implementing a number of programmes and projects related to DRR, EWS and agrometeorology services, including adaptation to climate change.

Conclusions and recommendations. At present, the country is undergoing a shift from a reactive to a proactive DRR approach. The country has various national DRR-related laws, plans, policies and strategies where agriculture is included, as well as national sectoral policy instruments where DRR is integrated – DRR is considered one of the key components of the country's overall national disaster risk management system. MoES both leads and coordinates DRR, including disaster preparedness and response activities. The agricultural sector is currently not substantially involved in DRR at national level and still takes a more reactive approach to disasters. At present, Armenia does not have an EWS established, but this is high on the government's policy agenda – it is already included in relevant policy instruments, and the government is currently in the process of adopting the related legal documents. Agrometeorological services need to be enhanced, in particular for the agricultural sector, such as the inclusion of agrometeorology information into its existing hydrometeorological bulletin in order to enhance applicable information products and services to farmers. The government is striving to implement more DRR-related activities, such as the introduction of agriculture insurance, increasing the effectiveness of risk monitoring and assessment and the establishment of modern irrigation and anti-hail systems, which will help to reduce the adverse impacts of natural and biological hazard-induced disasters on agriculture in Armenia.

Thus, suggested recommendations include the following:

Recommendations for improvement of agrometeorology services:

- Identify and implement low-cost, high-priority activities to achieve the minimal but highly critical capabilities to provide weather, climate and hydrological services.
- Initiate intermediate modernization, which includes investments to achieve a modest enhancement in its capabilities in terms of provision of hydrological, weather and climate services.
- Complete modernization, which entails investments needed to bring the HMC to the level of advanced middle-income countries' capabilities to provide data, forecasts and warning services to meet user needs.

Recommendations for improvement of early warning systems:

- Elaborate and establish criteria and a set of indicators for risk levelling (for each particular hazard).
- Identify thresholds to inform the activation of the EWS.
- Develop standard operating procedures (SOPs) and operational protocols for communication and decision making.
- Map potentially affected areas and indicate preferable action in terms of effectiveness of reduction, mitigation and disaster response interventions.
- Establish the requirements for regular risk monitoring and analysis.
- Draft standard procedures and templates for case-specific scenarios-based on contingency planning, implementation mechanisms and management procedures, including division of roles and responsibilities of the actors involved.
- Establish coordination mechanisms and protocols.
- Prepare a minimum standard preparedness checklist to develop response and preparedness plans.
- Elaborate SOPs for EWS public awareness and communication.

Recommendations for improvement of disaster risk reduction systems:

- Develop and introduce a disaster risk management strategy for the agricultural sector.
- Develop and adopt standard management and coordination procedures for DRR and disaster risk management to also be applicable to the agricultural sector.
- Elaborate and introduce DRR, disaster risk management, climate-change awareness, and agricultural education campaigns at the community level and among focus groups (farmers).
- Facilitate the government's (pending) adoption of a number of already drafted legal acts, including the Disaster Early Warning System Formation Concept (Government of Armenia, 2018a), and the Law of the Republic of Armenia on Disaster Risk Management and Population Protection (MoES, 2019b).[2]
- Expand the performance of the MoES National Disaster Observatory (NDO) by turning it into a large-scale and unified disaster data platform.
- Establish an online depositary of case specific DRR, disaster risk management, and climate-change adaptation models, and local and international good practices.
- Study and build on the experience gained throughout the introduction of agricultural insurance and introduce corrections, changes, and adjustments in the approaches and schemes.
- Introduce the already developed and approved disaster needs assessment methodologies and tools, including: Armenia's inter-agency needs assessment (ARIANA) tool;[3] post-disaster needs assessment (PDNA) methodology; guidelines and methodology for disaster needs assessments in the agricultural sector based on international standards; PDNA software for agriculture.
- Develop and approve standard procedures for early warning and contingency planning, including required forms and templates.
- Elaborate legislative provisions for the management and coordination of biological disasters clearly defining the roles and responsibilities of the actors involved.
- Establish a legal basis for public–private cooperation in emergencies as one of the key components of emergency response.

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[2] Although the draft law does not refer directly to the agricultural sector, it establishes a unified disaster risk management platform that is applicable to all socioeconomic sectors and respective development plans.

[3] This is a humanitarian needs assessment tool similar to the Multi-cluster Initial Rapid Assessment (MIRA) recommended by the Inter-Agency Standing Commission (IASC).

Introduction

The Europe and Central Asia (ECA) region is prone to various natural hazards, including flooding, drought, hail, avalanches, landslides, storms, and so on. 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, and impact food security, nutrition, and ecosystem services. The agricultural sector, and in particular smallholders, herders, fishers, and foresters, are particularly vulnerable to the adverse impacts of climate change, as the majority of these small producers are dependent on the sector and its activities for their food and livelihoods.

This Comprehensive analysis of the disaster risk reduction system for the agricultural sector in Armenia is part of a series of country baseline studies on the DRR system in the agricultural sector, conducted by the Regional Office for Europe and Central Asia (REU) of the Food and Agriculture Organization of the United Nations (FAO). The other countries included in the series are Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Tajikistan, Turkey, Turkmenistan, Ukraine, and Uzbekistan. Similar reports analysing the DRR and management system for the agricultural sector in Western Balkan countries (Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia) were completed in 2018.[4]

The country baseline studies review the current status of DRR, EWS, and agrometeorology services in the agricultural sector, including legislation, policies, capacities, and services related to the DRR system. They assess the gaps, and what is needed to improve and 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) as well as 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 the provided guidelines and developed 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.[5] Interviews took place from 8 May to 23 May 2019 and the list of people interviewed can be found in Annex I. In addition to primary data collection, extensive desk study was conducted.

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

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[4]The Western Balkan studies are available at http://www.fao.org/europe/resources/comprehensive-analysis-of-the-disaster-risk-reduction-and-management-system-for-agriculture-in-the-western-balkans/en/#c589778.

[5]CADRI brings together six United Nations organizations – FAO, United Nations Office for the Coordination of Humanitarian Affairs (OCHA), UNDP, UNICEF, WFP and WHO. This UN-led interagency initiative delivers customized capacity development support in DRR.

Country background

Armenia is a Eurasian country situated in western Asia. The country occupies the northeastern part of the Armenian plateau, located between the Caucasus and the Near East – and between the Kura and Aras rivers. It has a total area of 29 743 km². In the north and east, the country borders Georgia and Azerbaijan, and in the west and south it borders Turkey and the Islamic Republic of Iran. It stretches to 360 km from northwest to southeast, and 200 km from west to east.

More than three-quarters (76.5 percent) of the territory of Armenia is mountainous and located at between 1 000 metres and 2 500 metres, with an average altitude of 1 830 metres. The lowest altitude is 375 metres (Debed river canyon), while the highest point is 4 095 metres – at the summit of Mount Aragats. Most of the areas are covered with a complex combination of highlands, plateaus, valleys and rivers with limited land, water and river resources prone to adverse geodynamic processes. Agricultural land makes up 68.7 percent of the country's territory, while the rest is covered by forests (11.2 percent) (MoEnv, 2020) and surface water (4.77 percent) (OECD.Stat, 2015).

Armenia is subdivided into ten *marzes* (provinces), and the capital city of Yerevan. The marzes, defined by the Law on Administrative-Territorial Division of the Republic of Armenia, are: Aragatsotn, Ararat, Armavir, Gegharkunik, Lory, Kotayk, Shirak, Syunik, Vayots Dzor, and Tavush. Marzes are divided into urban and rural communities. They differ in territories, population size, number of communities, and level of economic development (MTAI, 2019). As of March 2020, the total number of communities was 502 (1 004 settlements) (SCRA, 2020). Armenia inherited centralized planning and state-owned large farms from the Soviet era, but since gaining independence in 1991, it has undertaken major reforms towards privatization of land and market liberalisation.

The total population of Armenia in 2020 was 2 959 694 people, of which about 36.1 percent was rural and 63.9 percent was urban. The population density is 100 inhabitants/km². The annual demographic growth was 0.44 percent in 2017. In 2018, GDP increased by 3.4 percent (SCRA, 2018c). However, it did not match pre-crisis (2008) levels of growth. Around one in four people live below the poverty line (25.7 percent in 2017), of which the extreme poverty incidence is 1.4 percent (2017). Unemployment is a serious and growing problem, affecting 17.8 percent of the economically active population (SCRA, 2018c) – it has been increasing since 2012, especially among women and young people. Yerevan has the highest percentage of unemployment, at 27 percent. The unemployment rate in Armenia averaged 12.15 percent from 1998 to 2017, reaching an all-time high of 20.7 percent in the first quarter of 2011, and a record low of 6.3 percent in the first quarter of 2008.

Approximately half of the country's territory and 80 percent of the population is exposed to catastrophic events (GFDRR, 2009). As stated in the PPRD-East report (2013),[6] Armenia is one of the most disaster-prone countries in the world, as it is exposed to all types of natural hazards, including severe earthquakes, frequent landslides, hailstorms, drought and flooding, that put people at risk and can cause considerable damage that may undermine the country's development.

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[6]Prevention, Preparedness and Response to natural and man-made disasters in Eastern Partnership countries (PPRD East 3) is an EU-funded programme.

Natural resources

Characteristics of landscape

The landscape in the country's central and northern parts is made up of rocky mountain ridges that are split into narrow, fertile valleys. In the south, along the left bank of the Aras River, the wide and fertile Ararat Valley is located. From Mount Aragats to the west and the north, and to the eastern part of the Lake Sevan (one of the largest mountain lakes in the world), the area is distinguished by rocky exposure. The southeastern part of the country is mainly covered by small, irregular valleys surrounded by high mountain ranges. Pastures are located at different altitudes of highlands. The existence of various altitudes is an important factor for the climate and the formation of vertical landscape zones. Armenia's territory has high seismic activity, with exogenous processes that contribute to the evolvement of landslides and land erosion.

The country is divided into two major river basins – the Aras basin in the southwest (76 percent of the country's territory) and the Kura basin in the northeast (24 percent). There are about 9 500 rivers and streams in Armenia, of 23 000 km length in total. Of these, 379 rivers have a length of 10 km to 100 km, and seven (Akhuryan, Debet, Vorotan, Hrazdan, Aghstev, Arpa and Metsamor-Kasakh rivers) are more than 100 km long. Around 4.3 percent of the country's territory is covered by Lake Sevan, one of the highest fresh-water lakes in the world, and by far the largest lake in Armenia with a volume of 38.31 km^3. In addition, there are around 100 other lakes in the country with a combined volume of 0.8 km^3 (FAO and AQUASTAT, 2008).

Despite the small size of the country, the relief is characterised by a variety of natural and climatic conditions,[7] which correspond to diverse agroecological zones ranging from semi-desert to alpine. Armenia's mountainous terrain has contributed to the formation of ten different landscape types, as shown in Figure 1. There are also a number of intra-zonal ecosystems (that is, wetlands, cliffs, cracks, stone accumulations) which are common for almost all high mountain zones.

With high-quality volcanic and alluvial soils in the river valleys, like the Ararat Valley and semi-arid mountainous highland soils and climates, Armenia is perfect for the production of vegetables, herbs, specialty tree fruit and nuts, as well as grapevines. High-elevation pasture supports the production of high-quality livestock meat and milk products, as well as apiculture products. This high-altitude mountainous environment is also ideal for the wild production, artisanal collection and processing of exotic herbs, spices, fruit, nuts, and berries.

Biodiversity

The diversity of landscapes and ecosystems in Armenia, along with relief peculiarities, vertical zonation and ten landscape-climatic zones, contribute to the formation of rich and unique plant diversity. The specific and intra-specific composition of plants in Armenia is also conditioned by the country's location, as it is at the intersection of important zones with regard to the formation of flora and fauna of the region. Despite the small size of the country, there are about 3 800 species of vascular plants, which is 3.8 percent of total flora in the world, and some are endemic. In addition, Armenia is ranked among the countries in the world with the highest density of vascular plants, about 107 species per $1 000 \text{ km}^2$ (Avagyan, 2019). The country has around 17 759 species of invertebrate and vertebrate animals. The biodiversity of Armenia is notable for high endemism – about 500 species of fauna (about 3 percent of the total fauna) and 144 species of flora are considered to be endemic (MNP, GEF and World Bank, 2014).

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[7]Almost all types of climatic patterns can be observed in Armenia – the country's climate ranges from arid subtropical to cold, high mountainous.

Figure 1. Landscape zones in Armenia
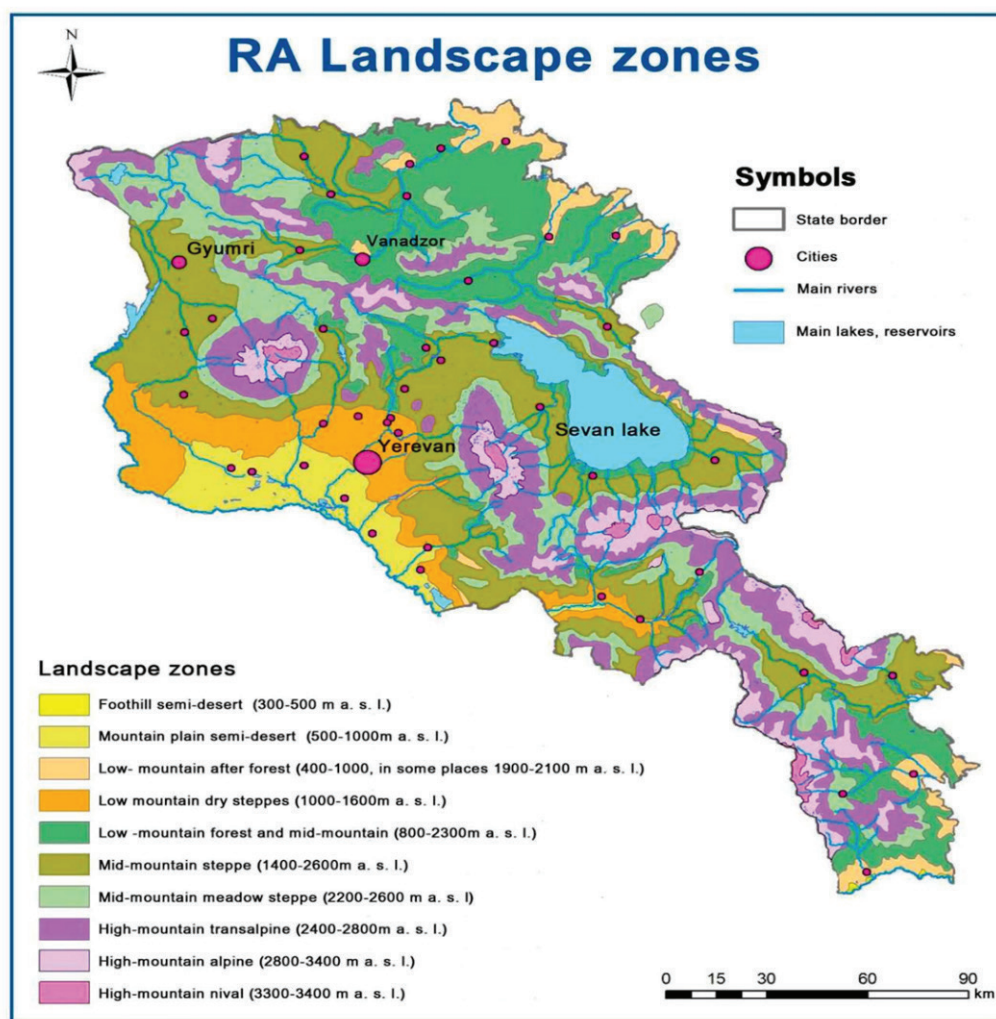
Source: MNP 2014.

Agriculture

Armenia is divided into nine agroclimatic zones, which is based on the similarity of climatic features and conditioned by the growth and productivity of plants. These zones differ in terms of moisture and heat (FAO and ENPARD, 2017):

1. Ararat valley – includes Ararat and Armavir marzes. The total area of the zone is about 32 000 ha (10.8 percent of the total area of the country). Agricultural land makes up 56 percent of the area, the main portion of which is 800 metres to 1 000 metres above sea level. Only irrigation farming is possible in this zone.

2. Uplands of Ararat valley – covers about 307 000 ha (10.3 percent). Agricultural land makes up 53 percent of the area and includes areas of 900 metres to 1 000 metres above sea level, and higher. Farming is undertaken both through irrigation and supplementary rain.

3. Central zone – covers an area of 194 000 ha (6.5 percent). Agricultural land makes up 50 percent of the area and includes areas of 1 400 metres to 1 800 metres above sea level. Farming is mainly conducted under rainfed conditions.

4. Sevan basin – includes the Gegharkunik marz. Agricultural land makes up 61 percent of the area. The first sub-zone is situated at up to 2 000 metres above sea level and the second sub-zone above 2 000 metres. There is a need for irrigation in the first sub-zone.

5. Northeastern zone – agricultural land makes up 22 percent of the area. The lower sub-zone is situated

at up to 900 metres above sea level and the second sub-zone above 900 metres. Farming is conducted mainly under rainfed conditions and partially by irrigation.

6. Lori-Pambak zone – agricultural land makes up 59 percent of the area. It is divided into two sub-zones, mountain forests (up to 1 500 metres) and mountain steppe (above 1 500 metres). In both sub-zones, farming is conducted under rainfed conditions.
7. Shirak zone – agricultural land makes up 60 percent of the area. The first sub-zone is situated at up to 1 700 metres above sea level and the second sub-zone above 1 700 metres. There is a need for irrigation in the first sub-zone.
8. Vayk zone – includes the Vayots Dzor marz. Agricultural land makes up 33 percent of the area. It is divided into three sub-zones – up to 1 400 metres, up to 1 900 metres, and above 1 900 metres. Irrigation is required for farming in the first two sub-zones.
9. Zangezur zone – includes the Syunik marz. Agricultural land makes up 27.8 percent of the area. In the first sub-zone (up to 900 metres), farming is conducted under irrigated conditions, while in the second and third sub-zones, it takes place mainly under rainfed conditions.

Agricultural production is primarily conditioned by the relative altitude of the area and the thermic conditions. On the basis of these factors, three main agricultural production zones can be identified: the Ararat Valley up to 1 200 metres, the pre-mountain zone (1 200 metres to 1 800 metres), and the mountain zone, higher than 1 800 metres. Crops are cultivated up to 2 400 metres (MoA, 2018).

Armenia is especially rich in fruit, berries and nuts, such as apricots, grapes, peaches, apples, plums, pears, pomegranates, quinces, figs, walnuts, and other fruit. Agroecological conditions also permit the cultivation of different types of vegetables, including tomato, pepper, eggplant, cabbage, potato, cucumber, carrot, pumpkin, bean, garden radish, parsley, basil, coriander, mint, fennel, estragon, cress, cauliflower, lettuce, watermelon, melon, and peas. Winter wheat and spring barley are the dominant cereals. Maize is mainly grown for feed, and in the mountainous areas there is limited cultivation of rye and oats. *Medicago sativa, onobrychis viciifolia*, some clover, mangolds, and vetch are also grown as feed crops, while a small amount of tobacco is cultivated as an industrial crop (Millns, 2013). Cattle, pig, poultry, and sheep breeding are the most developed type of animal breeding and currently the gross output of livestock products is more than half of overall agricultural production.

Land use for agriculture

Armenia is a country with limited land resources. The country's landscape is a combination of mountain ranges, uplands, plateaus, and valleys. Agriculture in Armenia is greatly influenced by the landscape. The predominant agricultural soils are generally fertile. According to Government of Armenia data, approximately 2 043 800 ha, or 68.7 percent of the total land in Armenia, is farmland. This includes arable land (446 000 ha), permanent crops (34 800 ha), grasslands (121 000 ha), pastures (1 050 800 ha), and other land (391 200 ha), as shown in Table 1, Figure 2, and Figure 3 (SCRA, 2018b).

Figure 2. Armenia's land use and surface hydrology map

Source: American University of Armenia, 2007.

Table 1. Land balance of Armenia, as of 1 July 2017

Description	Total	of which irrigated
	thousand hectares	
Area of Armenia	2 974.3	208.4
Farmland	2 044.5	154.9
of which		
Arable land	445.6	118.8
Permanent crops	35.3	34.6
Grasslands	121.0	1.5
Pastures	1 051.6	
Other land	391.0	

Source: SCRA, 2018b.

Figure 3. Farmland balance of Armenia (%), as of 1 July 2017
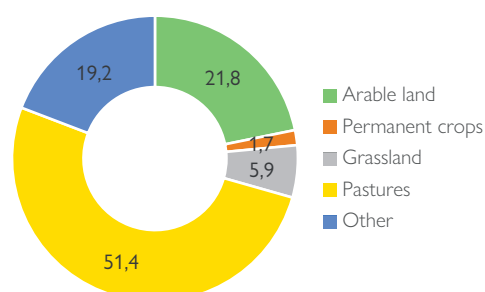
Source: SCRA, 2018b.

After comprehensive land reform in 1991–1994, which included land privatization, the agricultural sector in Armenia went through a transformation and moved away from agriculture based on large-scale state and collective farms, towards small, family-based farms. As of 1 January 1999, around 1 000 state and collective farms that existed at the start of the land reform were replaced with 333 800 family farms. The size of the newly established farms was on average 1.33 ha and consisted of three different types of land plot – arable land, perennials, and grasslands, located in different areas (SCRA, 1998). This resulted in high levels of fragmentation of agricultural land, which still contributes today to low agricultural productivity.

Since the land reform, the number of farms and their average size have not changed significantly, and the fragmentation of land has remained in place. The 2014 agricultural census registered a total of 361 064 farms, including 360 611 household-based farms (family farms), and 453 commercial farms. As shown in Figure 4, farms in Armenia are small – almost 60 percent of farms have less than 1 ha of agricultural land. Moreover, farms larger than 5 ha are make up around 5 percent of all farms and hold around 34 percent of agricultural land (FAO, 2020). These farms were involved in all types of agricultural activities, including plant production, livestock and poultry production, and other agricultural activities. A total of 346 217 farms, of which 345 875 are family farms and 342 commercial farms, have their own land. The average size of land owned and/or cultivated by family farms is 1.48 ha, which can be highly fragmented – on average, each family household consists of three different land plots, while the average size of commercial farms is 62.57 ha. Thirty-three percent of land which includes backyard land owned by family households is divided into six or more plots, while 59 percent of farmland is divided into three or more plots, and 18 percent of farmland is divided into six or more plots (FAO, 2020). The size of farms generally varies from marz to marz. According to 2014 agricultural census data, 236 600 family farms (or 74.5 percent of the total) are male-headed, while 80 800 (or 25.5 percent) are female-headed (FAO, 2018).

The majority of the family-based farms, around 89 percent, are of up to 3 ha, which shows that for many families in rural areas, their own agricultural production is still their main source of food for their consumption and survival (SCRA, 2016a).

Small, fragmented land parcels lead to farm inefficiency, non-optimal land use patterns, as well as limited investments in innovation and technologies, increased production costs (for example, operating costs of agricultural machinery), and difficulties using the infrastructure built during the USSR era for large-scale farms. In addition, the non-attractiveness of land as collateral (for loans) and the underestimated monetary value of land, leads to more disputes related to property and use rights, as well as abandonment of land (FAO, 2018).

Figure 4. Average size of land plots (ha), 2014

Source: SCRA, 2016a.

According to the 2014 agricultural census, on average 33 percent of arable land belongs to holdings that have no legal status (family farms), and 38 percent of holdings with legal status (commercial farms) are not in use. These figures do not reflect orchards and vineyards, and backyard land, which could potentially increase the area of land not in use.

In Armenia, several negative trends are adversely impacting agricultural production and food security, and those trends have economic, social and environmental aspects that are interconnected. Those trends have negative impacts on different segments of agricultural value chains, the main ones being:

- inefficient farm structure;
- land fragmentation and small farm sizes;
- land abandonment;
- migration and aging rural population;
- deterioration of quality of life in rural communities and increasing gap between livelihoods in rural and urban areas;
- lack of knowledge about and access to new agricultural technologies;
- lack of availability and reliability of irrigation water and in many areas limited access to affordable irrigation;
- slow formation of agricultural support infrastructures;
- low level of application of modern technologies;
- outdated agricultural machinery and lack of access to it;
- high level of production costs;
- lack of modern warehouse facilities;
- high transportation costs;
- low level of marketing and diversification of export markets;
- low quality of agricultural inputs;
- low level of organization and cooperation of farmers and low bargaining power as a result;
- high frequency of climatic hazards, in line with low prevalence of mitigation measures;
- limited investment in agriculture;
- ineffective use of land resources and increasing land degradation;
- weak agricultural land market.

Water use

The agricultural sector in Armenia is heavily dependent on irrigation and thus, irrigation infrastructure significantly supports agricultural production. It is reported that approximately 80 percent of gross crop output is produced on irrigated lands. High value crops, such as fruit, vegetables, potato, and grapevines, are cultivated on 84 percent of the country's total irrigated arable land (Dube *et al.*, 2018). Irrigation systems and canals that were built near major rivers in the 1920s during the Soviet era are still in use today. In 2018, the total irrigated
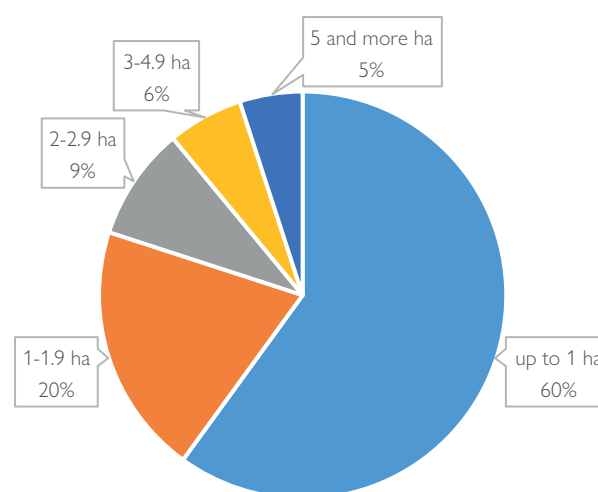
area in Armenia was around 208 400 ha, out of which 154 900 ha was irrigated agricultural land, and 53 900 ha was backyard land (Government of Armenia, 2018c), but the actual irrigated agricultural land is about 90 000 ha to 130 000 ha (Christensen, 2017).

The amount of total irrigated agricultural land has drastically decreased compared with before 1990, when it was 275 000 ha. The reasons for the decrease relate to poor maintenance and dilapidation of the country's irrigation infrastructure. The lack of irrigation limits opportunities for expansion of the agricultural sector, as well as the considerable investments required for the development of irrigation systems.

Table 2. Overview of Armenia's land resources and irrigated type of land (ha thousands), 2006–2017

Land resources (ha thousands)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Lands, total	2974.3	2974.3	2974.3	2974.3	2974.3	2974.3	2974.3	2974.3	2974.3	2974.3	2974.3	2974.3
of which irrigated	207.1	207.6	209	208.9	208.5	207.9	207.8	207.8	207.7	208.2	208.3	208.2
Agricultural, total	2129.6	2122.1	2121.2	2120.3	2100.1	2077	2052.4	2051.0	2049.4	2045.7	2045.5	2043.8
of which irrigated	153.9	154.6	155.9	155.8	155.2	154.6	154.4	154.2	154.6	154.7	154.8	154.7
Farmland	452.9	452.1	450.4	449.4	448.5	449.2	448.4	448.2	447.5	446.7	446.4	446.0
of which irrigated	126.2	124.3	123.5	122.5	121.6	120.9	120.3	120.2	120.1	119.6	119.4	119.1
Permanent crops	27.3	29.6	31.6	32.6	32.9	33	33.4	33.3	33.7	34.4	34.7	34.8
of which irrigated	26.2	28.8	30.9	31.8	32.1	32.2	32.6	32.5	33.0	33.6	33.9	34.1
Backyard land	89.1	94.6	94.7	94.9	95.0	94.9	94.4	94.6	94.5	94.5	94.5	94.6
of which irrigated	50.7	52.5	52.5	52.53	52.5	52.8	52.9	52.9	52.9	52.9	52.9	52.9

Source: SCRA, 2019a.

Climate and climate–change projections

Armenia's climate is influenced by the Caucasus Mountains, and ranges from dry subtropical to cold alpine. The climate is highland continental, with hot summers and cold winters, which is suitable for the growth of various agricultural crops. The climate depends on altitude, with dry subtropical weather in the lowlands, and a mountain tundra climate in the highlands.

Overall, the climate is rather dry, with an annual average precipitation of 592 mm, of which over 40 percent occurs from April to June. The average annual precipitation is between 200 mm and 250 mm in the lowland areas, and from 800 mm to 1 000 mm at higher altitudes. The average air temperature varies from -8 °C in the high mountainous regions (2 500 metres above sea level and higher), to 12 °C to 14 °C in the valleys. The lowest temperatures are recorded from December to February (ranging from -3 °C to -7 °C), and the highest in July and August (averaging about 20 °C). In the lowland areas, the temperature can reach between 24 °C and 26 °C in July and August, while in the high alpine regions it typically does not exceed 10 °C. Armenia's weather is characterised by a high number of sunshine hours, with an annual average of 2 700 hours. In the summer months, the Ararat valley is perpendicular to the sun, and each square centimetre of land receives 1.46 calories of heat per minute. The amount of sunshine hours has supported the development and advancement of greenhouse farming during the past decade.

Due to the shrinking of glaciers in the mountain regions by an estimated 50 percent, an increase in average temperature of 1.23 °C during the period from 1929 to 2016 was observed (MNP and UNDP, 2018). For 2018, average temperatures of -3.3 °C for January and 15.1 °C for June were reported, which indicate a deviation from the 1961–1990 norm of 3.5 °C and 1.7 °C, respectively (SCRA, 2019b).

The average annual precipitation in Armenia is relatively low at 526 mm, with higher precipitation in high-altitude regions, and May and June being the wettest months. The annual precipitation in over 60 percent of the country is less than 600 mm, and less than 400 mm in 20 percent of the country. The latest environmental data from the Statistical Committee of Armenia (SCRA) is also in line with these trends (Figures 5 and 6).

Figure 5. Annual average air temperature, 1935–2018; deviation from norm, 1961–1990
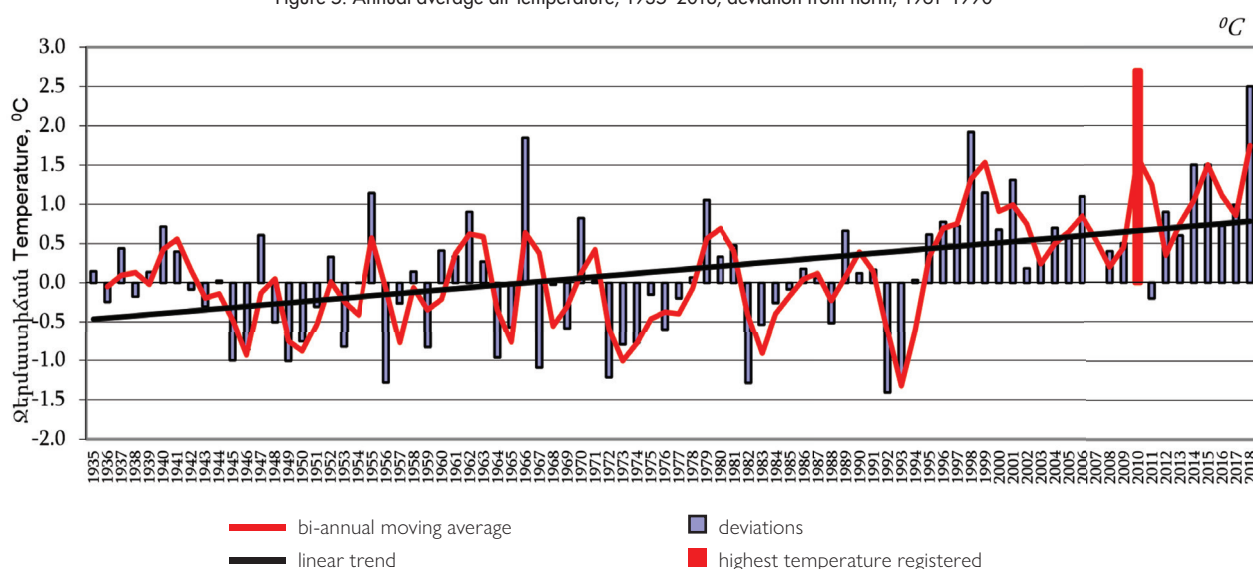
Source: SCRA, 2019a.

Figure 6. Annual average precipitation, 1935–2018; deviation from norm, 1961–1990
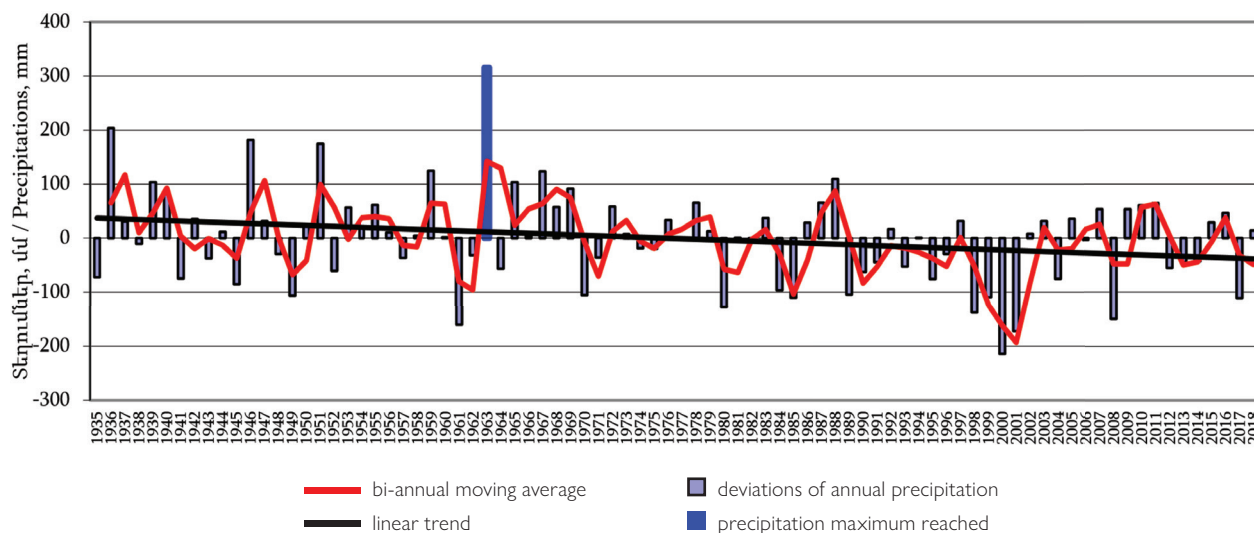
Source: SCRA, 2019a.

Armenia's Third National Communication on Climate Change (NCCC) report recommends various representative concentration pathway (RCP) scenarios for carbon dioxide emissions (MNP and UNDP, 2015). Three periods, namely, 2011–2040, 2041–2070, 2071–2100, were selected for temperature and precipitation projections to be compared with the 1961–1990 baseline. According to the report, the temperature will continue to increase across all seasons. However, according to the RCP8.5 scenario, the temperature will rise at a more rapid rate during the 2041–2100 period. According to the RCP8.5 scenario, it is very likely that by 2100, the average annual temperature in Armenia will be 10.2 °C, which exceeds the baseline (1961–1990) by 4.7 °C. That scenario also anticipates a 16.3 percent increase in annual precipitation in Armenia by the mid twenty-first century. There will be no changes in precipitation according to the RCP6.0 scenario. However, according to both scenarios, there is an expected significant decrease in precipitation in all three periods during the summer months, and specifically during the 2011–2040 period, precipitation is expected to decrease by about 23 percent compared with the baseline (1961–1990) period.

According to predictions, the city of Yerevan and the Ararat Valley will suffer most due to the largest reduction in precipitation – 30 percent less precipitation by 2100. Decreases in snow cover are also expected that will likely result in the reduction of spring runoff and river flow. Thus, the average river flow in Armenia will decrease by up to 24 percent by 2100 (MNP and UNDP, 2009).

Experts predict that the negative consequences of climate change may result in:

- degradation or disappearance of one-quarter to one-third of all forest land;
- 100-metre shift of agro-climatic zones upward by 2030, and 200 metres to 400 metres by 2100;
- reduction in crop yields as a result of temperature increases, reduced rain, and increasing evaporation;
- reduced productivity and degradation of agricultural land;
- increasing adverse impacts of extreme weather events due to expected increases in their frequency and intensity;
- inconsistent changes in average annual precipitation and expansion of irrigated land areas, and the need for additional irrigation water;
- more intensive degradation of land, including soil erosion and loss of soil fertility (MNP and UNDP, 2015).

According to a World Bank report (2014),[8] the direct temperature and precipitation effects of climate change on crops are anticipated to be mainly negative. As a result of climate change, the yields of some crops (wheat, tomatoes) are expected to increase in the pre-mountainous and mountainous regions, while in the lowlands

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[8] This study divided Armenia into three agricultural regions according to elevation: mountainous (between 1 700 and 2 500 meters), intermediate (from 1 000 to 1 700 metres), and lowlands (up to 1 000 metres), which includes the Ararat valley.

yields are predicted to decrease, especially on non-irrigated land, as shown in Table 3. Due to the temperature rise, it is expected that the outbreaks of plant and animal pests and diseases may increase, as well as the rise in the exposure of crops and livestock to new pests and diseases (World Bank, 2014).

Table 3. Projected impact of climate change on crop yields (%)

| Crops | Irrigated land | | | Non-irrigated land | | |
| | Agricultural regions | | | | | |
	Lowlands	Intermediate	Mountainous	Lowlands	Intermediate	Mountainous
Alfalfa	−5	−7	−2	−3	−8	−1
Wheat	−6	1	38	−8	1	38
Potatoes	−12	−9	−5	−14	−14	−8
Tomatoes	−16	6	50	−19	−8	34
Watermelon	−12	10	–	−18	0	–
Apricot	−5	−5	−5	−28	−7	−5
Grapes	−7	−5	−5	−24	−12	−1

Source: World Bank, 2014.

Natural and biological hazard profile

A wide range of national, international and sectoral studies provide information on Armenia's hazard profile, highlighting a large variety of hazards, some of which can result in significant damage and losses. For instance, a Global Facility for Disaster Reduction and Recovery (GFDRR) study (2009) outlines a hazard risk ranking matrix that was developed by the Armenian Rescue Service for the city of Yerevan and ten marzes, as shown in Table 4. This table shows that practically the entire territory of Armenia is at a high risk of earthquakes, hailstorms, landslides and flooding, with the most vulnerable marzes being Shirak, Kotayk, Armavir, Ararat, and Vayots Dzor. At the same time, in the event of a major earthquake of 7.0 or higher magnitude, the city of Yerevan, though ranked as a medium-risk area, will suffer severe fatalities and damage (according to estimations), possibly including 300 000 fatalities and with most of the buildings, residential houses, and critical infrastructure destroyed (UNDP, 2011a).

Table 4. Hazard matrix for Yerevan and marzes

Marzes	HAZARD											
	Earthquake	Hailstorm	Flooding	Landslide	Chemical waste	Snow	Flash flooding	Frost	Swamp	Wind	Drought	Average
Yerevan	1	0.35	0.7	0.7	0.35	0.35	0.35	0	0.35	0	0	0.37
Shirak	1	0.7	0.7	0.35	0.7	1	0.7	1	0.7	0.7	0	0.68
Kotaik	0.7	0.35	1	0.7	0.35	0	0.7	0.7	1	1	0	0.59
Vayots Dzor	0.7	0.7	0.7	1	1	0.35	0.7	0	0	0.7	0	0.53
Armavir	0.35	0.7	0.35	0.35	0.7	1	0.7	0.7	0.7	0	0	0.5
Ararat	0.7	0.35	0.35	0.7	0.7	0.7	0.35	0.35	0.35	0	0.35	0.44
Lori	0.7	1	0.7	0.7	0.35	0.35	0.7	0	0	0	0	0.4
Syunik	0.35	0.7	0.35	0.35	0.35	0.7	0.35	0	0	0	0.7	0.35
Aragatsotn	0.35	0.35	0.35	0	0	1	0.35	0.35	0	0	0.7	0.31
Gegharkunik	0.35	0.7	0.35	0.35	0.7	0	0	0.35	0	0.35	0.35	0.31
Tavush	0.35	0.7	0.35	0.35	0.35	0	0.35	0	0	0	0	0.22
Average	**0.6**	**0.6**	**0.53**	**0.5**	**0.5**	**0.49**	**0.47**	**0.31**	**0.28**	**0.25**	**0.19**	**–**

Each marz is assigned a rating from 0 to 1 considering a probability of occurrence of a particular hazard and a scale of expected negative impact, where 0 and 1 indicate 'no threat' and 'dangerous', respectively.
Source: GFDRR, 2009.

The 2020 INFORM Global Risk Index classified Armenia as a medium-risk country among 191 countries, taking into account its exposure to hazards, vulnerability, and coping capacity, as shown in Tables 5 and 6 (UNOCHA, 2020). The index clearly shows that Armenia is particularly prone to earthquakes, as well as to flooding and drought.

Table 5. Armenia's 2020 INFORM risk index, hazard and exposure and vulnerability data in comparison to Azerbaijan and Georgia

COUNTRY	INFORM RISK	3 YEAR TREND	RANK	RELIABILITY INDEX	HAZARD & EXPOSURE	3 YEAR TREND	NATURAL HAZARDS	Earthquake	Flood	Tsunami	Tropical cyclone	Draught	Epidemic	HUMAN	Projected conflict risk	Current highly violent conflict intensity	VULNERABILITY	3 YEAR TREND	Socio-economic vulnerability	Development & Deprivation
Armenia	3.6	→	99	5.0	3.8	↗	4.4	8.2	4.3	0.0	0.0	4.6	5.2	3.1	4.4	0.0	2.6	↙	2.2	1.6
Azerbaijan	4.6	↙	61	3.8	5.0	→	4.9	8.8	4.9	0.0	0.0	5.3	5.6	5.0	7.2	0.0	4.1	↙	2.2	2.9
Georgia	3.9	→	87	0.9	3.9	↗	4.4	7.9	5.1	0.0	0.0	5.3	4.8	3.3	4.7	0.0	4.8	→	2.9	2.4

Source: United Nations Office for the Coordination of Humanitarian Affairs (OCHA), 2020.

A lower value (closer to 0) represents a lower risk, while a higher value (closer to 10) represents a higher risk.
Reliability Index: more reliable 0 – 10 less reliable. Countries with lower Reliability Index scores have risk scores that are based on more reliable data. The arrows show ↗ for increasing risk, → for a stable situation, and ↙ for decreasing risk.

Table 6. Armenia's 2020 INFORM risk index, detailed vulnerability and coping capacity data in comparison to Azerbaijan and Georgia

COUNTRY	Inequality	Aid dependency	Vulnerable groups	Uprooted people	Other vulnerable groups	Health conditions	Children U5	Recent shocks	Food security	LACK OF COPING CAPACITY	3 YEAR TREND	Institutional	DRR	Governance	Infrastructure	Communication	Physical infrastructure	Access to health care
Armenia	2.9	2.5	3.0	4,6	0.9	0.3	0.8	0.5	2.0	4.8	→	6.7	7.5	5.9	2.0	2.0	1.2	2.7
Azerbaijan	2.3	0.5	5.6	8.1	0.9	0.8	1.5	0.0	1.3	4.7	→	6.4	×	6.4	2.3	1.8	3.1	2.1
Georgia	4.0	2.7	6.2	8.7	1.1	1.0	0.5	0.0	2.8	3.2	→	4.4	4.7	4.1	1.8	1.8	1.1	2.5

Source: UNOCHA, 2020.

The GFDRR 2017 risk profile of Armenia provides estimations on the impact of earthquakes and flooding on the population and the economy based on historical data. According to its risk model, earthquakes are the only hazard that may negatively impact the Shirak, Aragatsotn, Ararat, Vayots Dzor, and Tavush marzes, while Lori, Armavir, Kotayk, Gegharkunik, Syunik and the capital Yerevan are equally prone to both earthquakes and flooding (GFDRR, 2017). In addition, eight out of ten marzes, or 70 percent of the country's territory, are prone to medium and intensive hailstorms. Every year, hailstorms and strong winds result in average annual losses to the agricultural sector of USD 30 million to USD 40 million, and 3.6 million, respectively (World Bank, 2017). Over the past number of decades, Armenia has faced a dramatic increase in the intensity and scale of hydrometeorological hazards, which, apart from direct negative impacts, also contribute to the geophysical processes that facilitate the activation and expansion of landslide areas or the occurrence of new ones. Around 40 percent of communities in Armenia, that are inhabited by 470 000 people (or 15 percent of the Armenian population) currently reside in identified landslide areas. An analysis

of the distribution and movement of landslides shows that precipitation is the main cause of landslide activity. According to national statistics, since 2000 the total number of registered emergencies related to hydrometeorological hazards increased five-fold, as shown in Figure 7 (SCRA, 2004; 2005; 2006; 2007a; 2012; 2017; 2019b).

Figure 7. Overview of hydrometeorological disasters in Armenia, 2000–2018

Legend:
- Strong winds, tornados, storms, sandstorms, dust tornados
- Thunderstorms, lightning, fog, downpour, hailstorm
- Heavy showers, mudflows
- Abundant snowfalls, frosts, snowstorms, glaze
- Avalanches
- Forest fires
- Frostbite in vegetative period
- High water of rivers, floods
- Destruction, rock falls
- Rise of underground water
- Wheat field and land fires
- Landslides
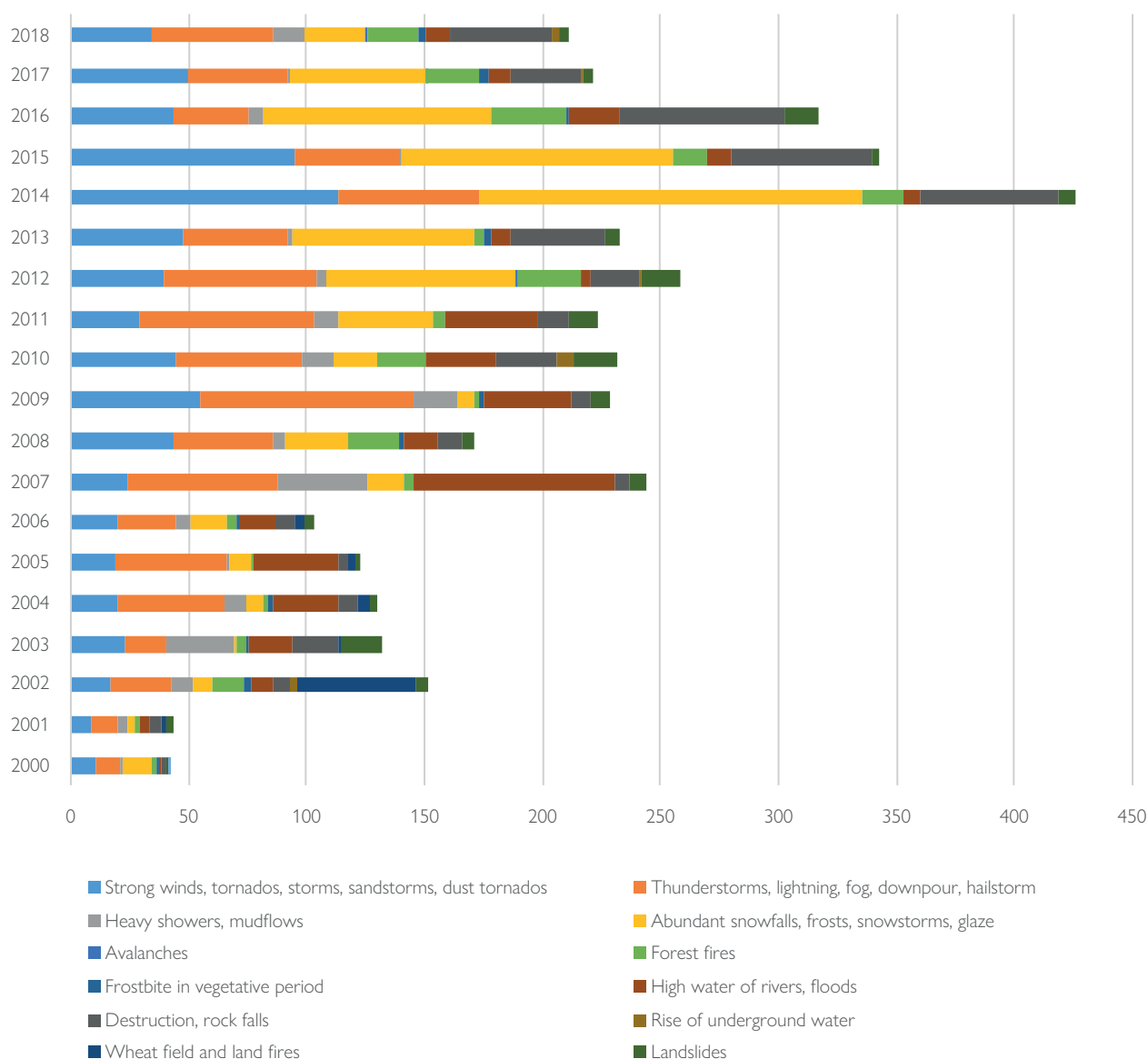
Sources: SCRA, 2004, 2005, 2006, 2007a, 2012, 2017, 2019b.

There is rather limited information on the situation with regard to biological hazards in Armenia. The SCRA provides certain statistics on the outbreak of some diseases; however, existing data are not sufficient to conduct an adequate analysis, particularly in relation to climate change.

Animal diseases have economic, trade, and food-safety importance for the country; they can easily spread and reach epidemic proportions, and the control and management of some of them sometimes requires cooperation between several countries. Infectious diseases in livestock are a major threat to animal welfare in Armenia and their effective control is crucial for safeguarding the economy, food security, and agricultural development in the country. In addition to that, zoonotic infections that are transmissible either directly or indirectly between animals and humans could be a serious threat to human health. The spread of many epizootic diseases, for example foot-and-mouth disease, could threaten potential exports.

Table 7. Livestock infectious diseases in Armenia, 2010–2020

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cattle infectious diseases											
Anthrax	–	–	17	2	–	–	–	–	–	–	–
Brucellosis	1487	1300	1605	1887	929	1048	1221	1353	1458	3335	1924
Tuberculosis	1	–	–	–	–	–	–	–	–	–	1
Foot–and–mouth disease	–	–	–	–	–	–	–	–	–	–	–
Carbuncle emphysematous (blackleg)	–	–	–	–	–	–	–	–	–	–	14
Sheep and goat infectious diseases											
Anthrax	–	–	–	–	–	–	–	–	–	–	–
Brucellosis	1557	881	1170	1582	606	609	738	914	1041	3659	1541
Tuberculosis	–	–	–	–	–	–	–	–	–	–	–
Foot–and–mouth disease	–	–	–	–	–	–	–	–	–	–	–

Sources: SCRA 2013, 2015, 2017, 2019c, 2021.

As shown in Table 7, brucellosis is the most widespread livestock infection disease in Armenia. This disease has a dual effect on food security and poverty. First, the wastage of infected animals through abortions and decreased milk production results in fewer growing and productive animals, less food and fibre from infected flocks, and reduced income generation. In addition, brucellosis in humans is a chronic debilitating disease that requires antibiotic treatment of several months, and has a prolonged convalescence phase. Besides brucellosis, the following infectious diseases were recorded from 2010 to 2020 in Armenia – cattle anthrax in 2012 (17 cases) and 2013 (two cases), cattle tuberculosis in 2010 and 2020 (one case each), and cattle blackleg in 2020 (14 cases). One transboundary animal disease, African swine fever, was recorded in 2011, and since then several cases were detected in the country in different years. A highly contagious viral disease of swine has significant economic consequences on a country's swine population and could pose a serious problem for the economic development of the livestock sector. During that period, cases of foot-and-mouth disease were not registered.

In order to ensure a stable anti-epizootic situation, the Government of Armenia implements a livestock preventive vaccination and diagnostic programme, particularly animal-epidemiological measures for the prevention and control of infectious diseases of animals, including animal-to-human infectious diseases. The government implements vaccinations for anthrax, foot-and-mouth disease, blackleg in cattle, clostridium diseases in small ruminants, classical swine fever in pigs, and Newcastle disease in poultry; and diagnostic testing (brucellosis, tuberculosis), and control of varroosis in honey-bee colonies. Vaccinations and diagnostic testing are both implemented by Agricultural Services SNCO, through community veterinarians.

According to national statistics, only one case of an epiphytotic outbreak was registered in 2004 within the 2000–2019 period (SCRA, 2004, 2005, 2006, 2007a, 2012, 2017, 2019).

In response to the COVID-19 outbreak, the government has introduced tight restrictions and declared a state of emergency. On 12 September 2020, the state of emergency expired, but many requirements and restrictions remained in place. Following the robust growth of the previous three years, which continued also in the first two months of 2020, growth turned negative from March 2020. The global financial crisis has affected the economy significantly, including the agricultural sector. Even though there is no official information of the impact of COVID-19 on agricultural sector yet, it has hit exports of primary agricultural products such as fresh and processed fruit and vegetables, which in turn has resulted in decreasing prices of agricultural products. For example, the pandemic hit Armenian wine and brandy producers. The consumption of wine and brandy fell both in domestic and foreign markets, and experts believe that the situation will not improve until the end of next year.

To minimise the impact of COVID-19, the government has launched 25 economic and social measures, including measures related to agriculture and agricultural processing, to mitigate damage caused by the pandemic at an estimated cost of roughly 2.3 percent of GDP.

Historical overview of damage caused to agriculture by various hazardous events

During the 1995–2013 period, as the result of various disasters, up to 129 819 ha of agricultural crops and perennial plantations were damaged, which led to total agricultural losses of over AMD 338 billion (USD 83 million) (Government of Armenia, 2017a). The negative impact of hydrometeorological disasters on crop production during the 2013–2018 period led to significant losses, which affected more or less all marzes.

- 2013: The heavy hailstorms in 12 May and 17 May caused significant damage in Armavir marz, which is one of the main regions for fruit, vegetable, and grape production. It damaged an area of 11 101 ha, affecting 12 817 households. The estimated total damage was AMD 25.3 billion (USD 61.7 million).
- 2014: There was heavy snowfall on 30 and 31 March 2014, which was later accompanied by freezing temperatures that damaged many fruit trees all over Armenia. This led to a severe reduction in fruit yields and in some orchards, it resulted in a total collapse of their production, as natural vegetation and flowers of trees were destroyed by the frost. Although the disaster adversely impacted the entire agricultural sector in Armenia, it caused significant damage in Ararat, Armavir, and Aragatsotn marzes, which are the country's main regions for fruit, vegetable, and grape production. As a result, 9 184 ha of orchards was damaged, and more than 6 700 ha of apricot orchards (75 percent) was completely lost. In Armavir marz, where 38.7 percent of apricot orchards are situated, the disaster resulted in a 100 percent loss, while in Ararat marz – home to about 31 percent of apricot orchards – the loss was estimated at up to 88 percent. The damage to other crops such as peaches, grapes, and cherries was less severe. It was estimated that 862 ha of peach orchards (or 20 percent of the country's total production), as well as 915 ha of table grape vineyards, were damaged. The disaster affected a total of 287 communities (32 percent of Armenia's communities) and 313 716 households, resulting in damage totalling AMD 11.2 billion (USD 27.3 million) (Amirkhanyan, 2014).

According to official data (Government of Armenia, 2017a; Ministry of Agriculture, 2019), hydrometeorological hazards, including hailstorms, caused severe damage to the agricultural sector in Armenia, affecting practically all marzes, during the 2014–2018 period.

- A hailstorm occurred in Shirak and Lori marzes in May and June 2014, which resulted in damage to the 15 101 ha of sown areas in 15 communities of Lori and 37 communities of Shirak (cereals 12 947 ha, potato 1 764 ha, vegetables 390 ha), with total damage of AMD 6.7 billion (USD 16.1 million). As a result of hailstorms and frost, the total damage in 2014 came to over AMD 17.9 billion (USD 4 million).
- In 2015, 82 communities in eight marzes were affected by hailstorms and around 8 800 ha of agricultural land was damaged that resulted in a total loss of 57 500 tonnes of crops that amounted to AMD 7.8 billion (USD 16.3 million).
- In 2016, due to hailstorms, 150 communities in nine marzes were impacted and approximately 23 100 ha of cultivated land was damaged, which resulted in a loss of 278 600 tonnes of crops worth AMD 33.6 billion (USD 69.9 million).
- In 2017, 91 communities in eight marzes were affected and around 15 490 ha of agricultural land was damaged by hailstorms that resulted in the total loss of 79 551 tonnes of crops, amounting to damage of AMD 12.9 billion (USD 26.7 million).
- In 2018, as a result of different disasters (hailstorms, frost, flooding), 14 650 ha (of which 596.6 ha was affected by frost) of the sown areas and perennial crops suffered damage worth AMD 13.4 billion (USD 27.74 million) (Ministry of Agriculture, 2019).

Table 8 provides the estimated damage caused by hydrometeorological disasters during the 1995–2018 period.

Table 8. Damage to Armenia's agriculture as a result of hydrometeorological disasters, 1995–2018

Years	Total damaged agricultural land area (ha thousands)	Total damage (in AMD billion)	Official exchange rate AMD to USD (period average)	Current value (USD thousands)
1995	86 959	17.0	405.91	41 881
1996	36 654	12.6	414.04	30 408
1997	129 819	26.5	490.85	54 049
1998	63 411	15.0	504.92	29 609
1999	43 026	11.3	535.06	21 175
2000	N/A	59.8	539.53	110 801
2001	83 500	23.9	555.08	43 129
2002	74 546	15.1	533.45	28 381
2003	48 667	82.6	578.76	142 770
2009	35 368	11.9	363.28	32 729
2010	17 474	35.5	373.66	95 006
2011	4 061	0.9	372.50	2 443
2012	2 219	0.5	401.76	1 220
2013	11 101	25.3	409.63	61 763
2014	24 286	17.9	415.92	43 037
2015	8 800	7.8	477.90	16 321
2016	23 100	33.6	480.49	69 929
2017	15 490	12.9	482.72	26 724
2018	14 650	13.4	482.99	27 744
Total		**423.5**		**879 119**

Sources: Avetisyan *et al.,* 2017; Dube *et al.,* 2018; Ministry of Agriculture, 2019.

According to the EMDAT-CRED database,[9] the types of disaster that have affected Armenia the most during the 1992–2018 period include for instance the complex disasters of 1992, drought of 2000, and storm of 2013, as shown in Table 9.

Armenia has had to cope with the collapse of the USSR, followed by the complete deterioration of society and the economy, the impact of the Spitak earthquake (which destroyed one-third of the country), and the war in Nagorno-Karabakh, which resulted in more than 300 000 refugees from Azerbaijan, and led to a large-scale famine in 1992 that affected the entire population. Unfortunately, data on damage and financial estimations do not exist.

An earthquake with a magnitude of 4.2 hit the Tavush region in July 1997, which destroyed a significant number of houses and affected around 15 000 people. Moreover, the drought of 2000 was among the most damaging, with eight out of ten marzes impacted. It affected 297 000 people and led to total damage of up to USD 100 million. Severe drought during the summer sharply reduced crop production, devastated rangeland vegetation for livestock grazing, and significantly reduced other feed sources, including grains, potatoes, and crop residues. Rain in important agricultural areas was up to 70 percent below normal during the crucial cultivation months. The drought exacerbated issues associated with the crumbling irrigation infrastructure. Where winter wheat was the main crop, crop losses were estimated at 65 percent of anticipated production, while barley losses were estimated at 74 percent, and potato production fell by nearly 40 percent to 250 000 tonnes. Pastures were devastated and this negatively impacted milk production. The drastic shortage of animal feed caused under-nutrition in livestock, which resulted in a significant increase in animal mortality during the cold winter months (FAO, 2000).

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[9] In 1988, the Centre for Research on the Epidemiology of Disasters (CRED) launched the Emergency Events Database (EM-DAT). EM-DAT was created with the initial support of the World Health Organization (WHO) and the Government of Belgium.

Table 9. Major disasters, number of people affected and damage caused in Armenia, 1992–2018

Year	Disaster type	Name of marz	Disaster subtype	Occur-rence	Total deaths	Injured	Affected	Home-less	Total affected	Damage (thousands USD)
1992	Complex disasters		Famine	1	–	–	3 500 000	–	3 500 000	
1997	Earthquake	Tavush	Ground movement	1	–	–	15 000	–	15 000	33 333
1997	Flooding	Syunik	–	1	4	–	7 000	–	7 000	8 000
1998	Flooding	Yerevan	–	1	–	–		144	144	120
2000	Drought	Ararat, Armavir, Tavush, Lori Gegharkunik, Aragatsotn, Kotayk, Shirak	Drought	1		–	297 000		297 000	100 000
2004	Flooding	Aragatsotn, Armavir, Ararat Gegharkunik, Tavush	Riverine flooding	1	1	–	–	–	–	–
2013	Extreme temperature	Yerevan	Severe winter conditions	1	–	–	12 000	–	12 000	–
2013	Storm	Armavir	Convective storm	1	–	–	64 000	–	64 000	60 000
2016	Landslide	Gegharkunik Shirak	Landslide	1	–	–	750	–	750	–
2018	Storm	Shirak	Convective storm	1	–	–	9 900	–	9 900	1 822
	Total:			**10**	**5**	**–**	**3 905 650**	**144**	**3 905 794**	**203 275**

Source: EMDAT-CRED database, 2019.

Table 10 provides data on damage caused by hailstorms, including the numbers of marzes and communities affected, during the 2015–2018 period.

Table 10. Area of damaged orchards and vineyards affected by hailstorms, 2015–2018

Years	Number of affected marzes	Number of affected communities	Area of damaged orchards and vineyards (ha)	Total damage (AMD billion)	Total damage (USD million)
2015	8	82	2 900.0	3 585	7 501.5
2016	7	151	9 135.5	16 348	34 023.6
2017	7	74	2 990.0	4 681	9 697.1
2018	7	104	1 762.9	2 712	5 615.0

Source: Government of Armenia, 2019a.

Forests make up 334 100 ha, or 11.2 percent, of Armenia's territory (SCRA, 2019d). The increased risk of forest fires is seen as one of the major threats to Armenian forests. Within the past decade, the number of forest fires has dramatically increased.

During the 1998–2018 period, forest fires damaged a total of up to 4 181.2 ha of forests. The largest areas burnt by forest fires during this period were observed in 2010, 2011, 2017, and 2018. The number of forest fires has increased significantly, as shown in Figure 8 and Figure 9. The most vulnerable marzes to forest fires are Lori, Tavush, Aragatsotn, Kotayk, Vayots Dzor, and Syunik. Fires broke out in August 2017 in Khosrov

Forest Reserve,[10] Vayots Dzor forest, and Aragatsotn forest,[11] which burnt hundreds of hectares of vegetation. Data obtained from the Forest Monitoring Centre (FMC)[12] estimated the size of the burnt areas, through the analysis of satellite images, at 1 716.3 ha in and around the Khosrov Forest Reserve, and 609 016 ha and 762 ha of the Vayots Dzor and Aragatsotn forests, respectively. In 2017, total hectares of burnt forest was 1 111.8 ha (Gyulkhasyan, 2017).

Figure 8. Forested area affected by fires (ha thousands) in Armenia, 1998–2018
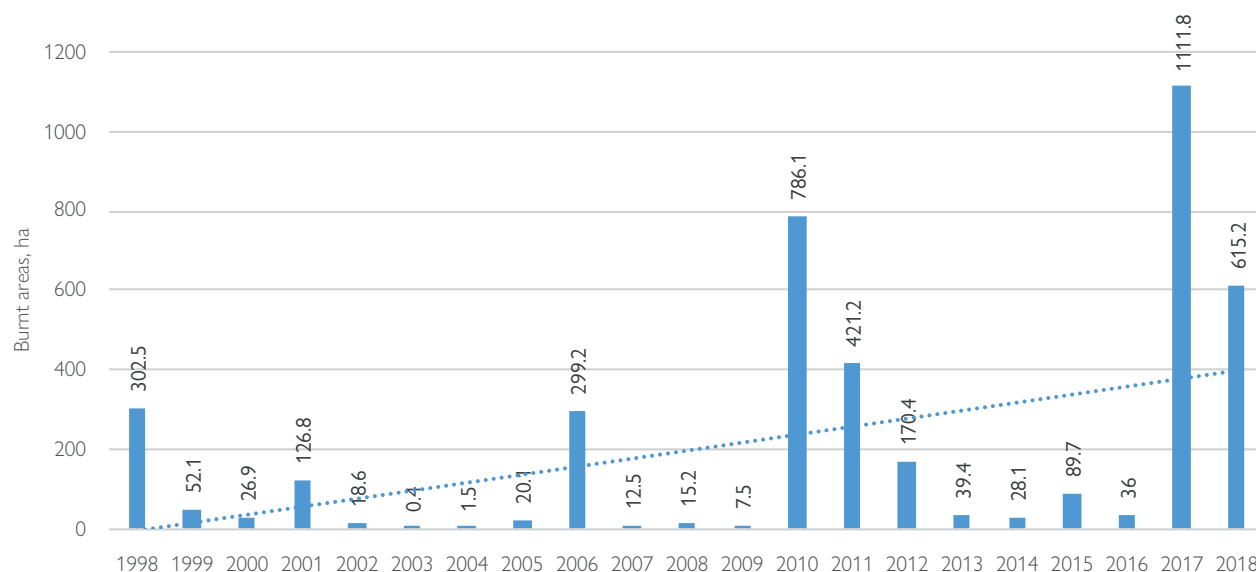
Sources: SCRA, 2002, 2007b, 2011, 2016d, 2018d, 2019d.

Figure 9. Number of forest fires in Armenia, 1998–2018
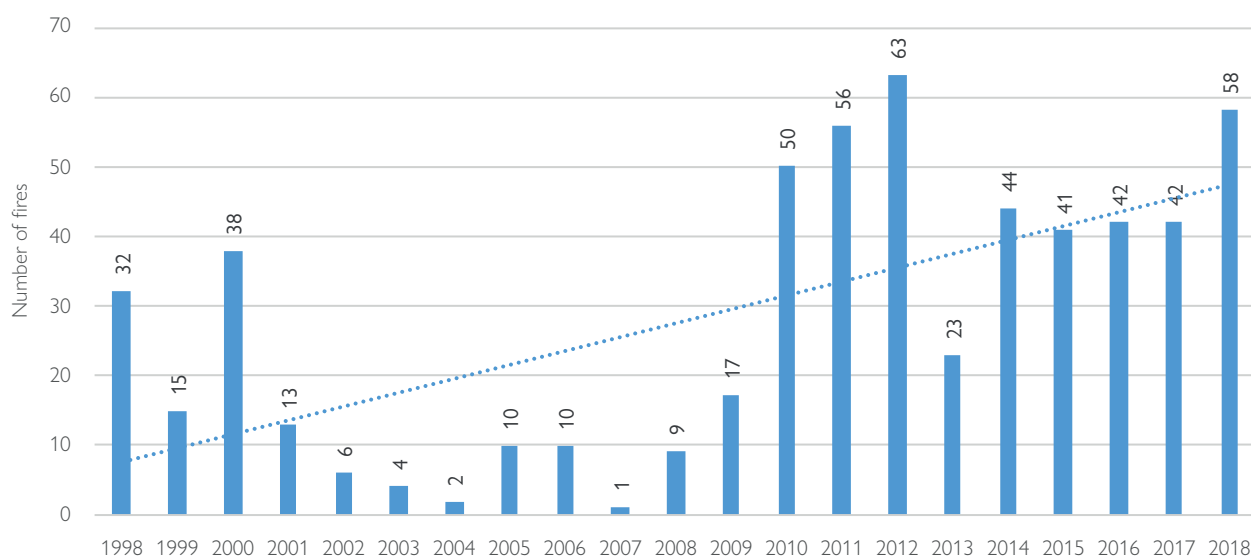
Sources: SCRA, 2002, 2007b, 2011, 2016d, 2018d, 2019d.

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[10]One of the specially protected areas of the Ministry of Environment.

[11]Both are the branches of Hayantar SNCO (Armforest). In 2018, the Hayantar was moved from the Ministry of Agriculture to the Ministry of Nature Protection. It operates under the authority of the Forest Committee, which was established in 2018 within the structure of the Ministry of Nature Protection (currently the Ministry of Environment).

[12]The centre is a state non-commercial organization (SNCO), which was recently transferred from the Ministry of Agriculture to the Ministry of Environment, see http://armmonitoring.am/page/260

The main causes of the majority of forest fires in Armenia are anthropogenic, including the burning of adjacent agricultural land, recreation activities, and other human-related practices, as shown in Figure 10. Climate change remains one of the key factors that contribute to the flammability of vegetation, by creating drier conditions and resulting in an increase in the frequency and severity of wildfires (UNDP, 2012).

Figure 10. Causes of forest fires in Armenia, 2007–2011
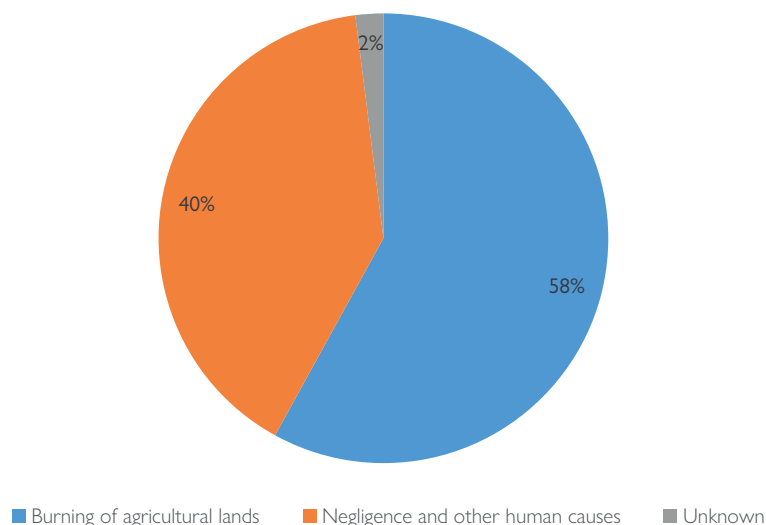
Source: UNDP, 2012.

Agricultural and food security profile

The agricultural sector plays an important role in the economy of many countries in the region, including Armenia. The sector provides food for the population, employment and livelihoods for the rural population, raw materials for agricultural processors, and it is an important consumer of a number of industrial products and services (machinery, chemical industry, and so on).

In the 1990s, Armenia implemented one of the most comprehensive land reform programmes of former USSR countries. As a result, around 340 000 private farms were created, but they lacked suitable machinery and equipment, water for irrigation, and knowledge of good practices. Since then, agriculture has been the one of the main drivers of the country's economic growth. At present, the agricultural sector still remains essential for the economy of the country. It is the main source of economic activity in rural areas and a significant contributor to GDP. In 2017, the agricultural share of the country's GDP was 14 percent (SCRA, 2018a). In 2015, the country experienced 3 percent GDP growth – with 2.3 percent (or about 70 percent of the 3 percent) coming from the agricultural sector alone. Gross agricultural output, at current prices, was AMD 908.1 billion (USD 1.9 billion) in 2017, as shown in Table 11.

Table 11. Main macroeconomic and agriculture indicators, 2007–2017

INDICATORS	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP growth rate, %	13.7	6.9	−14.1	2.2	4.7	7.2	3.3	3.6	3	0.2	7.5
Share of agriculture in GDP, %	18.2	16.1	16.7	16.8	19.9	17.9	18.4	18.1	17.3	16.4	14.5
Employment in agriculture, %	46.0	44.1	45.6	45.3	38.9	37.3	36.3	34.8	35.3	33.6	31.3
Gross agriculture output, at current prices, in USD billion[13]	1.9	2.1	1.5	1.7	2.1	2.1	2.2	2.4	2.1	1.8	1.9
Change of Gross agriculture output at current prices in comparison to previous year, %	14.0	−0.9	−12.1	15.3	24.9	5.8	9.2	8.1	0.8	−12	3

Source: SCRA, 2018a.

In 2017, agriculture employed about 36.6 percent of the working population, of whom almost 56 percent were female farmers (SCRA, 2018d). Informal employment in agriculture, not captured by official statistics, is estimated to be substantial. For instance, in 2015, 99 percent of agricultural jobs were informal, as well as 74 percent of employment in rural areas (SCRA, 2016b).

Women are over-represented in seasonal and precarious employment, and it is estimated that 82.1 percent of all women who work in agriculture, do so informally (SCRA, 2016b). This informality leads to reduced access to social protection schemes, along with limited access to land and other agricultural assets, and results in women being more vulnerable due to their lack or limited access to and control over resources, compared to men.

Farm structure in Armenia, like in many other countries in the region, is dominated by a large number of small and fragmented farms and land holdings. According to the 2014 census, there are a total of 317 346 family farms, which contribute more than 97 percent of total agricultural output and comprise 99.86 percent of all active agricultural holdings. In addition, 45 percent of these farms have three or more land plots and 20 percent of farms have five or more plots. Smallholders constitute the vast majority of farmers in the country and represent around 95 percent of all farms; they are estimated to produce around 97 percent of the gross agricultural product (FAO, 2018).

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[13]Data of Central Bank of Armenia on annual averages of USD-AMD exchange rates are used in this report, see https://rate.am/en/armenian-dram-exchange-rates/central-bank-armenia

Agricultural production in Armenia has developed in two main directions – crop production and livestock production, with the share of the crop production exceeding the share of livestock production. However, the share of crop production has steadily decreased from 67.8 percent to 51.6 percent over the past ten years (2007–2017), and fluctuated from 59 percent to 68 percent in overall agriculture. Livestock production, as a proportion of the country's gross agricultural output, has increased from 32.2 percent in 2007 to between 44.6 percent and 48.4 percent in 2016–2017 (SCRA, 2018f).

Food security

Armenia's relatively strong agricultural performance since 2001 has resulted in a substantial increase in self-sufficiency for the main food products, and overall food availability. Armenia's average daily dietary energy supply has increased by nearly 30 percent since 2000, at nearly 2 900 kcal/capita in 2015, which is approaching FAO's maximum dietary energy requirement level of 3 217 kcal/capita (WFP, 2018).

In recent years, agricultural production has steadily increased, although there is still a reliance on the imports of many staple food items. Due to this, Armenia remains vulnerable to changes in external markets and economies, which poses a risk to food availability, particularly in the event of an emergency. According to Mo data, the level of self-sufficiency in the country – in terms of most important food products based on the average dietary energy supply – is around 52.5 percent (MoE, 2019). The country has a high degree of self-sufficiency in potatoes, fruit, grapes, vegetables, lamb, eggs, and fish, and above-average self-sufficiency in beef, milk and milk products, as well as (more recently) in sugar. The country still has a low level of self-sufficiency in wheat, maize, legumes, vegetable oil, and other types of meat. As a result, the availability of food in Armenia depends highly on imports, especially with regard to cereals and certain types of meat. In addition, the country depends heavily on grain imports, especially cereals. It is estimated that during the 2017–2019 period, the country imported between 65 percent and 74 percent of its wheat, 80 percent to 95 percent of its maize, 50 percent to 62 percent of legumes, 74 percent to 78 percent of poultry, 43 percent to 47 percent of pork, and more than 95 percent of its vegetable oil, as shown in Figure 11 (SCRA, 2019e). This shows the vulnerability of the country with regard to foreign food markets and food-price fluctuations.

Figure 11. Key food items imported (% of total imports), 2010–2019
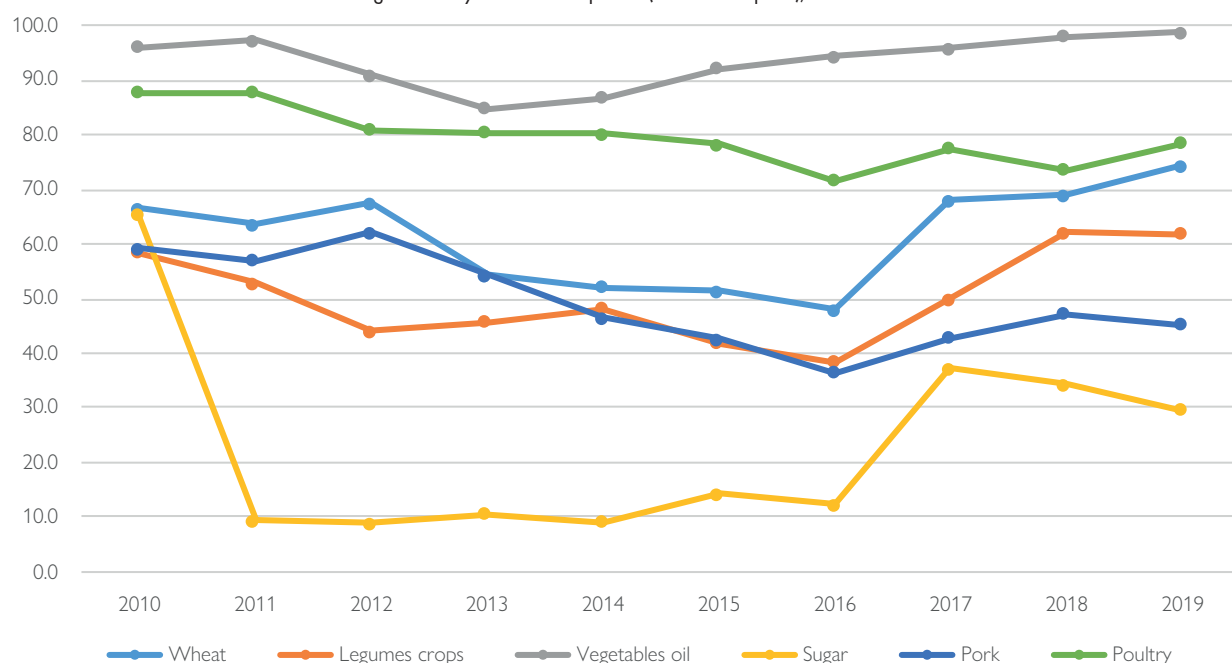
Source: SCRA, 2019d.

According to the WFP Comprehensive Food Security and Vulnerability Analysis report (2019), food insecurity and malnutrition in Armenia are mainly caused by the limited availability, access, and use of nutritionally diversified food at all times. Fifteen percent of Armenians do not have physical or economic access to the

food they need for an active and healthy lifestyle, and are food insecure. Six percent of Armenians are not able to acquire the food they need to meet their daily needs and are undernourished. Children are the most affected – it is estimated that 9 percent of them are stunted, and 14 percent of those under five years old are overweight. This leads to increased levels of child mortality and morbidity, and a high risk of susceptibility to non-communicable diseases (WFP, 2019).

The agricultural sector has great export potential, which is one of the main reasons for increasing investments in the sector. Agrifood-sector exports have increased in recent years, and almost doubled in 2019 compared with 2015 (Figure 12). Despite that, export volumes from the sector are still low – food and agricultural products as a proportion of total exports in 2018 and 2019 were 28.9 percent and 30.2 percent, respectively.

Tobacco products (particularly cigarettes) form a significant percentage of exports. The production of tobacco products is mostly based on imported raw materials, and without this commodity group, the agricultural-product portion drops to 17.8 percent (2018) and 19.2 percent (2019). The main exported commodities are beverages, tobacco, fruit, and vegetables.

Figure 12. Export and import of food and agricultural products in 2014–2020, USD thousands
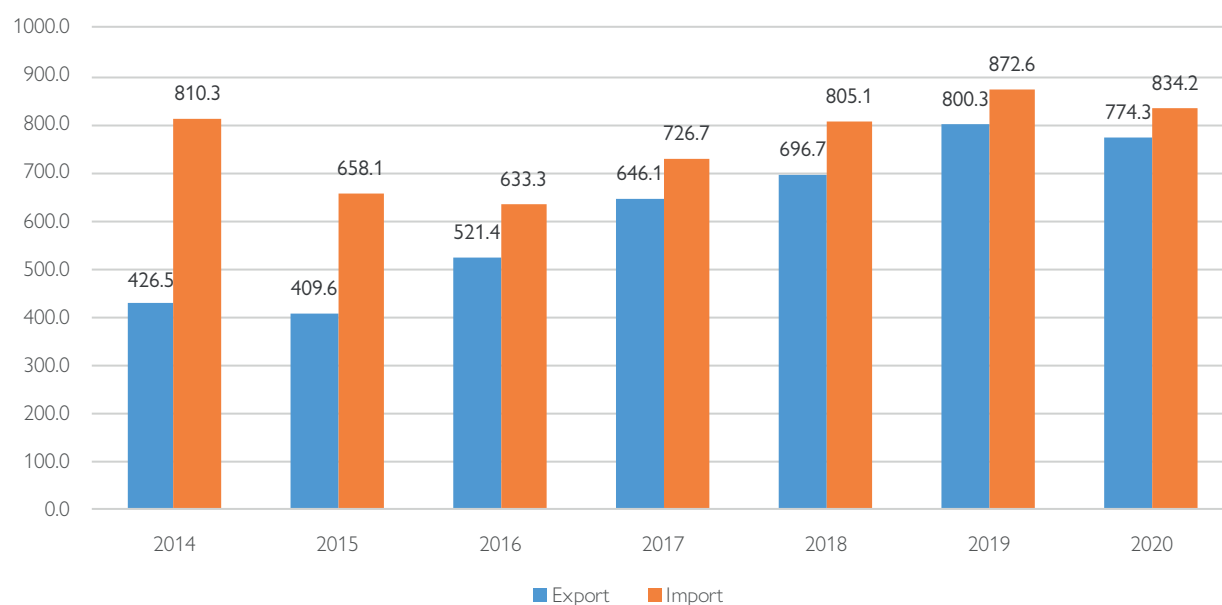
Source: SCRA, 2019e.

National legal, policy and institutional framework

This section provides an overview of the DRR and management-related legislation, policy and institutional framework of Armenia and its relation to agriculture in addressing agricultural risks.

There are two major documents that guarantee the security and safety of the Armenian people, including by governing and guiding government action to reduce the adverse impacts of natural and man-made hazards:

- The Constitution of the Republic of Armenia (Constitution of Armenia, 2015), which refers to Armenia's commitments on the sustainable use of its natural resources (Chapter I, Article 12).
- The National Security Strategy of the Republic of Armenia (NSSRA) adopted in 2007 (Security Council of Armenia, 2007) and its recent update (Security Council of Armenia, 2020) serves as an overarching document, which provides guidance to the development and implementation of policies and strategies to prevent and respond to hazards and risks to national security. Defining its strategic priorities in fostering the country's sustainable development, the NSSRA outlines actions to ensure Armenia's resilience-building by addressing internal and external challenges, and addresses the risks to national security posed by natural and technological hazards, including those induced by climate change (Chapter 7).

Thus, the government has supported DRR and management (sometimes referred to in official documents as "emergency management") approaches, processes and systems, which are fully aligned with the constitution and the NSSRA, and are reflected in the respective policies and strategies.

The related national legislation and systems introduced through national laws, government decisions and sectoral acts (orders, instructions, directives, etc.) form the legal and institutional frameworks that define the principles and procedures for the planning and implementation of DRR and management activities.

Legal framework

Agriculture is one of the most vulnerable sectors in terms of exposure to disaster risks caused by various hazards, including those induced by climate change. However, there is a limited number of legal provisions that target disaster risk management challenges in agriculture. The majority of disaster-related legal acts refer equally to all sectors, including agriculture. Having said that, during the past ten to 15 years there has been a significant change in the government's disaster risk management approach, with more attention given to the increasing intensity of hydrometeorological hazards as a result of climate change.

The legal framework of Armenia that is dedicated to emergencies and disaster risk management for various sectors consists of relevant laws, government decisions, and other legal acts enabling the implementation of the government's respective policies and strategies.

Thus, in terms of agriculture-related DRR and management legal provisions, the existing legislation can be divided into three categories (see Annex II for further detail):

- emergency legislation defining the liabilities of emergency authorities in relation to all types of disasters and presuming shared responsibilities (participation) of sectoral authorities, including agriculture;
- sectoral legislation addressing particular disasters (for example infrastructure, energy, health, environment, public administration, education, socioeconomic) which may also impact or be relevant for the agricultural sector;
- agriculture-specific legislation, which addresses particular disasters that adversely impact the sector, as well as other related sectors.

The emergency legislation outlines the main objectives of emergency management and provides general principles for action. It also defines roles and responsibilities of liaison authority(ies) and supporting functions in addressing various hazards through prevention, mitigation, disaster response and recovery activities. The related scope of laws (on Population Protection in Emergency Situations, on Fire Security, on Civil Defence Troops, and on Rescue Service) does not differentiate between specific disaster causes, but rather regulates performance of the actors engaged, outlining management and coordination principles for activity(ies) planning and implementation. This particular category of the DRR and management legislation refers first to the responsibilities of the government's emergency liaison agency, MoES, and covers the entire area of emergency management. For the specific high-risk natural and man-made events, which may turn into large-scale disasters such as earthquakes, flooding, landslides, and chemical, biological, radiological, nuclear hazards, there are national prevention and response plans approved by the government. These plans serve as guiding principles for managing the respective preparedness and emergency response activities, which agricultural authorities as well as other sectoral agencies are also considered responsible for. However, this type of DRR and management legislation does not consider weather hazards as potential causes of large-scale disasters.[14] Consequently, the potential impact of climate change and related preventive and preparedness measures are not reflected.

The sector-based DRR and management provisions are placed in various sectoral legal acts, which have specific dedication, but do not refer directly to emergency management. For instance, the Law on Local Self-Governing Bodies is about public administration at community level. It outlines the legal basis for municipalities' performance, their functions and relations with other branches of public power. It also includes certain clauses on emergency management, which define municipalities' role in disaster prevention, preparedness and response. The same refers to other sectoral laws (Land Code, Water Code, Forest Code, on Atmospheric Air Protection, on

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[14] Except for flooding, which falls under hydrometeorological hazards – they are not really linked to climate change, but rather considered as regular seasonal events.

Flora, on Fauna),[15] where certain clauses address particular risks that can be found under the term 'protection'. All laws in this category directly or indirectly refer to the agricultural sector and presume certain DRR and management actions to be implemented in the agricultural sector. For instance, the Law on Atmospheric Air Protection prohibits agricultural burning to reduce the risk of wildfires, while the Law on Hydrometeorological Activities determines the legal basis for agrometeorological services and the monitoring of hydrometeorological events. Laws in this type of category, as well as the previous category laws, do not include specific links to the adverse effects of climate change or the dynamics of weather hazards.

In addition, there are also a number of governmental decisions on the adoption of national sectoral policies and strategies that are of importance, which focus more on hydrometeorological hazards. These decisions refer to water and land use, management of forests and specially protected nature areas, protection of environment and biodiversity, the fight against desertification and wildfires or forest fires, and contain certain provisions to address the risks of hydrometeorological hazards. In this sense, the agricultural sector is seen as one of the key sectors of concern and is integrated into the overall scope of envisaged actions.

Agriculture-specific legislation considers risks to agriculture and outlines related measures, such as the prevention of epidemics and infectious diseases, pest control, food security and safety, and the protection of crops, plants and the livestock. Laws in this category, on Seeds (2005), on Organic Agriculture (2008), on Land Code (2011), Phytosanitary (2014), on Veterinary (2014), on Feed (2014), on Food Safety (2014), either target the traditional hazards to agriculture or contain particular clauses on the protection of agroecosystems and biodiversity. However, in these laws, the potential negative impacts of hydrometeorological hazards on these areas of concern are not considered. In 2010, the government adopted the Sustainable Agriculture and Rural Development Strategy of the Republic of Armenia 2010–2020 and the Action Plan, where a special chapter (14) is dedicated to the mitigation of agricultural risks, which includes the following:

Given the high-risk nature of agriculture in Armenia for the prediction, prevention (to the extent possible) and overcoming the adverse impacts of disasters on the sector, it is anticipated to focus on following areas:

- facilitation of the introduction of the insurance system process;
- implementation of a pilot programme on the improvement of an anti-hail system;
- introduction of water-saving technologies;
- regulation of irrigation water use to address drought and water scarcity;
- implementation of prevention measures to reduce the impacts of flooding and landslides;
- introduction of agricultural crop yield forecasting and programming system (Government of Armenia, 2010).

The implementation plan of the strategy, although actions are envisaged in the indicated areas, is rather vague in terms of the strategic approach towards risk reduction. It does not address the prioritized directions in a systematic way, although it contains certain DRR activities, including one on the reduction of agriculture's vulnerability to climate change, namely "increasing the sustainability of the agricultural sector in relation to climate change" (Government of Armenia, 2010).

Recently, the government adopted the Strategy of the Main Directions Ensuring Economic Development in Agricultural Sector of the Republic of Armenia for 2020–2030 (Government of Armenia, 2019c), where natural and climate-related hazards are mentioned among the main challenges that hinder the development of the agricultural sector. The strategy describes the current situation of disaster risk management in Armenia and states that in the absence of clearly established state, political and institutional mechanisms, it becomes rather problematic to address these risks in an effective manner. In addition, 'climate-change adaptation and environmental sustainability' is among the seven principles on which the strategy is anchored. According to this principle, it is anticipated that there will be an increasing focus on climate-change awareness, adaptation and mitigation strategies (for example, improve climate-change monitoring for the agricultural sector, promote climate-smart agriculture practices, and support the dissemination of climate-adaptation inputs, such as drought-resistant seeds). At the same time, work will ensure that agriculture sectoral development is informed by a focus on the sustainability of natural resources, including most critically, the implementation of good water and soil-management practices. The strategy further highlights that the gradual introduction of agricultural

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[15]See Annex II for more details.

insurance is one of the priority strategic objectives in the sector. The following measures and actions are suggested in the strategy with regard to supporting risk mitigation and climate-change adaption:

- Develop the agricultural insurance market in agriculture.
- Develop and implement the hail risk mitigation programme.
- Identify and promote broader climate adaptation measures (for example, drought-resistant seeds, new agricultural practices, optimization of natural inputs, climate-smart and sensitive technologies and practices).

Since 2015, the government has adopted a number of decisions that promote the introduction of risk reduction and adaptation measures, including subsidy programmes aimed at encouraging the application of anti-hail nets, the introduction of a modern irrigation system, the establishment of intensive vineyards and orchards, and so on.

Armenia, being a party to multiple international treaties, has undertaken a broad set of commitments related to environmental protection and sustainable development. Following these commitments, the government initiated a large process that addresses the legal, institutional and infrastructural insufficiencies which limit the achievement of sustainable development objectives. In its 2018 report for the UN High-level Political Forum on Sustainable Development and SDG implementation in Armenia, the government indicated progress achieved so far, and identified areas of concern, challenges, and areas that require action (Government of Armenia, 2018d). Environmental protection, community resilience-building, and rural and agriculture development where improvements need to be made, play a significant role towards attainment of the set sustainable development targets. However, improvements need to be made in all these areas. The international community was heavily engaged and facilitated the Armenian government's development efforts, including the achievement of the SDG targets. This equally refers to the programmes implemented in the areas of DRR and management, environmental protection, rural and agricultural development, improvement of natural resource management, and community resilience-building. United Nations agencies, the World Bank, European Union, and other international funding organizations, development actors and banks – including the European Bank for Reconstruction and Development (EBRD), Asian Development Bank (ADB), and International Bank for Reconstruction and Development (IBRD) – were and remain the main cooperation partners for the Armenian government in this area. One of the best examples is the long-lasting partnership between FAO and MoA, which is guided by the Country Programme Framework (CPF) 2016–2020, where one of the identified priority areas is the 'sustainable use of natural resources, disaster risk reduction and management' (FAO, 2019).

Overall, it could be said that over recent years, and particularly within the last decade, there has been a substantial change in the government's position towards DRR and management in agriculture. Despite that, these efforts are still fragmented, have an ad-hoc character, and require a more consistent and systematic approach to reduce the adverse impacts of natural hazards on the sector.

Policies, strategies, and plans/ programmes

There are a number of policies and strategies which serve as guiding documents for DRR and disaster risk management in general, and the agricultural and environmental sectors in particular. The Armenia Development Strategy (ADS) 2014–2025 (Government of Armenia, 2014a) is an overarching strategic document that defines strategic objectives in various development directions, which are further elaborated in the more specific sectoral strategies that also reflect DRR and management issues.

Article 7 of the ADS, on 'forecasting risks' (clauses 97-99), states that non-human driven related risk (that is, risk related to unfavourable natural and climate conditions) may have a negative impact on agricultural growth. It highlights the importance of risk and impact assessments, defines risk management mechanisms, as well as the implementation of relevant measures. Clause 110 of Article 7.2 on 'risk management' states that the establishment of necessary preventive measures and their consistent implementation is important for the management of catastrophic events, including technology-driven and natural hazard-induced disasters.

Article 9.4 of the ADS provides the priority directions and objectives for the development of the agricultural sector, which also include provisions on plant protection, veterinary, pest and disease control, designated use of arable lands, agricultural turnover of degraded land, establishment of protected forests, effective use of pastures and hayfields (clauses 219-221), improvement of the irrigation water supply system (227), development of food safety system (230). In the same article, there is a special clause (232) on the mitigation of agricultural risks that points out the following in order to mitigate agricultural risks:

- Introduction of an insurance system, which requires the implementation of a programme to evaluate insurance-related risks in the agricultural sector. Based on the findings of the evaluation, develop mechanisms for the introduction of the insurance system and the implementation of its phase-by-phase approach.
- Expansion of protected areas prone to natural hazards, especially hail protection stations, enhancement of their effectiveness and support in the implementation of other hail protection measures.

Article 25 of the ADS on 'environmental problems and planned measures' defines the environmental risks and measures to be taken. The priority risks considered by the government as the most challenging for the environment and environmental protection, and those related to reducing natural hazards, include issues such as:

- illegal forest logging, as a result of higher gas prices;
- resource depletion of water, due to the rapid development of the subsectors' use of underground water resources and as a result of climate change;
- increased risk of desertification, as a result of the combined effect of insufficient management of natural resources (forests, agricultural land, pastures, and water) and climate change.

One of the key measures highlighted in the ADS is the development of the Republic of Armenia Law on Environmental Protection. Furthermore, the highlighted ADS strategic priorities referring to DRR and management issues are more elaborated in the specific policy, strategic, and programme papers approved by the relevant government decrees and decisions. Some of them, although not approved by the government, have been developed by international partners to support government initiatives. These documents either refer directly to DRR and disaster risk management issues, or are of a generic or sectoral nature, but contain DRR and management provisions.

The list of the key national and sub-national level policies, strategies, and plans relevant to DRR and management, climate-change adaptation, rural and agricultural development, as well as related and relevant projects and programmes, are provided in Annex III.

Institutional framework

National disaster risk reduction and disaster risk management system in Armenia

Disaster risk reduction (DRR) in Armenia is considered one of the key components of the overall National Disaster Management System. The government's liaison agency is the Ministry of Emergency Situations (MoES), which leads and coordinates both DRR, including disaster preparedness, and response and recovery activities. At least five MoES units play a key role and contribute directly to DRR, including:

- Rescue Service – this is separated subdivision within MoES, which is responsible for risk identification and monitoring, planning and implementation of risk-specific prevention and mitigation, preparedness and response activities. In cooperation with relevant partners, it also contributes to the mitigation of the adverse impacts of disasters and the recovery of affected areas. It has its functional branches in Yerevan and in ten marzes, where it provides emergency services and coordinates local-level disaster risk management activities (including for all sectors, such as agriculture).
- Seismic Protection Service – performs earthquake risk monitoring and analysis, conducts research and studies on the evolution of the seismic situation in and around Armenia, supports the development of seismic risk scenarios for densely populated settlements, performs seismic risk mapping of the country, and predicts possible negative developments in the country's seismic activity.
- National Crisis Management Centre – is an integral part of the Rescue Service, being in charge of real-time emergency data collection, quality control, verification, storage and analysis. It operates the 911 emergency call centre and carries out the coordination of disaster response activities, ensuring operational management and coordination of emergencies through the following functional units:
  - 911 service
  - 7/24 operational shift
  - information management and statistics
  - monitoring and forecasting
  - psychological support service
  - emergency response department.
- National Centre for Technical Safety – is in charge of the organization and implementation of technical security operations in operational, conserved or dismantled hazardous production facilities in Armenia, except for nuclear power plants, radioactive materials processing, water systems, aviation, automobile, and military. It implements population and civil protection measures in emergency situations.
- Crisis Management State Academy – has a status of SNCO and operates within the MoES structure. The academy is an educational and scientific institution, which strives to implement educational, scientific, methodological, expertise, publishing and research activities in the field of civil defence and protection of the population in emergencies. It provides opportunities to all educational levels, including for bachelor, master and postgraduate studies.

The government, through the specially established National Disaster Management Committee (Government of Armenia, 1998), Figure 13, which is headed by the prime minister of Armenia, governs the DRR and disaster risk management national system. The committee's primary role is to ensure the proper response in the event of major emergencies, deciding over the response strategy, indicating the priority needs and mobilising resources, providing strategic guidance on humanitarian coordination, and assessment and estimation of damage caused with the involvement of required technical experts. There are sector-specific based instructions and norms for the estimation of the financial value of damage. The committee also takes decisions on the ways of covering the incurred costs as compensation to physical/legal persons, and recovery and rehabilitation activities.

The committee also decides on the need to appeal for international humanitarian assistance in case the coverage of response and recovery needs is far beyond the state's capacities.

Figure 13. National disaster risk management structure
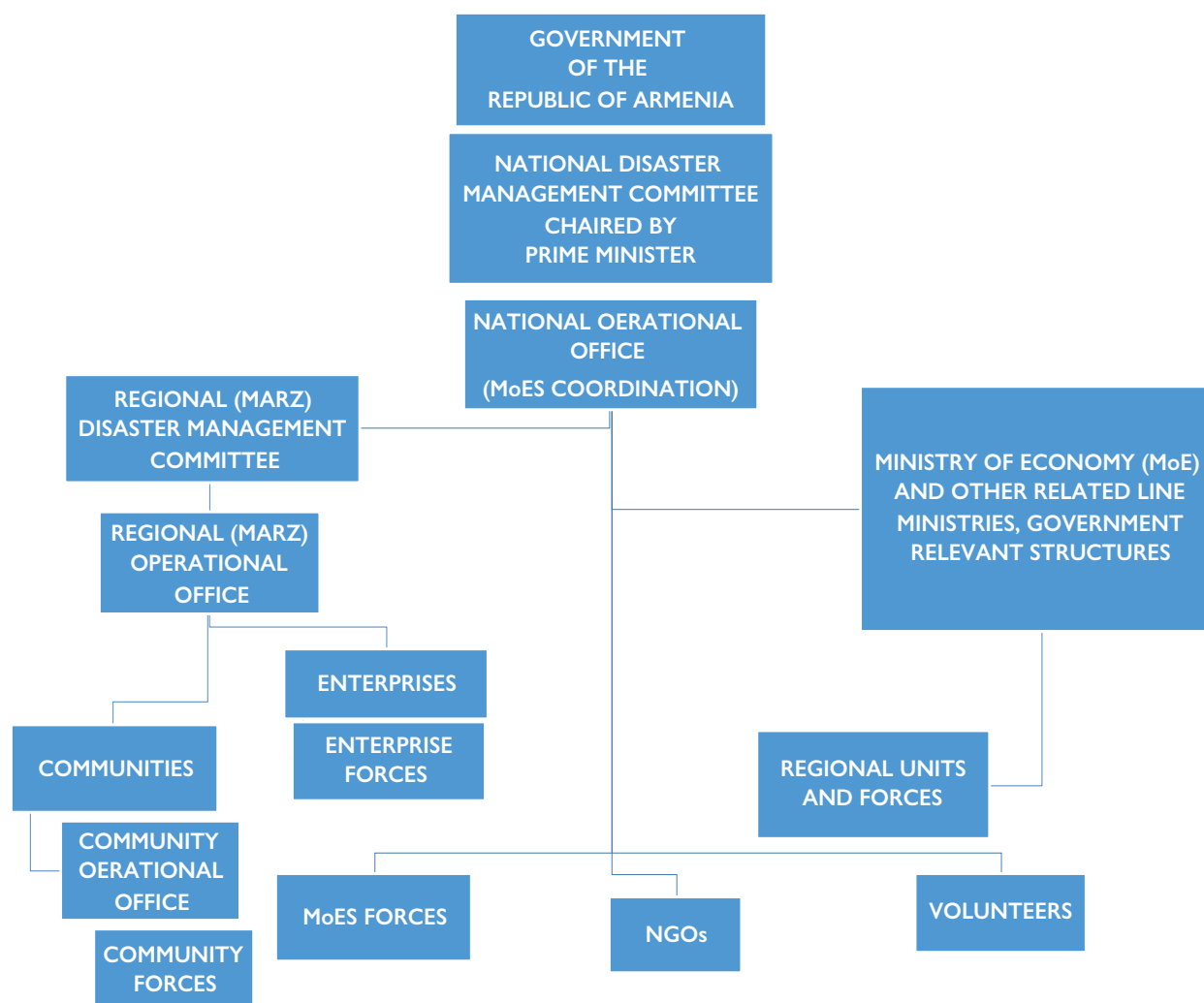
Source: Provided by the MoES Rescue Service, 2020.

Operational management and coordination is performed by the National Operational Office, which is led by the minister of emergency situations. This office is in charge of the overall response coordination in the field, including the performance of state bodies and institutions, as well as the NGOs involved. Marz-level emergency committees and operational offices perform locally the same tasks as at national level, which covers the entire marz territory. The marz governor is in charge of the committee's performance, while the marz branch of the MoES Rescue Service is responsible for operational activities. The Ministry of Economy, which is responsible for agriculture also, is part of this setup along with other ministries. The committee is a standing body that is activated when a disaster occurs. It is presumed that formally, the same setting is valid for disaster prevention and mitigation activities. However, in practice, DRR is the responsibility of MoES.

In order to enhance national level integrated DRR efforts and coordination, an inter-agency operative working group (IOWG) was established in 2019 by a decree of the prime minister (Prime Minster of Armenia, 2019) with the aim to introduce timely efforts to reduce the risk of disasters, prevent possible emergencies, and undertake disaster prevention and mitigation measures. The IOWG is chaired by the minister of emergency situations and consists of 11 members that represent various ministries. Unfortunately, the agricultural sector is not represented in the IOWG (neither by the former Ministry of Agriculture, nor by MoE that currently executes the role and responsibilities of MoA). The marz authorities, local self-governing bodies, private businesses, NGOs, community members and volunteers, form an integral part of the national disaster risk management system.

Ministry of Economy (agriculture) and other related line ministries and national structures

The institutions and agencies dealing with agricultural risks act as part of the overall emergency management system coordinated by MoES. A key player within this structure, which is in charge of sector-specific disaster risk management responsibilities, was MoA, which was dissolved in 2019 as part of a major restructuring of the government (Armenia Parliament, 2019a). Currently, MoE is in charge of agriculture and executes MoA's functions aimed at ensuring the development and effectiveness of its agricultural sector. The areas of responsibility of the former MoA and the organizational structure are provided in the revised structure of MoE (MoE, 2020), which is represented by the following specialised departments:

- Department of Primary Agricultural Production
- Food Safety Department
- Food Security and Agro-Processing Development Department
- Department of Agricultural Programmes Elaboration, Resource Use and Cooperative Development
- Department of Agricultural Extension, Innovation and Monitoring
- Agricultural Programmes Implementation Department.

The above-mentioned departments are in charge of the entire agricultural sector and cover the following specific functions:

- agrarian policy
- agricultural processing
- animal husbandry
- veterinary services
- horticulture
- agricultural cooperation
- fish breeding
- food security
- organic agriculture.

There is no special structure dedicated to disaster risk management. However, it exists in various forms throughout the structures mentioned above.

Public extension – the current extension system in Armenia includes public and private service providers, input suppliers, international and local NGOs, and other organizations. The former MoA was the main actor supporting the development of agriculture and providing extension services in the public sector to the farmers. The public sector extension network includes the Department of Science and Extension of MoE, which provides extension services to farmers and other organizations under the ministry, which are part of the agricultural innovation system and provide professional services to farmers.

The public extension system has been restructured a few times. In 1992–1997, the extension service AgroGitaSpyur agricultural support service, established with support of the United States of America Department of Agriculture, was integrated into the National Agrarian University of Armenia. The main office of the service was located in Yerevan, with 37 branches located in the districts, with one branch in Artsakh. In August 2002, the Government of Armenia established the Agricultural Support Republican Centre CJSC to continue providing management and professional leadership to the marz agriculture support centres (MASCs). In March 2017, the government established the Agriculture Development Foundation (ADF). However, due to the government decision dated 13 April 2017, some state closed joint stock companies were removed, including MASCs and the Agricultural Support Republican Centre, which were then integrated into the established ADF structure as regional support groups with specific extension functions. As a result of the liquidation of the ADF in 2019, the extension service was integrated into the structure of MoA. Currently, MoE provides extension services to farmers through its regional divisions.

There are a number of other organizations performing under MoE, as part of the agricultural innovation system, which provide technical services to farmers, particularly the following:

- Vine and Wine Foundation of Armenia;
- Seed Agency SNCO;
- Centre for Agricultural Services SNCO;
- State agency Rural Areas Economic Development Programmes Implementation Unit;
- Agriculture Scientific Centre;
- Scientific Centre of Vegetable, Melon and Industrial Crops;
- Scientific centre for risks assessment and analysis in food safety area CJCS;
- Gyumri Breeding Station CJSC.

Other key players contributing to disaster risk management in agriculture are listed below.

Ministry of Environment (MoENV) – The MoENV develops and implements state policies and strategies in the field of environmental protection and rational use of natural resources, including water and land resources. It is in charge of monitoring and assessing the climate change-induced negative effects on the environment and loss of natural resources. The MoENV, under the guidance of the Inter-agency Climate Change Council, coordinates the preparation of the UNFCCC national communication reports, which provide regular updates on the implementation of the convention in Armenia. The development of a National Adaptation Plan (NAP) is also assigned to the MoENV. Referring to forests, it gives particular responsibilities to the implementation of state policies in the field of forest protection, reproduction and use of state forests, as well as those existing within the borders of specially protected areas.

- Forest Committee – is a state-run body established by the government decree of 18 June 2018, which operates within the context of the MoENV. It is responsible for the sustainable management of state forests, which refers to the protection (including fire protection), defence, forestation, reforestation and recovery, and the effective use of state forests.
- *Hayantar* (Armforest) – a SNCO acting previously under the authority of MoA. Currently, it is a separated unit of the Forest Committee, which maintains the same juridical status. Its goal and objectives are identical to those of the Forest Committee, but they have a more operational character. It is seen as an implementer of the Forest Committee's adopted policies and programmes. *Hayantar* organizes its activities through 19 countrywide forest enterprises (SNCOs administered by *Hayantar*).
- Forest enterprises – 19 forest enterprises function within the context of *Hayantar*, which are local SNCOs that manage assigned forest areas. These entities have primary responsibility for the protection (including fire protection), defence, forestation, reforestation and recovery, and effective use of state forests. Forest-enterprise staff are tasked to identify, monitor and prevent fire threats, plan (as a part of the forest management plan) and implement protection measures, including for fire prevention, preparedness and response.
- Hydrometeorology and Monitoring Centre (HMC) – an SNCO which operates within the structure of the MoENV. The HMC activities are based on the provisions of national law on hydrometeorological activities. It was recently established by the government decision number 81-ն of January 30 2020 through consolidation of functions of three separate entities that were previously part of different ministries: the HMS (previously part of MoES), the Environmental Monitoring and Information Centre (EMIC), and the Forest Monitoring Centre (FMC) of the MoENV.

On hydrometeorology, HMC:

- conducts monitoring of hydrometeorological events and environment;
- produces short and long-term hydrometeorological forecasts (including on wildfire threats) based on the monitoring results;
- disseminates this information among state and non-state interested parties, and the population;
- performs activities influencing atmospheric phenomena;
- organizes and conducts radar monitoring;
- ensures collection, processing, use, and storage of data obtained from observations, as well as issues official forecasts and warnings;
- carries out analysis of climatic and climate-change spatial-time patterns, assessments and predictions, and provides recommendations to interested organizations on the vulnerability of different sectors of economy to the impact of climate change;
- provides various hydrometeorological services, including for the agricultural sector.

On environmental monitoring, it supports the protection of natural resources through:

- observation of environment and natural resources dynamics, monitoring and evaluation;
- collection, registration, storage and analysis of relevant data and regularly informing concerned parties;
- analysis and prognoses related to the negative impact on the environment and natural resources caused by possible natural and man-made hazards.

On forest monitoring, it supports the prevention of illegal logging of state-run forests and other negative interventions of an anthropogenic nature, through conducting:

- forest monitoring activities and assessments;
- producing analytical reports and elaborating solutions;
- since 2017 (after widespread wildfires at Khosrov Forest Reserve), the HMC Forest Monitoring Centre has been engaged in the monitoring and analysis of burned areas, using GIS and satellite images.

Entities in charge of Specially Protected Nature Areas (SPAN) – specialised structural units, which are in charge of protected areas that encompass four types of nature preservation in Armenia:

- State wildlife sanctuaries
- National parks
- State reserves
- Natural monuments.

Performing DRR and management activities in these areas requires particular approaches and is limited by the specific area regimes defined by national legislation.

Ministry of Territorial Administration and Infrastructure (MTAI) – develops and implements state policies for effective territorial administration and development. It implements measures to ensure risk-informed development planning and active involvement of territorial units at local level, including emergency prevention, preparedness and response activities. Due to the above-mentioned government restructuring, it assumed the execution of the functions of the former Ministry of Energy Infrastructure and Natural Resources and partially of the Ministry of Transport, Communication and Informative Technologies. At present, the MTAI shares with other actors involved in DRR and management certain responsibilities over the entire energy sector and related infrastructure, the water and land use, transport, and mining sectors. Under the coordination of MoES and in cooperation with the ministries of economy, environment and defence, it executes the required actions to mitigate the negative consequences of disastrous events in the above-mentioned sectors on the population, settlements, environment, and agriculture.

- Territorial administrations – 11 territorial administrations, including the city of Yerevan, are MTAI territorial units. These ensure the implementation of MTAI policies at territorial level (marz) through the development and implementation of the marz-specific development strategies and plans. They also coordinate the functioning of the local self-governing bodies, including with regard to DRR and management, and climate-change adaptation activities. In the event of an emergency (including wildfire and agricultural burning), the territorial administrations, in cooperation with Rescue Service territorial branches, ensure mobilisation and allocation of available human, technical, and financial resources.
- Local self-governing bodies – these bear primary responsibility for the local-level risk management and risk-informed community development. They ensure community members' active participation in emergency prevention, early warning, preparedness and response activities, including the establishment of voluntary teams.
- Water Committee – is in charge of the development and implementation of national water policy and ensures the management and safe use of state-run water systems, implementation of the national water programme, and water system-related investment programmes. Among the wide range of activities, the Water Committee determines the norms for water supplies and water system losses, and establishes limits and norms for the use of irrigated lands and their protected water ecosystem zones.

Ministry of Defence (MoD) – ensures the protection of Armenia's territory and population in the event of an external armed conflict through the prevention and combat of a possible armed attack, neutralization of hot spots and implementation of military action, and imposing ceasefire or peace with the partial or full involvement of the armed forces. It has a particular responsibility to support the emergency authorities in major emergencies and take part in the protection of the population, provision of logistics and technical assistance in evacuation and delivery of humanitarian assistance. It also cooperates with the agricultural authorities in undertaking preventive measures with respect to the use of agricultural lands bordering Azerbaijan, and the hazard of landmines that remain in these areas due to the Nagorno-Karabakh conflict.

Ministry of Education, Science, Culture and Sport (MoESCS) – ensures the protection and development of education, science, culture, and sport as exceptional factors in economic development, competitiveness, public progress, and the country's security. There is a DRR thematic area within the MoESCS's general education programmes – which provides behavioural knowledge on addressing various hazards, including environmental issues – that is included in the curricula of specialised higher education universities.

- Armenian National Agrarian University (ANAU) – is a foundation performing under the overall management of the MoESCS. It is aimed at the implementation of agriculture-related educational, scientific, expertise, consulting, industrial, and publishing activities, and preparation of various profile specialists for the agricultural sector, as well as conducting scientific research and provision of recommendations for all areas of agriculture. The five faculties that are part of the ANAU include agronomy, food technology, agrarian engineering, veterinary medicine and animal husbandry, agribusiness and economics. Each faculty possesses chairs that cover certain agricultural risk-related issues, such as the horticulture and plant protection, phytosanitary, veterinary, and the protection of forests, land, and water resources.

Structures under the government:

- Food Safety Inspection – implements the assessment of food products' conformity aligned with applicable standards, regulation of the administration of veterinary and sanitary services, and ensures the control and application of sanctions on behalf of Armenia. It carries out state regulations on food safety and the evaluation of compliance in the veterinary and phytosanitary areas, and with regard to special cases. The laws of Armenia on Veterinary Medicine, on Phytosanitary, on Food Safety, on Compliance Assessment, as well as other laws, legal acts, decrees and decisions of the government, define the powers of this food safety service.
- Inspectorate for Nature Protection and Mineral Resources – is aimed at nature and subsoil protection by undertaking risk management measures, inspecting the implementation of legislative requirements and taking preventive actions when required. It also implements measures to prevent or reduce the negative impacts on the environment, and irrational use of natural resources.
- Nuclear Safety Committee – is responsible for state regulation in the field of nuclear energy use (safety of nuclear facilities, safe use of ionizing radiation sources, safe management of radioactive waste, safe transportation of nuclear and radioactive materials) to ensure the safety of personnel, surrounding communities and the population at large, as well as protection of the environment.
- Urban Development, Technical Standards and Fire Safety Inspectorate – carries out risk management activities and implements preventive measures in urban development, technical and fire safety, transport, energy, geodesic and cartographic areas that are of significance to the state and local level, as well as to land use.

In addition to these organizations, there are a significant number of commercial organizations and NGOs that are directly or indirectly (through health, environment, education, social and economic activities) involved in the agricultural sector and also contribute to the mitigation of agricultural risks, such as the:

Agricultural Alliance of Armenia – a voluntary multi-partner national platform, which aims to establish partnership and advocacy activities in the agricultural sector in Armenia. It is a joint commitment of 19 civil society organizations that work towards agricultural development in the country. The scope of its thematic area includes:

- agricultural education
- agricultural loans
- development of agricultural cooperatives
- gender mainstreaming of agricultural policies
- improvement of food security
- monitoring and evaluation of policy development and implementation
- agricultural insurance.

Association of Farmers of Armenia – is a voluntary NGO of Armenian farmers which provides consultancy support and professional expertise to farmers and agricultural authorities in Armenia. It also carries out advocacy and public awareness campaigns on hazards to the agricultural sector and the environment.

Centre for Agribusiness and Rural Development (CARD) foundation – the leading private-sector player, which provides integrated services to farmers and the agro-industrial sector based on the "one-stop shop" model through its two affiliated, for-profit organizations. The CARD foundation was established in 2005 as the successor to the Marketing Assistance Project funded by the Unites States of America Department of Agriculture, and moved from a donor project to a commercial, for-profit entity. It promotes modern agricultural technologies, machinery and equipment, and supports agricultural processing companies to improve the competitiveness of their products for sale in local and export markets. It helps to improve food safety and food security at all stages of the production cycle, and works on the improvement of animal genetics, animal health and husbandry practices. The foundation is one of the organizations in Armenia that has acquired knowledge and information, through the implementation of agriculture development projects since 2005. Among those projects are a large proportion that focus on the animal husbandry sector and veterinary services. The CARD Agro-service provides agricultural services and products to farmers and the agro-industrial sector, while the universal credit organization CARD Agro-Credit provides agricultural and agricultural business financial services to beneficiaries.

The CARD model is based on the establishment of the farm and veterinary service centres in communities, which provide different services, including those the field of plant protection and veterinary services. At present, CARD has established 19 centres in Armenia. The services provided by the CARD Agro-service depend on the agricultural specialisation of the location. For example, the farm service centres in the Darakert community in Ararat marz, and Norapat community in Armavir marz, support greenhouse and horticultural farmers. The centre in Darakert also has three modern adjacent greenhouses which were established for the demonstration of advanced greenhouse management techniques, new cultivation tools and equipment, as well as input supplies. These greenhouses are used for trials of high-quality vegetable seeds, new technologies, and innovations in the industry. The farm service centres have also modern laboratory equipment for soil, water, and plant analyses. The centres in other marzes mostly serve farmers involved in animal husbandry. The centres in these three regions offer a wide range of advanced veterinary services, including genetic improvement, disease prevention and treatment, medicines, veterinary input, and farm supplies.

DRR National Platform (DRRNP) – a non-state and non-commercial organization that has the juridical status of a foundation. It was established by a government decision within the country's implementation of the Hyogo Framework for Action, and operates under the auspices of MoES. The DRRNP is an advisory institution that acts as an open partnership platform for all local and international, state and non-state actors involved in DRR and disaster risk management. The DRRNP supports the government's disaster management capacity-development efforts by consolidating the available DRR and management expertise and elaborating policy, strategic and programmatic solutions for various thematic areas. The DRRNP particularly supports the promotion and implementation of local-level risk management methodology in communities of Armenia, and ensures the integration of DRR and management-related measures in community development plans (including the agricultural sector, such as for wildfire threats).

Disaster Management Country Team (DMCT) – is an informal humanitarian coordination mechanism established under UN auspices and coordinated by the UN Resident Coordinator. It includes more than 20 organizations involved in DRR, including relevant UN agencies present in Armenia (UNDP, UNICEF, UNHCR, UNFPA, UNOCHA, FAO, WFP, WHO), international and local NGOs, the Armenian Red Cross Society, with the International Committee of the Red Cross as an observer. The DMCT aims to ensure the readiness of the humanitarian community to support the government's response efforts in case of a major emergency. It also cooperates with national emergency authorities by contributing to the capacity development of the emergency system.

Hydrometeorological service

Until recently, the provision of hydrometeorological services was one of the key functions of MoES. It was operated by a MoES structure called the Service of Hydrometeorology and Active Influence on Atmospheric Phenomena (also called Hydromet Service, and referred to as the HMS here also). In July 2019, within the context of the government's global restructuring (Armenia Parliament, 2019b), the HMS was transferred from MoES to the MoENV and joined a newly established structure called the Hydrometeorology and Monitoring Centre (HMC) SNCO (http://www.armmonitoring.am/). It was merged with two other structures operating within the MoENV – the Forest Monitoring Centre (FMC) and the Environmental Monitoring and Information Centre (EMIC). The HMC covers the entire territory of Armenia and executes functions such as those of the former HMS, including the monitoring of the weather, climate, hydrological and geophysical observation, and it provides hydrometeorological services to its partners (including those in the agricultural sector). Its observation network consists of a significant number of meteorological and hydrological stations, including the following types of observation:

For meteorological and climatic observation and monitoring – 47 stations (Figure 14), of which:

- meteorological stations in Yerevan, Gyumri and Ararat equipped with automated stations possessing agro-sensors. In addition, sensors measuring soil humidity are installed in ten other stations;
- five meteorological stations with more than 100 years of observation history;
- 41 stations provide agrometeorological services, including seven automatic stations;
- 12 stations situated at 2 000 metres above sea level and higher, of which six stations are remote, hard-to-reach stations. One of those stations, the Aragats high-mountainous station (3 229 metres above sea level, established in 1929), is the only station in the Caucasus region located at such a high altitude that has a long-time series of temperature and precipitation measurements. It plays an important role in the investigation of regional climate variability and change. In 2008, it was included in the General Comprehensive Operating System (GCOS) Surface Network and since then provides historical data and monthly updates (CLIMAT)[16] to the World Climate Data Centre;
- one aerological station (radiosonde and balloons);
- six actinometrical stations to **measure** the heating power of radiation;
- one operational open-air station located in Yerevan at 1 134 metres above sea level, which performs aerological, meteorological, and radiation observations. It was established in 1973 and is the only operating upper air station in the Caucasus region. The station is part of the Regional Basic Synoptic Network and the GCOS;
- 27 stations for solar radiation observations;
- three radars (outdated);
- 20 of the listed stations provide data for international exchange.

For hydrological observation and monitoring – the surface water quantitative monitoring network consists of 91 hydrological observation posts (82 placed in rivers, five in reservoirs, and four in lakes), the performance of which is coordinated by the seven river-basin hydrological stations. Water level automatic registration stations equipped with data transmission online systems are installed at the 11 hydrological posts (six of radar-level measurement and five of hydrostatic-level measurement capacity). Two of the 11 stations transmit data using satellite communication, while the other nine use the GSM network. At the remaining 80 hydrological posts, observations are performed manually.

According to a recent World Bank-GFDRR assessment report (Dube *et al.*, 2018), approximately 35 percent of HMS (now HMC) stations possess observation sets of at least 70 years old, 10 percent ones of 80 years or more, and four stations have more than 100-year old data. These data sets are originally in paper form and comprise meteorological (45 percent), hydrological (26 percent), agrometeorological (7 percent), aerological (4 percent), and other (17 percent) data. Currently, almost 80 percent of the data is digitised and the digitisation is ongoing; however, about 35 percent of the data requires proper checking.

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[16]CLIMAT and CLIMAT SHIP, and CLIMAT TEMP and CLIMAT TEMP SHIP are the names of the codes for the reported monthly values of meteorological parameters from land and ocean weather stations and for the monthly reported aerological data from land and ocean weather stations. Thus, CLIMAT (SHIP) refers to CLIMAT and CLIMAT SHIP codes and CLIMAT TEMP (SHIP) to CLIMAT TEMP and CLIMAT TEMP SHIP codes. CLIMAT (TEMP) (SHIP) refers to all four codes (WMO, 2009).

Figure 14. Network of meteorological stations of the Hydrometeorology and Monitoring Centre

Source: HMC, RA MoEnv, 2021.

The government defines the overall scope of the services and products (agrometeorological services included) to be delivered by the HMC. It regularly adopts the action plan for the provision of hydrometeorological services. The latest programme for 2018–2020 approved by the Government Decree of 3 May 2018 (Government of Armenia, 2018b) defines the:

- purpose of HMS activities – using the HMS observation network to monitor hydrometeorological events and processes, and ensure the communication of the monitoring results to the government executive branches and state institutions, physical/legal persons and general public, thus meeting their respective needs;
- scope of activities – refers to various types of observations/provision of services;
- performance of scientific research – contains a wide range of various activities, including through international cooperation;
- expected results – provides the list of HMS information products, including the product type and the frequency or time schedule of product delivery.

The provision of agrometeorology services is one of the HMC's key functions. The HMC submits agrometeorology services information to MoE for further communication among relevant partners. Previously, a working group was established containing representatives from MoA, Hydromet Services, National Statistical Services, and the Agrarian University, to co-develop agrometeorological bulletins.[17] The experience of such collaboration

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[17]The working group no longer functions due to recent changes in government structures.

could serve as a best example for wider involvement and cooperation among interested parties. It is expected that something similar will be established in the near future, probably with a wider circle of partners, that will facilitate the strengthening of interagency linkages and communication. A detailed list of the services and products, including recipients, delivery schedule, and mechanisms (communication), are also defined by the 3 May 2018 decree.

The HMC maintains a meteorological database that includes metadata, synoptic, daily, sunshine duration, and snow data, as well as data on hydrometeorological hazards. The current HMC telecommunication system operates through the WMO and the e-platforms of their global information service centres, which collect, process, and distribute data from the stations and satellites.

The HMC contributes to the World Weather Information System and provides five-day weather forecasts; it also participates in the WMO Information System (WIS). Under the Commonwealth of Independent States Interstate Council on Hydrometeorology, the HMC exchanges data from 16 hydrometeorological stations with Commonwealth of Independent States national partner agencies. It also shares data from 32 stations with the Russian Federation's hydrometeorological services within the context of the bilateral cooperation programme on hydrometeorological forecasting.

The development of a hydrological database of the HMC hydrology services is in process. On-paper data for the 1938–2000 period are already digitised in Excel format. The database has been developed with the support of EU Water Initiative Plus. It is currently in the reconsideration, adjustment, and improvement process.

To communicate data or disseminate hydrometeorological information to its local partners, the HMC uses the existing connection opportunities, including its newly developed website.[18] The HMC widely uses SMS text messages, the mass media and social media to communicate this information to all interested agencies, institutions, and the general public. In terms of investments, it depends on the action plan, which is currently being developed within the context of the National Framework of Climate Services based on an assessment report of the NGO, Zoï Environment Network. This report includes as one of the proposed actions that national forums are held twice a year and would involve all potential users to ensure targeted investments are tailored to user needs. The HMC bulletins, including on agrometeorology, are not available publicly, but are shared with particular partners via e-mail – the government and all line ministries, including MoES and MoE (agriculture). However, it should be noted that a new page on the HMC website was recently introduced called the "hydrometeorological bulletin",[19] which provides daily hydrological updates for rivers and lakes (including Lake Sevan). Unfortunately, meteorological and agrometeorological information is still not included. The HMC provides short-range weather forecasts (24-hour, five-day) based on its own data and by using global models obtained via the internet. The HMC also experiments with a 3 km weather research and forecasting model, while its database in Excel format is accessible to all forecasters. It should be noted that the weather research and forecasting model did not prove itself for Armenian conditions. Hydrometeorological vulnerability is being estimated based on observed wind, extreme precipitation and extreme temperatures, and vulnerability maps exist and are available.

For monthly and seasonal forecasts, the HMC refers to the EUROSIP products that are available at the European Centre for Medium-Range Weather Forecasts (ECMWF) website and include multi-model model seasonal forecasts from the ECMWF, Met Office, Météo-France, US National Oceanic and Atmospheric Agency National Centres for Environmental Prediction, and Japan's Meteorological Agency (JMA). The HMC also provides the predictions from the global information service centres with access to 12 such centres provided by the WMO.[20]

The HMC is currently striving to implement more tailored regional and national-scale models using the regional climate downscaling techniques (RCD). The RCD, contrary to the Global Climate Models (GCM), which provides predictions on 1 000 square kilometres, may contribute effectively to local needs and provide essential support to climate-change relevant measures, DRR and adaptation strategic planning and decision-making.

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[18]At present, the HMC website is under development and only monthly and five-day forecasts are available, see http://www.armmonitoring.am/#home
[19]For the Ministry of Environment's hydrometeorological bulletin see http://meteomonitoring.am/page/79
[20]Access is provided by the WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble, see https://www.wmolc.org/

Early warning system

According to United Nations International Strategy for Disaster Reduction (UNISDR) studies, it is estimated that 35 percent of losses caused by natural hazards could be prevented through a properly set warning system (Tammelin, 2012). Armenia, unfortunately, is still working on such a system to be established. There are government-adopted regulations which outline warning procedures in emergencies (Government of Armenia, 2005a). In addition, there is the latest Government Decree on the approval of regulations for state executive and self-governing bodies, organizations and the public on warning and awareness in emergencies (Government of Armenia, 2017b). It describes the responsibilities of all actors involved and provides instructions for action (similar to the chain of command), defines warning tools and the meaning of different signs. However, these regulations refer to major disasters (for instance, external military attack, including from the air, hazards such as radiation, chemical hazards, and dam collapse) for which particular national plans are available. However, it should be noted that certain warning elements are available to warn the population against various hazards. These warning schemes are available in the civil defence operation procedures, as well as in the major infrastructural procedures for high-risk accidents (for example, nuclear and thermal power plants, dam management institutions, air and rail transport companies). Nevertheless, early warning is an essential element of disaster preparedness and response planning, but it has never been introduced. This issue has been high on the government agenda, and particularly on the MoES agenda, for a long time. It was highlighted in the first DRR National Strategy, but only a few pilot projects have been undertaken that mainly tested warning tools and technologies. The EWS improvement was also included in the Disaster Risk Management National Strategy and the respective action plan (Government of Armenia, 2017c). Accordingly, MoES elaborated and presented a draft government decree which is supposed to approve a "disasters' early warning system concept", and is available as an e-draft in the overview website of published legal acts (Government of Armenia, 2018a). The concept describes the EWS formation principles, and required technical, funding, and operating resources. It is envisaged that the presumed EWS system will include not only the technical means and technologies, but also the EWS management principles that support the data collection, analysis, communication, and decision-making SOPs. The establishment of an EWS will contribute to the elaboration of case-specific scenarios and contingency planning, which serves as a sign for the activation of disaster preparedness or response plans.

Overview of legislative and institutional gaps and constraints

In order to classify the findings of the analysis of the existing DRR and management legal and institutional structure in general, and for the agriculture in particular, they are outlined according to DRR components – prevention, mitigation, preparedness, response and recovery. Below is a consolidated list of findings, which show gaps, constraints and the extent of their applicability to the current DRR and disaster risk management situation, with a focus on the agricultural sector.

Disaster prevention, mitigation and preparedness

- There is a lack of a formal definition of DRR and disaster risk management and as a result, actions are partially or fragmentally implemented, and DRR is not systematically integrated in the agricultural sector.
- There is a discrepancy between sectoral and emergency documents when referring to DRR and management as a function. In many sectoral legislative acts and policy papers, DRR is simply missing, even when referring to particular disaster prevention, mitigation or response measures. There is a misunderstanding of the term 'disaster management' by sectoral authorities (equally refers to agricultural authorities), who still believe that it is the sole responsibility of MoES.
- There is a lack of a common understanding of DRR and disaster risk management terms, arbitrary interpretation and use of terminology, which is among the main obstacles for the implementation of systemic and integrated approaches, and consolidation of DRR efforts. Apart from emergency-related papers, there is a lack of consistency in the use of terms such as 'hazard', 'disaster', 'disaster risk', 'risk reduction', and 'risk mitigation'. The use of 'threats', 'mitigation or prevention of threats' instead is the common expression in other sectors, while presuming any action referring to DRR and management. Another constraint is in relation to the understanding of DRR and related activities. Actions such as combating erosion and desertification, landslide and flood management, cleaning of mud-flow channels and drainages, and preventing epidemics and diseases, are included in emergency management policies and legal papers and used within the context of DRR and disaster risk management, or climate-change adaptation. One can hardly find the terms DRR and disaster risk management, or climate-change adaptation, in official agricultural policy or strategic documents. In reality, this does not mean that DRR and management and climate-change adaptation actions – such as disaster prevention in agriculture, or the protection of natural resources – are not included in agricultural plans. Initially, this may sound a purely technical issue, which does not substantially affect the meaning of the undertaken activities. However, in reality, it leads to two substantial issues:

  1. It leaves aside the understanding and implementation of the DRR and management cycle and the related sequence of phases in different sectors, including in agriculture. Instead, disintegrated preventive activities are implemented and mixed with reduction, prevention, preparedness, and response. This situation often leads to ad-hoc solutions, rather than a well-planned and systematized management approach.
  2. It makes it impossible to link the DRR and management, and climate-change adaptation, strategic/policy papers with actual activities in the field. It is practically impossible, for instance, to find any references between the climate-change adaptation measures for agriculture prescribed in the Third National Communication on Climate Change, and agriculture-related activities envisaged in the Disaster Risk Management National Strategy Implementation Plan (Government of Armenia, 2017c). Thus, the "integrated approach" that links DRR and climate-change adaptation within the context of sustainable development – in order to be resilient to climate variability and change – is missing in sectoral thinking, planning, and implementation.

- There is inconsistency and a lack of continuity in the implementation of laws due to conflicting sectoral interests – for instance, the issues of burning of agricultural land adjacent to forest areas, or prescribed burning, as it is entirely prohibited by the Law on Atmospheric Air. However, in reality, these issues remain unregulated. This is due to farmers' traditional thinking and behaviour, and secondly, as a result of contradicting sectoral instructions on the rules and norms of agricultural and prescribed burning (see details in Annex II).

- There is a lack of standard procedures in the existing regulations on hazard and risk assessment and monitoring, needs and capacity assessment, and the evaluation of damage and losses.[21]

- There is an absence of a legally defined and institutionalised national and sectoral EWS. As a result, there is no legal requirement for the development of scenario-specific contingency plans at local and regional levels. However, there are already certain attempts in MoES towards its establishment. The EWS national concept is at least already drafted, officially circulated, and pending government adoption.

- The role of the HMC is not sufficiently defined in the entire DRR and management process. As one of the key contributors to hazard risk monitoring and assessment, its role in this regard is limited to information-sharing only (for example seasonal, monthly and daily forecasts, provision of agrometeorological services, hydrological data) and it is not further involved in decision-making or disaster management planning.

- There is a lack of a mandatory procedure to regularly update country hazard and risk profiles, at least annually or bi-annually – although there have been certain achievements in mapping and monitoring the largest risks, such as earthquakes or flooding, which may cause substantial damage and losses. In addition, different agencies and units in MoES, the MoENV, and MoE (including the agricultural sector) are monitoring various hazards seasonally or on a daily basis. However, there is no formal procedure for the collection, consolidation, and analysis of this information by an authorised government agency. Based on the analysis, such an agency should highlight the actual priority risks to which the Government should align its DRR and management plans, actions, and resources.

- There is an inadequate information management system and lack of a centralized emergency database for the collection, registration, analysis, and maintenance of emergency data from all socioeconomic sectors, including agriculture. This is one of the major gaps in the entire DRR national system. The same refers to HMC-produced data, which is supposed to be an integral part of the national emergency database. During the past decade, it was always on the government agenda, which aimed to establish a unified national information platform, where data is consolidated and available in an emergency database. Despite of a number of government-adopted decrees and strategic papers, this issue is still pending.[22] Practical measures that were supported by international partners did not achieve any remarkable progress either.[23]

- Unregulated DRR and climate-change adaptation activities in agriculture and environmental protection result in a scarcity of consistent activities in this area. There is also a lack of case-specific standard management models to be adapted and used in DRR and climate-change adaptation planning and implementation. As a result, a limited understanding of risk-development linkages exists in different levels of development planning (including at sub-national level), which requires substantial improvement through ensuring consistency when translating policy or strategy documents into action, the usage of universal terminology as stipulated by law, and raising knowledge and awareness among decision makers and managers at various levels.

- There is an absence of a dedicated DRR and disaster risk management unit in the sectoral authorities (including in agriculture) to ensure the consideration of sector-specific disaster risks in sectoral planning, equipped with relevant knowledge and performing under the coordination of the relevant MoES departments, and in partnership with units of other sectors.

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[21]In 2015, FAO within the context of the EU-funded ENPARD project published the 'Guidelines on risk reduction of key natural and man-made hazards with negative impact on agriculture in the Republic of Armenia' (FAO and ENPARD, 2015). The publication aimed to support the agricultural authorities in moving towards more proactive DRR in its disaster planning and implementation and it is expected that certain DRR and disaster risk management procedures in agriculture will be formally adopted.

[22]These documents are available in Annex II.

[23]The National Disaster Observatory (UNDP, 2011b) is currently not operational due to technical issues. Neither is the National Forest Management Information System (NFMIS), which was initiated in 2011 and was initially designed for MoA, but its implementation is also pending (MoA and GIZ, 2019).

Disaster response and recovery

- The disaster response phase of disaster risk management is well covered by legislation and consequently reflected in institutional arrangements. However, as was already mentioned, the existing national disaster response plans refer to major large-scale disasters due to different hazards. The existing issues refer to local-level disasters and community emergency plans. According to current legislation, there are community civil defence plans that presume in the first place that the community undertakes action in case of an external armed conflict, and nuclear and radiological hazards. During the past decade, these plans were also used to respond to emergencies caused by natural and technological hazards. However, there is still a gap in addressing the specific local disasters (flooding, small-scale earthquakes, landslides) that affect communities. The major challenge related to disaster response remains the unregulated humanitarian needs assessment issue.

- The recovery phase is not regulated at all. There are no formally adopted policy and management procedures that define the post-disaster recovery framework. The government has a state reserve and emergency funds, but those are mainly preserved for response operations and addressing urgent needs during emergencies. In the event of a major disaster (beyond the government's response capacity), the government appeals for international assistance, including for recovery and rehabilitation.

- There is also a system of compensation which the government provides to the affected population based on the damage assessment. Due to state budget limitations, this is often much less than the actual cost of damage and losses. The evaluation and estimation of damages fall under the responsibility of the state-run disaster management (emergency) committees. Though the Government Decree on damage assessment (Government of Armenia, 2011b), along with the establishment of emergency committees, provides instructions for the estimation of damages, the issue of having a comprehensive post-disaster recovery framework based on the proper assessment of damage and losses, remains uncovered. The government also intends to promote the introduction of an agricultural insurance system, which is among the proposed climate-change adaptation measures for the Armenian agricultural sector.

- There is a lack of policies and established formal procedures for local and international resource mobilisation; and there are no regulations for requesting international assistance in specific cases that do not cause human loss or damage to livelihoods, but require special equipment or machinery.

Agrometeorology services and products

As reported by the HMS during WMO's Technical Conference on Future Challenges and Opportunities in Agricultural Meteorology, held in 2018, the aim of the HMS is to provide timely and effective agrometeorological services, including early warnings, climatological assessments, forecasts across different time scales from real-time to seasonal forecasting, and climate-change projections. In addition, it estimates the agroclimatic resources of the country, which is critically important for ensuring sustainable agricultural development, increasing crop productivity, and ensuring food security. Timely warnings help to reduce damage and losses (HMS, 2018).

With the aim to improve the HMS forecasting capacity, a workshop was organized jointly by the HMS and FAO under the EC/FAO Programme on Information Systems to Improve Food Security Decision Making in the European Neighbourhood Policy (ENP) East Area on 13 October 2010 (HMS and FAO, 2010). One of the results of the workshop was a proposal to improve crop forecasting and communication of the information by the participating partners, through the HMC website (which is currently being developed), which will include two-way communication feedback mechanisms, as well as support to farmers to ensure that they are able to apply the information. Following the recommendations, a working group composed of the HMS, MoA and the SCRA was established, which then implemented the proposed recommendations through a FAO-supported project (2010–2013). The project facilitated the co-design and co-development of agrometeorological bulletins, and the development of three automated agrometeorological stations, including training of the HMS staff involved. The stations now comprise part of the HMC network.

The products and information provided by the HMC to the interested parties are described in detail in the HMS Programme of Activities 2018–2020 (Government of Armenia, 2018b), and the list of products essential for the agricultural sector is outlined in Table 12.

Table 12. List of HMS agrometeorological products

N	Product/information type	Provision frequency or time schedule
1.	Actual weather map	Daily
2.	Hydrometeorological bulletin	Daily
3.	Monthly weather conditions forecast	Monthly
4.	Seasonal weather conditions forecast	October–March
5.	Review of observed weather conditions	Monthly
6.	Review of observed and expected events	Weekly
7.	Provision of weather forecast and warning on hazardous events to the MoES Crisis Management Centre and communicating those via internet	May–October
8.	Hydrometeorological bulletins for ten marzes	Daily
9.	Preparation of information on the expected or observed hydrometeorological hazardous events	Daily
10.	Weather forecast and review for mass-media channels	Daily
11.	Evaluation and forecast of the ultraviolet radiation intensity and changes in the situation with geomagnetic field	Daily
12.	Provision of warnings to partners and general public on hydrometeorological hazardous events	Upon occurrence of such risks
13.	Website update on climate variations and hazardous events, including surveys and warnings	Daily, based on the factual observations
14.	Analysis of vegetation period by applying the satellite data	Per decade during the vegetation period
15.	Evaluation of water availability data for wheat, grapes and potato in the different growing phases	Per decade during the vegetation period

N	Product/information type	Provision frequency or time schedule
16.	Prediction of spring flooding	March
17.	Adjustment of spring flooding predictions	June (as required)
18.	Prediction of rivers' average runoffs	Daily, ten-day period, quarterly, once a year for average vegetation runoff
19.	Data on snow coverage	March
20.	Sevan Lake water balance	Monthly and annually
21.	Sevan Lake water level	Daily
22.	Data on the quantity of water released from Sevan Lake for irrigation purposes	Daily in accordance with water release schedule
23.	Data on the rivers' surface level and water runoff	Daily
24.	Analysis and GIS mapping of observed flooding data	May–October
25.	Assessment of river bed deformations	First half of the year
26.	Information on autumn wheat sowing conditions in mountainous and foothill areas	1-2 times in autumn
27.	Information on the conditions of autumn wheat during winter	2 times in February-March
28.	Identification of damage to autumn wheat during winter based on vitality data	2 times in February-March
29.	Data on the conditions of autumn wheat during the vegetation period	Once in spring
30.	Moisture forecasting in the beginning of the autumn wheat vegetation period in the mountainous areas	Once in spring
31.	Data on the autumn wheat wax maturity timing	Once during the spring/summer period
32.	Term forecast of autumn wheat spike development in particular areas	Once during the spring/summer period
33.	Forecast of country autumn wheat average yield during the spike development period	Once during summer
34.	Forecast of average crop yield of cereals, including during: • vegetation period • sprouting • spike development.	May Once during spring Once during spring Once during the spring/summer period
35.	Information on the dates of early potato planting in the valleys	Once during February-March
36.	Prediction of country average of potato yield	Once during spring
37.	Information on planting of heat tolerant crops in Ararat valley and foothills	Once during spring
38.	Prediction of country average of vegetables yield	Once during the spring/summer period
39.	Prediction of apricot and peach blooming times	Once during spring
40.	Prediction of average yield of apricots	Once during spring
41.	Prediction of grape blooming times in Ararat valley	Once during spring
42.	Prediction of gross grass yield in mountain grasslands	Once during the spring/summer period
43.	Prediction of yield of spring barley by development phases	2-3 times during the spring/summer period
44.	Prediction of soil moisture at the beginning of vegetation at 0-10 cm, 0-20 cm and 0-50 cm soil layers	Once during spring
45.	Development of agro-bulletin	Per decade
46.	Development of agrometeorological bulletin for the plants' winter rest period	Monthly during winter
47.	Information on expected agroclimatic conditions during autumn wheat harvesting in the southern foothills	Once during summer
48.	Prediction of yields of autumn wheat, potato and grapes through application of satellite data	July
49.	Provision of climatological analysis to the VMO VI Regional Association Centre and SCRA	February
50.	Monthly, seasonal and annual analyses of climatological characteristics (average temperature, precipitation quantity and their deviation from norm)	Permanent, continuously

Source: Government of RA, 2018a.

Overview of agrometeorology services challenges

The HMC faces serious challenges regarding its technical and human capacities in providing effective agrometeorology services to users. This has to do with the quality of the main stations, which are 30 to 40 years old. A couple of automatic stations provided by international partners within the context of the pilot projects being successfully installed and integrated into the network only highlighted the existence of chronic gaps, such as the lack of an integrated information management framework, and the deficit of professionals with modern knowledge and skills. The existing radar system (two stations) is absolutely insufficient for effective real-time weather forecasting. A lack of capacity to provide locally viable and tailored agrometeorological information to meet the users' actual needs diminishes the HMC role in meeting the challenges caused by climate change and taking an active position on DRR and national adaptation planning and implementation.

As already mentioned, the HMC bulletins, including on agrometeorology, are not available publicly. There has been an attempt to make the HMC bulletins public by creating a 'bulletins' page on the HMC website. At least the 'hydrometeorological bulletin', providing daily hydrological updates for the rivers and lakes, is already available. Unfortunately, open access to meteorological and agrometeorological bulletins is still missing.

During the WMO's Technical Conference on Future Challenges and Opportunities in Agricultural Meteorology held in Korea in 2018 (HMS, 2018), the HMS presented a summary of its capacity self-assessment results, also based on the users' actual demands. These results, which then served as a basis for the planning for further agrometeorology services capacity development, include:

User needs (feedback from users)

- more frequent data/information provision;
- provision of very short-range weather forecasts (real-time);
- effective hail protection system;
- agro-extension/advisories;
- training seminars for users – awareness of users on hydrometeorological products;
- use language (terms) understandable by users;
- close interaction, cooperation, joint discussion of information required to meet users' needs.

Agrometeorology capacity-development needs

Establishment of:
- national framework for climate services;
- agrometeorological extension service.

Technical modernization

- re-equipment and extend existing observation network;
- automation of observation network;
- establishment of radar network;
- upgrade database management system;
- strengthening of telecom system, information transmission in real-time.

Application of new methodologies and investment in ICT and communication channels

- introduction of needs-based effective agrometeorological, and;
- hydrological forecasting models.

Building knowledge and skills capacity through conducting:
- education, training for personnel;
- training for users;
- forums/seminars.

Since 2010, a number of capacity assessments on the HMS and agrometeorology services have been undertaken by international partners, which have indicated similar gaps (Tammelin, 2012; MoES, HMS and UNDP, 2013; World Bank, 2014; Ahouissoussi *et al.*, 2014; Dube *et al.*, 2018). One of the most comprehensive reports with regard to this is the World Bank report Modernizing Weather, Climate and Hydrological Services: A Road Map for Armenia, developed in cooperation with the HMS (Dube *et al.*, 2018).

Early warning system in the agricultural sector

At present, it is the HMC that provides the initial information and triggers the activation of an early warning. This is an alert rather than a warning with presumed standard communication and operational procedures. As mentioned earlier, a systematic management procedure with clear distribution of roles and responsibilities, chain of management, and decision-making procedures, does not exist. Upon receipt of the HMC's alert regarding potential hazards (received through the government's internal electronic communication), the agricultural authorities (MoE) proceeds with informing the population regarding the required preventive measures to be undertaken. Both the HMC and MoE use media channels and messaging options to inform organizations and the general public.

There are no structured EWS in the fields of plant protection and animal health. An EWS in the plant-protection field is a strong guarantee for responding to the increasingly dire situation of major pests and diseases, and ensuring national food security. Such a system is aimed at collecting, processing, storing and disseminating observational data on the main crop pests. It supports the farmers, technicians, advisers and other users to collect, share and consult real-time data. At present, there is no such system in Armenia, and plant protection is mainly carried out spontaneously.

At present, there is no structured and planned system for animal health protection in place. A combination of early warning, good surveillance for early detection, and early response, can significantly reduce the impact of disease outbreaks and improve the animal-health situation in the country. The introduction of a combination of such systems will also significantly reduce losses in the livestock sector, improve food security and nutrition and, in the case of zoonotic diseases, save human lives.

Armenia does not have a market information nor a price monitoring system. There is no official grading system for price differentiation according to quality either.

Overview of early warning system challenges

There are two main conclusions arriving from the observation above on the EWS situation in Armenia (which refers equally to all sectors, including agriculture):

- Early warning, as a preparedness measure, is completely lacking from the existing Armenian warning framework. It is intended to be introduced as a structured national system underpinned by risk assessment and monitoring results for all kinds of hazards of a local or sub-national nature, which is seen as a component of the overall disaster risk management cycle and assumes certain communication and decision-making standards.
- The lack of legislative and institutional frameworks for all levels of emergency authorities with regard to the development of risk-specific contingency plans, is a direct result of the absence of EWS. Consideration of EWS information-based worst-case scenarios, and the development of relevant contingency plans, is one of the preparedness key components. Such national plans exist for the major disasters;[24] however, a similar approach to community or enterprise-based emergencies does not exist. Consequently, the disaster preparedness plans are not based on the analysis of contingency

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[24]These include a national plan for major earthquakes (Government of Armenia, 2011a) and accidents at the nuclear power plant (Government of RA, 2005b), which are strictly followed within the context of the government's planning and relevant simulation exercises.

plans and relevant vulnerability and capacity assessments (including for authorised agencies, communities and relevant governing bodies).

The EWS concept that is already circulated is developed with the aim to increase the effectiveness of disaster response and prevention measures, which shows the conceptual incorporation of EWS as an integral part of the entire disaster risk management process. While the concept is officially endorsed by the government, it is recommended that SOPs are elaborated for the entire EWS management process, which starts from risk levelling to communication and decision making.

Disaster risk reduction in the agricultural sector

The agricultural sector, as one of the key DRR beneficiaries, is not substantially involved in DRR at national level. Formally, however, it exists in all official policy, strategic and legal documents, with a defined role and function. In practice, it does its portion of the work, but in isolation and in a reactive way by responding to disasters that impact the agricultural sector.

In Armenia, DRR and disaster risk management as a regular and structured approach and framework, with a set of management procedures, does not exist in the agricultural sector. There are elements of disaster risk management, which mainly refer to the traditional areas of protection, such as the prevention of plant and animal infectious diseases and epidemics, pest control and emergency response to the impacts of natural hazard-induced disasters.

At the same time, the government has made a significant attempt to improve the effectiveness of use of natural resources, elimination of risks, and protection of agricultural production through the application of modern technologies and approaches in the sector, including the:

- improvement and effectiveness of risk monitoring and assessment through modernization of the HMC and agrometeorology services;
- introduction of agricultural insurance;
- planting of intensive orchards;
- promoting the construction of smart barns;
- introduction of modern irrigation systems;
- improvement of anti-hail system and wider use of anti-hail nets.

Agricultural insurance is a specific agricultural risk mitigation solution, which the government considers among its priorities in its agricultural development policies. However, at present, it is almost non-existent in the country and there is no legal or policy framework for agricultural insurance. The insurance companies are not very interested in developing agriculture insurance products due to the perceived high risk and low profitability in the sector. The insurance promotion programmes have not provided expected results so far. Another issue is that the risks are not equal across the entire country, and vary depending on the type of hazard, exposure, and vulnerability. On the other hand, the lack of suitable agricultural insurance products significantly hinders farmers' access to loans, income, and even food security, particularly within the context of increasingly erratic weather patterns and increasing losses from different types of disasters.

The government, together with different organizations, donors, and insurance companies, have already started discussions and even initiated certain steps towards the development of a modernized agricultural insurance system in Armenia. In 2014, UNDP Armenia conducted a Needs Assessment for Introducing Agricultural Insurance in Armenia in the Context of Climate Risk Mitigation, by analysing the challenges of crop insurance in Armenia as well as agricultural insurance products and delivery models (Tatin-Jaleran, 2014).

In 2014, the Business & Finance Consulting company conducted for the Central Bank of Armenia and KfW (the German development bank, Kreditanstalt für Wiederaufbau Entwiclungsbank) a feasibility study for the design and setup of an agricultural insurance system.[25] One of the findings of the study was that the insurance system would significantly improve Armenia's agricultural risk management environment, contribute to stabilizing farmers' incomes, increase the creditworthiness of agricultural borrowers, and provide an effective alternative

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[25]This document has not been published.

to governmental ad-hoc relief payments used in the event of disasters caused by natural hazards.

The Swiss-based CelsiusPro Insurtech company has recently completed a multi-stakeholder international tender on behalf of KfW and the Central Bank of Armenia (CelsiusPro, 2018). The tender was for the technical assistance to set up a nationwide agricultural insurance scheme in Armenia from scratch. The envisaged agricultural insurance programme, which was supposed to start in 2019, contained:

- a set-up phase (18 months) for data gathering, actuarial analysis, design of insurance products, and the creation of NARMA (National Agricultural Risk Management Agency), a governing body composed of private and public insurance market actors;
- an implementation phase (42 months) to run simultaneously with the set-up phase. It includes the preparation and management of the pilot phase of insurance products, the recalibration of the pilot products, and the final launch of the insurance scheme.

According to the Strategy of the Main Directions Ensuring Economic Development in Agricultural Sector of the Republic of Armenia for 2020–2030, agricultural insurance is one of the strategic priority objectives in the sector. In order for the insurance model to be sustainable, this national strategy states that further government and donor support is required, as well as the need to be largely market-driven and based on new technologies (for example, index insurance products enabled by remote surveillance for automated insurance underwriting and claims processing). The introduction of the agricultural insurance system is one of the 24 actions that the government adopted as part of the Action Plan 2000–2022 for the implementation of the Strategy. It is planned to invest AMD 3.3 billion (USD 6.8 million) for the 2019–2022 period.

In October 2019, the Armenian government approved a procedure for subsidising insurance payments, and within the framework of the pilot agricultural risk insurance programme, the National Agency of Agricultural Insurers was established. The government, in support of KfW, subsidises 50 percent of the cost of the insurance policy. During the first phase, insurance applies to the following crops: apricot, apple, pear orchards, vineyards, winter and spring cereals (wheat and barley); and hail, frost, and fires are defined as insurance risks. The Central Bank of Armenia intends to gradually expand the agricultural insurance programme, both in terms of covering a wider range of crops, and risks, covered by insurance.

As detailed above, the agricultural insurance set-up phase prescribed the creation of NARMA. This is certainly a key measure which may dramatically change the situation for DRR and disaster risk management in agriculture. With this, a more structured, systematic, approach towards risk management in agriculture will be ensured and a sound base for the planning and implementation of well-grounded DRR and management solutions (including the introduction of agricultural insurance) will be established. Eventually, the creation of NARMA will promote the institutionalisation of DRR throughout the entire agricultural sector.

There is an excellent example from Africa on the application of DRR in agriculture (Figure 15).

Figure 15. An overview of DRR mainstreaming in agriculture from Zambezia province, Mozambique
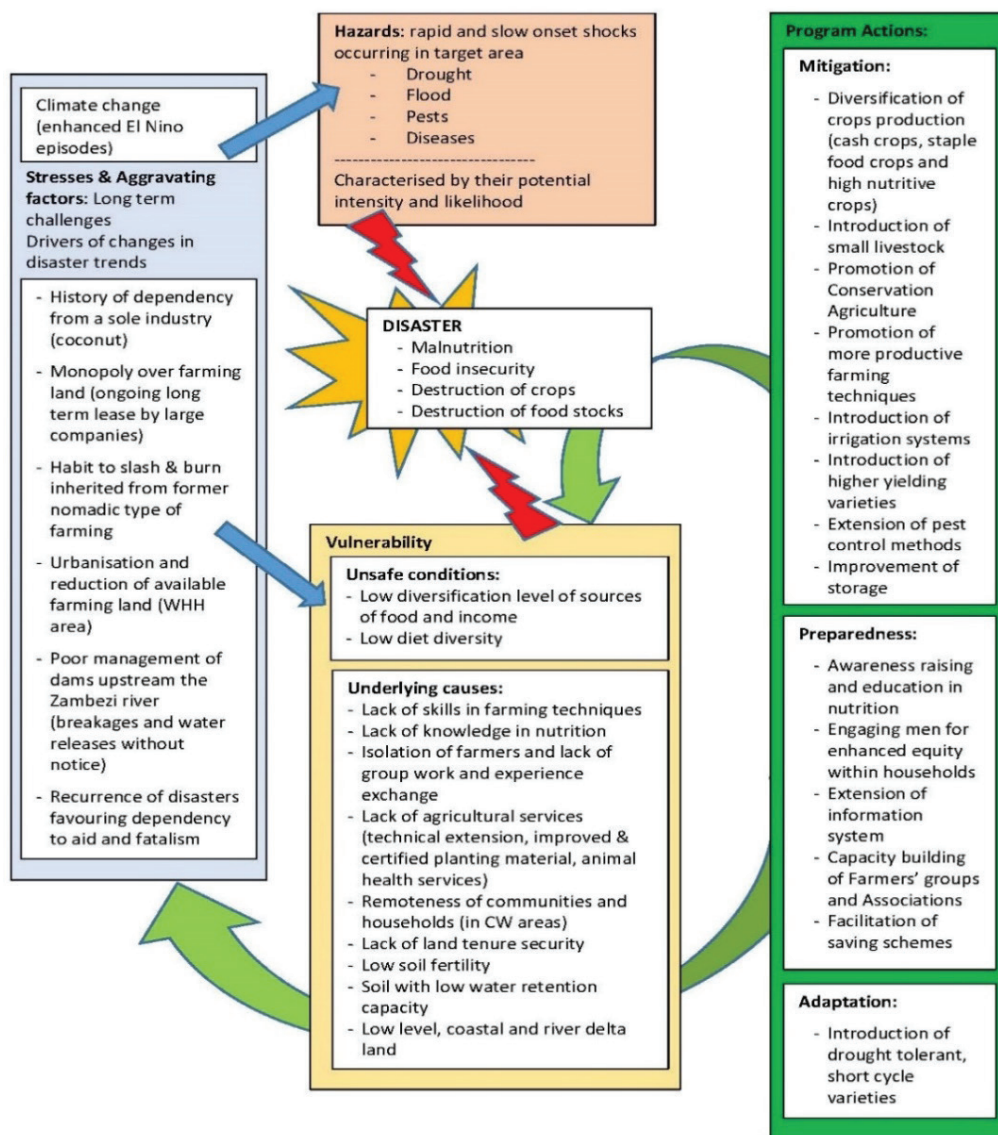
Source: Potier, 2017.

The example in Figure 15 shows the practical application of the DRR and disaster risk management framework to help reduce agricultural risks. It follows the logic and phases of the disaster risk management cycle, particularly referring to mitigation and preparedness as part of DRR. Though Armenia is not a coastal country and is not exposed to a similar set of hazards, there are, nevertheless, many similarities between communities in Armenia and the African province. This refers practically to all risk components described and even to proposed DRR solutions. In this regard, the provided case may serve as a good learning exercise for the authorities in charge to be further adapted and replicated in the Armenia communities.

Overview of DRR and management challenges

As outlined in this section, there are certain DRR measures already undertaken in the Armenian agricultural sector, including those piloted through different internationally supported projects. However, the obtained skills and knowledge, available technical means and methodologies remain fragmented and do not yet represent a comprehensive implementation of DRR in the sector. There is a lack of common understanding and ownership over the DRR and disaster risk management issues in the agricultural sector. For instance, there are currently no regular procedures on:

- risk identification, monitoring and analysis;
- risk prioritization, development of case-specific scenarios and contingency planning;
- defining risk evolution criteria and threshold indicators for early warning;
- early warning communication and decision making;
- elaboration of DRR and mitigation measures and plans;
- mainstreaming DRR into agricultural and rural-development plans.

With the establishment of NARMA, the agricultural sector in Armenia will attain a completely new degree of understanding and way of addressing agricultural risks. However, approaches similar to the one described in Figure 14 would need to be introduced to ensure the full implementation of the disaster risk management framework in agriculture.

Conclusions and recommendations

Summing up the findings of the study, it is worth noting that there are a number of issues in all three areas of concern – disaster risk management, early warning systems, agrometeorology services – which require careful consideration and improvement. Addressing these gaps through the introduction or revision of approaches and policies, elaboration and application of management procedures, communication and information management standards, may substantially increase the system's effectiveness, in particular within the agricultural sector. This will have a positive impact on the sector, as well as in terms of the establishment of risk-informed programmes and enhanced development planning. The recommendations below refer to selected issues that the study team has prioritized.

Hydrometeorology and Monitoring Centre/agrometeorology services

It was already mentioned that various capacity assessments and demand-based self-analysis of the hydromet services highlighted four areas as priorities for capacity development: establishment of a national framework for climate and agrometeorological extension services; technical modernization; application of new forecasting methodologies; and enhancing knowledge and skills capacity. According to a World Bank (2018) report, the findings from a gap analysis of Armenia's hydrological services are outlined, and concrete recommendations given for the HMC's improvement of its agrometeorology services (Dube *et al.*, 2018). One of the main advantages of this report is the analysis of socioeconomic benefits and cost effectiveness with regard to the performance improvement of the HMC. The road map that is included in this report suggests three scenarios for HMC modernization:

- Identify and implement low-cost, high-priority activities to achieve minimal, but highly critical, capabilities to provide weather, climate and hydrological services.
- Initiate intermediate modernization, which includes the need for investments to achieve a modest enhancement in its capabilities to provide hydrological, weather and climate services to meet the three most important user needs – strengthening hydrometeorological observation, data analysis, and forecasting.
- Complete modernization, which entails investments needed to bring the HMC to the level of advanced middle-income countries' capabilities to provide data, forecasts and warning services to meet user needs (focused on improving hydrometeorological and climate services). This option will be guided by three main modernization components: institutional strengthening and capacity development; modernization of observation infrastructure, data management systems and forecasting; and enhancement of service delivery.

In this context, the HMC specialists highlight the importance of local forecasting and the need for relevant capacity development, emphasising particularly that:

- It is impossible to ensure the sufficiency of DRR measures due to the lack of local forecasting. For this purpose, it is proposed to introduce local forecasting digital models for frost, drought, and hailstorms for the entire territory of Armenia, which will enable the production of local area specific forecasts.
- Availability of very accurate local forecasts on hazardous hydrometeorological events is a precondition for establishing and maintaining a DRR system in agriculture. Due to the rugged relief of the country and a big difference in altitudes, the numerical methods of weather forecasting, using the 9 km step, causes serious problems. Such a large step derivation results in the disappearance from forecasting maps of precipitation data, special zones of temperature rotation, and a number

of other phenomena formed in the result of relief direct influence. This leads to serious prediction errors. To avoid such problems, it is necessary to introduce at least a 3 km weather forecasting digital method in Armenia, which will allow for forecasting localization and will support the precise identification of the peculiarities of atmospheric phenomena exposure in different parts of the country.

At the same time, there is a new initiative of the HMC, supported by the World Bank and the Swiss-based Zoï Environment Network NGO, which concerns the development and introduction of National Framework of Climate Services (NFCS), which is already developed. Since January 2020, engaged experts have conducted an assessment of the existing climatic services in Armenia. They also met with key partners to better understand the local demands for such services. It is certain that this initiative will also positively influence the HMC modernization process.

Along with the ongoing modernization of the HMC, there are certain measures that do not require major investment, but may have a significant effect in terms of user demand. This refers, for instance, to the issue of accessibility to HMC data. This data could be obtained through the completion of the already existing hydrometeorological bulletin – on the HMC bulletin web page – by adding, besides hydrological data, data from meteorological and agrometeorological services.

Meanwhile, the study team is in complete agreement with the proposed improvement measures mentioned in the road map and believe that the HMC's ongoing institutional transition will not affect the modernization process that has already started.

Early warning system

The EWS has never been introduced as an essential element of disaster preparedness and response planning. In this regard, more intensive advocacy measures are required to finalise the adoption of the already drafted EWS national concept by the government. Furthermore, it is recommended to elaborate and apply the system-wide EWS management standards, leaving a space for hazard-specific peculiarities. It is recommended that the management standards should address the following:

- Elaborate and establish criteria and a set of indicators for risk levelling (for each particular hazard).
- Identify thresholds to inform the activation of the EWS.
- Investigate the relevance of the existing measurement tools and the need for technological upgrading.
- Introduce modern digital technologies (GIS, remote sensing) to enhance disaster risk management effectiveness, including of EWS.
- Develop SOPs and operational protocols for communication and decision making among institutions in charge.
- Map potentially affected areas and indicate preferable action in terms of effectiveness of reduction, mitigation, and disaster-response interventions.
- Establish the requirements for regular risk monitoring and analysis.
- Implement the food price monitoring and analysis (FPMA) tool at country level to enhance accessibility of price data and strengthen national capacities to monitor price trends contributing to improved policy decisions for food security.
- Draft standard procedures and templates for case-specific scenarios-based contingency planning (refers to agricultural sector, targeting agricultural production and food security issues, for instance), implementation mechanisms and management procedures, including division of roles and responsibilities of the actors involved.
- Establish coordination mechanisms and protocols.
- Prepare a minimum standard preparedness checklist to develop response and preparedness plans (including on resource mapping and mobilisation), which will help to ensure the implementation of contingency plans.
- Elaborate SOPs for EWS public awareness and communication to the general public.

Disaster risk reduction and management, and climate–change adaptation

Among many general DRR and management and climate-change adaptation issues that require improvement, there are a number which are also highly important for the agricultural sector. Among those are:

- Develop and introduce a disaster risk management strategy for the agricultural sector. The issue is already envisaged by the Agricultural Development Strategy 2020–2030 (Government of Armenia, 2019c) as a necessary measure to address the environmental risks.
- Develop and adopt standard management and coordination procedures (including legally defined volunteering services) for DRR and management to also be applicable to the agricultural sector. Facilitate the adoption of the Law on volunteerism (in circulation currently, pending government adoption).
- Elaborate and introduce DRR and climate-change adaptation awareness, and agricultural education campaigns, at the community level and among focus groups (farmers).
- Facilitate the government's adoption of a number of already drafted legal acts, which are currently in circulation, particularly the Law on Disaster Risk Management and Population Protection (MoES, 2019b), which is the first formal legal document that defines the DRR and disaster risk management process and relevant definitions, as well as the post-disaster recovery framework and national EWS concepts (Government of Armenia, 2018a).
- Expand the performance of the MoES National Disaster Observatory (NDO) by turning it into a large-scale and unified disaster data platform, as it was initially designed for. Develop and introduce an emergency information management and communication policy. Revisit the NDO operational Terms of Reference and re-establish the information management experts' national network.
- Establish an online depositary of case specific DRR and climate-change adaptation models, and local and international good practices, to be used to enhance risk-informed programming and development planning at national and local levels. A multi-hazard approach based DRR and climate-change adaptation solutions should be carefully studied and replicated in highly vulnerable communities who have prior local adaptive capacities and legal requirements.
- Study and built on the experience gained throughout the introduction of agricultural insurance and take into account the current challenges and constraints, and the resilience of the selected insurance modes for complex emergencies, which Armenia is currently facing. Introduce corrections, changes, adjustments in the approaches and schemes to help further the expansion of agricultural insurance, including the likelihood of an increased need for government subsidies.
- Introduce the already developed and approved disaster needs assessment methodologies and tools, including:
- Armenia's interagency needs assessment (ARIANA) tool, MoES, DMCT, with support from UNOCHA;
- post-disaster needs assessment methodology, MoES with UNDP support;
- guideline and methodology for disaster needs assessments in the agricultural sector based on international standards, with support from FAO and in cooperation with MoA;
- post-disaster needs assessment software for agriculture, provided by FAO;
- online software to assess direct loss attributed to disasters in agriculture, fisheries and forestry, which is aimed at reporting against indicator C2 of the Sendai Framework for Disaster Risk Reduction, and SDG indicator 1.5.2.
- Develop and approve standard procedures for early warning and contingency planning, including required forms and templates.
- Elaborate legislative provisions for the management and coordination of biological disasters, and clearly define the roles and responsibilities of the actors involved.
- Establish a legal basis for public–private cooperation in emergencies as one of the key components of emergency response. The role of the state, and mutual responsibilities in local emergencies, should be stated clearly so that communities are aware of what to expect from the authorities.

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Annexes

Annex I.
Experts and organizations interviewed for the study

Date of the interview	Name	Title	Organization
8 May 2019	Dianna Harutyunyan Gohar Hovhannisyan	Climate Change Programme Coordinator UNDP-GCF Project Coordinator	UNDP
10 May 2019	Georgi Arzumanyan Armen Chilingaryan	Programme Policy Adviser Sustainable Growth and Resilience Portfolio DRR Programme Coordinator	UNDP
15 May 2019	Levon Azizyan Gagik Surenyan Andryush Avagyan	Deputy Director of Service of the Hydrometeorology and Active Influence on Atmospheric Phenomena SNCO Head of Hydromet Service of SNCO Head of Meteorological Forecasting Department	MoES
16 May 2019	Garnik Petrosyan Karine Yesayan	Deputy Minister Head of the Horticulture Development and Plant Protection Division	MoA
16 May 2019	Rudik Nazaryan	Head of Plant Production and Protection Department	MoA
23 May 2019	Norik Barseghyan Gevorg Tovmasyan	Head of the Food Safety and Phyto-Sanitary Services Centre SNCO Deputy Head of SNCO	MoA

Annex II.
Review of Armenia disaster risk reduction and disaster risk management legislation (agriculture)

EMERGENCY LEGISLATION
– refers to all sectors including agriculture.

Note that the mentioning of the Ministry of Agriculture in the legislative documents here refers to the Ministry of Economy, which after the recent government restructuring and dissolution of the Ministry of Agriculture, is fully in charge of the entire agricultural sector.

Laws

1. **On Population Protection in Emergency Situations**, 2 December 1998 – defines the basis and the arrangement of population protection in emergency situations (including prevention, mitigation and response measures), the rights and responsibilities of state and local authorities, enterprises, institutions, organizations, as well as officials and the citizens in this sphere. It considers, along with direct human losses, the entire scope of negative effects of possible disasters to human lives and well-being, including on natural resources, environment, and agriculture (https://www.refworld.org/pdfid/5b2b7cd04.pdf).

2. **On Fire Security,** 18 April 2001 – defines the legislative, economical and organizational basis for ensuring the fire security in Armenia. It regulates relations of the state bodies and local self-governing bodies, organizations, and citizens in the fire security-ensuring sphere. The provisions of the law refer to person, property, society and state protection from fires defining the responsibilities of the state and authorised bodies in fire prevention and suppression. No specific provisions are included on the protection of nature, the environment, forests or agricultural lands from fires apart from the point in article 20, which highlights the issue of state control over the perseverance of the normative documents of forest fire security (http://www.parliament.am/legislation.php?sel=show&ID=1269&lang=eng).

3. **On Civil Defence Troops,** 31 March 2004 – regulates the order, recruitment, preparation, the order of fighting application, competence and organizational basis and principles of activities of the Civil Defence Troops of the Republic of Armenia. It particularly prescribes the implementation of the duties by the servicemen of the Civil Defence Troops in the areas contaminated by the radioactive, chemical and biological means, and in the disaster zones. The Civil Defence Service is considered to be a military service (http://www.parliament.am/legislation.php?sel=show&ID=1980&lang=eng).

4. **On Rescue Service**, 8 July 2005 – defines the main principles of the Armenian Rescue Service in emergencies and civil defence, which particularly underlines its role in the prevention and mitigation of emergencies, emergency response and elimination of consequences, recovery and rehabilitation, public awareness and education as well as the coordination of response efforts (http://www.parliament.am/legislation.php?sel=show&ID=2380&lang=arm).

Government decisions

5. **On the approval of the 2019–2023 Action Plan of the Government of the Republic of Armenia**, 16 May 2019 – envisages actions related to the improvement of the EWS system, particularly related to hydrometeorological hazardous events (page 56). It refers to the building of forecasting and early warning capacities of hydrometeorological services in Armenia. There is also a big range of activities dedicated to the implementation of prevention, mitigation and adaptation measures corresponding to government commitments towards international agreements (page 75) to eliminate the negative consequences of climate change including in agriculture (https://www.gov.am/files/docs/3347.pdf).

6. **On the approval of Plan for Organization of Population Protection in the Event of Major Earthquake**, 10 January 2011 – identifies the issues, actions and procedures of public administration and local self-governing bodies (state and local government agencies), organizations and rescue forces during implementation of population protection measures in case of strong earthquake in the territory of Armenia. The Ministry of Agriculture is involved in the plan; some of its functions focus on for example food security, the organization of sustainable activities of its subordinate organizations, creation and maintenance of agricultural raw materials, equipment and foodstuffs, and protection of the population. The Ministry of Environment is involved in the plan; some of its functions refer to environmental security (environmental degradation, water/air pollution) (https://www.arlis.am/DocumentView.aspx?docid=69787).

7. **On the approval of the National Plan of Protection of the Population (national nuclear power plant or external emergency plan) in case of Nuclear and (or) Radiation Accidents of the Armenian Nuclear Power Plant**, 22 December 2005 – defines the requirements for the protection of the population from harmful effects of ionizing radiation in nuclear and/or radiation accidents of the Armenian Nuclear Power Plant CJSC. The Ministry of Agriculture is involved in the plan, ensuring food security related issues. The Ministry of Environment is in charge with regard to the livelihoods of the displaced population (http://www.irtek.am/views/act.aspx?aid=34332).

8. **On the approval of the Protection of the Population and Post-Accident Recovery Plan in the Chemical Hazardous Objects in the Event of Accidents in the Chemical Objects or Chemical Threat in the Republic of Armenia,** 8 July 2010 – sets the order for the implementation of actions to protect the population from exhausted chemical substances as a result of a chemical accident, performs rescue and post-accident recovery activities. According to this plan the agricultural authorities should perform the veterinary, sanitary and phytosanitary activities, manage the evacuation of livestock and food products from the polluted zone as well as ensure food and biological security (https://www.arlis.am/documentview.aspx?docid=59590).

9. **On the approval of the Procedure for the Evaluation of Damages to Physical and Legal Persons Caused by the Consequences of Emergencies**, 10 November 2011 – defines the principles and performance procedure for evaluating damage to physical and juridical persons as a result of emergencies. According to the set procedure, commissions at three levels (central marz, and community, depending on the scale of disaster) to be established to perform the damage assessment. The four defined areas to undertake the damage assessment include: agriculture, people's property and goods, infrastructure, and health and sanitary facilities. This is the only document addressing the post-disaster damage and losses issue; however, it does not contain a full assessment methodology that takes into account direct and indirect negative effects and a comprehensive analysis of socioeconomic impact, including externalities (https://www.arlis.am/DocumentView.aspx?docID=72227).

10. **On the approval of the Landslide Disaster Management Plan of the Republic of Armenia,** 25 May 2017 – is a landslide management plan that consists of activities that address landslide risk reduction and mitigation issues. The Ministry of Agriculture is in charge of monitoring landslides that threaten the rivers, draining channels, performing the inventory of landslide zones which pose a direct risk to agricultural objects, conducting assessments of most hazardous landslide areas, and implementing preventive activities including cleaning of river beds and draining channels. The Ministry of Environment possesses similar responsibilities in relation to specially protected nature areas monitoring the adjacent landslides and conducting inventory

of landslide hazardous zones. However, it is not involved directly in risk reduction or mitigation activities (http://www.irtek.am/views/act.aspx?aid=90068).

Ministerial decrees

11. **On the approval of Fire Safety Rules**, 18 June 2015 – is a decree of the Minister of Territorial Administration and Emergency Situations.[26] It does not possess any special clause on agricultural land. As related to forest fires, it refers to the relevant government decision on fire security rules (http://www.irtek.am/views/act.aspx?aid=81574).

SECTORAL LEGISLATION CONTAINING DRR and MANAGEMENT PROVISIONS
– possess DRR and management provisions relevant to the subject of this study

Laws

12. **On Local Self-Governance,** 7 May 2002 – defines the notion of local self-governance, its bodies, performance principles, powers, also legal, economic, financial bases of operations of self-governing bodies and the respective guarantees, regulates relations between the state authorities and local self-government bodies. The law possesses special provisions on the responsibilities of self-governing bodies in the event of emergencies referring particularly to the protection of the environment, households and community land, including the agricultural sector. The activities covered by the law refer to entire cycle of disaster management (http://www.nature-ic.am/Content/posts/3701/LocalSelf-GovernanceLaw.pdf).

13. **On Atmospheric Air Protection**, 11 October 1994 – defines the state responsibility in protecting atmospheric air by ensuring the maintenance of air purity and improvement of its quality, reduction and prevention of chemical, physical, biological and other harmful influences on atmospheric air, regulation of public relations and strengthening of the rule of law in this area (http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2018/10/8725.pdf). Furthermore, on 14 September 2011 an amendment (supplement) was introduced in the law adding a special paragraph in Article 21, which bans the burning of stubble, plant residues and dry vegetation areas, vegetation of pastures and meadow lands in agricultural, forest, forest neighbouring and specially protected nature areas (http://www.nature-ic.am/Content/announcements/7247/Law_Amendment_Atmospheric_Air_Polution_eng.pdf).

14. **On the Protection of Selection Achievements**, 23 November 1999 – regulates the economic relationships and the non-economic personal relationships associated with the creation, legal protection and exploitation or use of the plant variety selection achievements. There is a reference to emergencies providing that for the purpose of national security and in emergencies, the Government of Armenia is empowered to use or authorise third parties to use a selection achievement without the consent of the patent owner (http://www.nature-ic.am/wp-content/uploads/2013/10/Ptotection-of-Sellection-Achievments.pdf).

15. **On Flora**, 22 December 1999 – defines the state policy of Armenia on scientifically motivated protection, maintenance, reproduction and use of natural flora. It also regulates the use of flora objects for agricultural and industrial purposes. Protection of flora objects from plant pests, diseases and natural catastrophes, integrity of plant species diversity and the security of water maintaining, soil protective, climate regulatory and recreational properties of the plant covering, are among the objectives of the law (https://www.ecolex.org/details/legislation/law-on-flora-1999-lex-faoc050260/).

16. **On Fauna,** 3 April 2000 – defines the state policy on protection, maintenance, reproduction and use of the wild species in Armenia. It regulates the use of fauna objects for agricultural and industrial purposes. It also provides that during emergencies (for example, epidemic diseases of the population, wild and domestic animals, menace for the development of cattle breeding, danger of breaking the ecological balance), special measures with regard to the regulation of the quantity of certain animal species will

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[26]For a short period of time, the Ministry of Territorial Administration and Ministry of Emergency Situations were merged.

be undertaken through the decision of the Government of Armenia (http://www.endangeredearth.com/wp-content/uploads/es_laws/Armenia_Law_on_fauna.pdf).

17. **On Energy**, 7 March 2001 – regulates the relationships between government bodies, legal entities of the energy sector operating under this law, and consumers of electricity, thermal energy and natural gas in Armenia. The law spells out state policies in the energy sector, stating particularly the environmental protection and efficient use of domestic and alternative energy sources, as well as the implementation of economic and legal mechanisms for this purpose (http://www.minenergy.am/storage/files/news/news_5752620560951_210301HO148eng.pdf)

18. **Land Code**, 2 March 2001 – defines the types of land, including the classification of agricultural land, provides regulations of land use, outlines the responsibilities of state authorities and land users under protection norms, describes rules for the use of contaminated lands as a consequence of technological, epidemiological and other types of disasters, envisages measures for nature protection, sanitary-hygienic and other requirements for drafting and exploitation of buildings and constructions, protection of agricultural and other land from micro-parasitic and quarantine pests, and from other negative phenomena, as well as the implementation of protection measures and use of natural monuments and preservation of green belts (http://www.nature-ic.am/wp-content/uploads/2013/10/Land-Code.pdf).

19. **On Hydrometeorological Activities**, 7 February 2001 – regulates the hydrometeorological activities of Armenia, determines the legal basis for hydrometeorological activities (including agrometeorology services) and aims to satisfy the needs of public, government officials, legal and physical entities in the acquisition of information on hydrometeorological phenomena and processes. The law provides guidance on hydrometeorological monitoring, provision of weather forecasts, including on temperature and precipitation extremes, dissemination of information among interested parties and general public (http://www.cawater-info.net/library/eng/am_hyd_act.pdf). Through the amendments introduced in 30 April 2008, Article 1 on the law's objectives was enriched with an additional point ensuring hydrometeorological security. The context of the law was changed by describing new areas of concern and introducing new terms, such as hazardous hydrometeorological and helio-geophysical events, unfavourable hydrometeorological events, and hydrometeorological security. Consequently, the scope of hydrometeorological activities was enlarged by the requirement to collect and disseminate information on hydrometeorological hazardous and security-related events (http://www.parliament.am/legislation.php?sel=show&ID=3250&lang=arm).[27]

20. **On Eliminating the Consequences of Drought,** 20 March 2001 – was adopted in response to the major drought of 2000, which nearly hit the entire territory of Armenia and affected 297 000 people. The damage caused by the drought is estimated at around USD 100 million. This law regulates relations referred to in the implementation of state policy for the elimination of consequences of drought in Armenia, and defines the principles for the implementation of the respective state programme. It precisely describes the government's post disaster responsibilities in meeting the needs of the affected population. It does not provide any prevention or risk-reduction measures, or presume any preparedness or contingency planning action (http://www.parliament.am/legislation.php?sel=show&ID=1270&lang=arm).

21. **On Ecological Education of Population,** 20 November 2001 – regulates principles of state policy, legal, organizational, financial and economic bases in the area of continuous ecological education of the population. It is aimed at:

   • strengthening of the ecological culture of the population;
   • their correct and reasonable orientation in the area of nature protection and nature management;
   • revealing of skills and formation of norms of behaviour directed regarding reasonable nature management and maintenance of the natural environment for people's health and safety;
   • orientation of ecological education in the decision-making process on the natural environment protection matters (https://www.ecolex.org/details/legislation/law-on-ecological-education-of-the-population-2001-lex-faoc050264/).

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[27]Most of the legislative documents are available in Armenian only.

22. **Water Code**, 4 June 2002 – aimed at the conservation of the national water reserve, the satisfaction of water needs of citizens and economy through effective management of useable water resources, securing ecological sustainability of the environment, as well as the provision of a legal basis to achieve the code's objectives. Chapters 13 and 14 of the code on "Prevention and Eradication of Waters Harmful Impact" and "Water Systems Use and Maintenance in Emergency Situations" refer to the prevention and mitigation of water-related hazards, particularly flooding, mud flows and landslides, informing the population on possible hazardous events, undertaking measures on water scarcity and drought, as well as ensuring water security in emergencies (http://www.parliament.am/law_docs/290602HO373eng.pdf?lang=eng).

23. **On Energy Saving and Renewable Energy,** 9 November 2004 – defines the principles of state policy with regard to the development of energy-saving and renewable energy and the enforcement mechanisms to ensure the country's energy security, independence, safety of energy systems, as well as the reduction of adverse impacts of technological hazards on the environment and human health. Defining state priorities in this area, the law indicates, as a high priority, the environmental protection and efficient (economic) use of natural resources, while implementing measures/activities aimed at the development of energy-saving and renewable energy (http://policy.thinkbluedata.com/sites/default/files/Law%20of%20the%20 Republic%20of%20Armenia%20on%20Energy%20Saving%20and%20Renewable%20Energy.doc).

24. **On Waste**, 24 November 2004 – regulates relations on waste collection, transportation, storage, processing, recycling, removal, volume reduction and other relations regarding the before-mentioned activities, as well as the legal and economic basis for the prevention of adverse effects of waste on human health and environment. It establishes the main approaches for state regulation in the area of waste management, highlighting the protection of human health and environment from adverse effects of waste, developing directions for the required measures, establishing norms on waste production and disposal for the involved entities as well as collecting, recording and analysing related information. The law sets the responsibilities of all waste management related parties, including the notification about emergency situations with regard to human health and the environment that may occur during the management of waste and taking measures to address it (http://procurement-notices.undp.org/view_file.cfm?doc_id=160529).

25. **On Environmental Supervision**, 11 April 2005 – defines the principles of organization and implementation of environmental supervision in meeting the norms of environmental legislation of Armenia. It specifically underlines the performance of state bodies in charge of preventing accidents and emergencies which pose a threat to the environment and also sets rules for acting in emergencies (http://www.parliament.am/legislation.php?sel=show&ID=2286&lang=arm).

26. **Forest Code**, 24 October 2005 – regulates relations connected to sustainable forest management; monitoring, protection, rehabilitation, afforestation and the rational use of forests and forest lands, as well as with regard to forest stock-taking, monitoring and control of forest lands. Forest protection measures include those that are aimed at the prevention of forest destruction, drying, loss of useful properties of forests due to harmful organisms (pests and diseases) and the improvement of their sanitary conditions. The law also defines forest management measures to reduce the adverse impacts of fires, unauthorised occupations, illegal logging, grazing, pollution, waste dumping, and other actions prohibited by legislation on forest biodiversity. The law sets responsibilities to forest owners as well as marz, self-governing authorities, and to the public on following the forest protection norms, as well as undertaking preventive and response measures in combating forest fires, pests and diseases. Article 17 of the code, on "forest monitoring", provides the purpose of the monitoring stating that it shall be implemented for the assessment of the processes of quantitative and qualitative changes in the forests and forest lands, assessment and prediction of the negative impact of anthropogenic and natural factors, and for initiating measures for prevention or liquidation of negative phenomena. The data obtained from the state monitoring of forests shall be used for sustainable forest management purposes. The law does not possess any provision on risk identification and early warning (http://www.nature-ic.am/wp-content/uploads/2013/10/Forest-Code-of-RA.pdf).

27. **On Specially Protected Nature Areas (SPAN)**, 28 November 2006 – provides the legal basis for the natural development, recovery, conservation, reproduction and use of ecosystems in specially protected nature areas. The law sets the principles for SPAN management planning including protection, and also

for elaboration and implementation of a SPAN-specific regime. It does not provide any instruction on risk reduction or emergency action taking into consideration the peculiarities of SPAN regimes. Describing the principles of SPAN use, the law allows agricultural activities to produce ecologically clean products, prescribing authorised bodies to ensure the monitoring of such activities in terms of SPAN regime maintenance and protection (http://www.parliament.am/legislation.php?sel=show&ID=2781&lang=arm).

28. **On the Hunting and Management of Hunting Areas**, 9 April 2007 – sets rules for hunting and the management of hunting areas, including the list of species and seasons allowed for hunting (http://www.parliament.am/legislation.php?sel=show&ID=3010&lang=arm). Through an addition to the law introduced on 4 February 2010, the hunting via the use of vegetation burning or smoke is prohibited and limitations set for hunting in specially protected nature areas and agricultural land (http://www.parliament.am/legislation.php?sel=show&ID=3770&lang=arm).

29. **On the Supervision of Land Use and Protection**, 8 March 2008 – defines the issues of effective use and protection of lands, liabilities of authorised bodies, principles of supervision against the requirements of the Land Code by the land users, irrespective of type of ownership, rights and responsibilities of supervision bodies and land users, performing principles and procedures. (http://www.parliament.am/legislation.php?sel=show&ID=3230&lang=arm).

30. **On the Provision of Sanitary-Epidemiological Security of the Population,** 16 November 1992 – establishes the legal, economic and organizational framework for the sanitary–epidemiological security of the population of Armenia; it also defines guarantees envisaged by the state to avoid impact of harmful and dangerous environmental factors on the human body, and provides favourable conditions for the viability of the population and future generations. There is a specific clause in the law (Article 5, p. 3) referring to the state programmes addressing the consequences of disasters in terms of infectious diseases and the protection of the population to epidemic outbreaks (https://countrysafeguardsystems.net/sites/default/files/Law%20on%20Provision%20of%20Sanitary%20Epidemiological%20security%20of%20%20the%20Population%20%281992%29.pdf). The law was revised on 21 March 2018 and includes modern approaches and structural changes in performing sanitary–epidemiological control (http://www.parliament.am/legislation.php?sel=show&ID=6254&lang=arm).

Government decisions

The decisions provided below cover mainly the environmental sector and refer to forest and forest/wildfire management. This is the area where the Ministry of Agriculture played a significant role as an owner of the state forests. After the establishment of the Forest Committee, the authority over the entire forests and forest covered territories was transferred from the Ministry of Environment to the Forest Committee, which also includes relevant structures of the Ministry of Agriculture. Nevertheless, it seems essential to provide certain understanding on forest-related government decisions and normative acts. Irrespective of which ministry the forests belong to, and which ministry is currently in charge of agriculture (Ministry of Economy), many forest and agriculture-related risks are mutually interdependent and require coordinated DRR and management action. Agricultural sector related responsibilities are still relevant and fulfilled by the Ministry of Economy.

31. **On the approval of Fire Security Rules in the State Forests of the Republic of Armenia**, 19 September 1998 – sets the rules for fire security in the state-run forests, including the prohibition of grassland burning in the forest covered areas. During the high fire risk seasons, the ministries of agriculture and environment, and local authorities, are eligible to prohibit fire making in forest areas under their jurisdiction. The document also provides requirements for the safe burning of forest adjacent to agricultural land (https://www.arlis.am/DocumentView.aspx?docID=6853).

32. **On the approval of Changes in the Decision of the Government of the Republic of Armenia, No. 589, 19 October 1998** (on fire security rules), 24 December 2015 – the rules defined in 1998 were improved to provide control over the implementation of the fire security rules to the Ministry of Agriculture along with the Ministry of Environment and local self-governing bodies. The article on agricultural burning was removed (https://www.arlis.am/DocumentView.aspx?docid=103315).

33. **On the approval of the Strategy and National Action Plan in the Areas of Preservation, Protection, Reproduction and Use of Biodiversity of the Republic of Armenia**, 10 December 2015 – Land degradation, environmental pollution by the chemical hazardous substances, pollution of rivers and underground waters, accumulation of industrial waste, are listed among the main factors threatening the environment and biodiversity. The agricultural sector is also considered one of the major contributors to biodiversity protection. The main issues that are adversely influencing the biodiversity caused by agriculture include the inappropriate use of agricultural land and irrigation water and related losses, soil erosion and salinisation, and agricultural waste induced pollution. The strategy and the action plan envisage activities to address the above-mentioned issues and ensure the preservation and protection of biodiversity and sustainability of ecosystems. The 2016–2020 action plan envisages activities in five strategic directions: 1) improvement of legal and management system, 2) improvement of biodiversity, effectiveness of ecosystems protection and restoration of damaged environment, 3) reduction of direct pressure on biodiversity and promotion of its sustainable use, 4) elimination of main causes of biodiversity losses through the improvement of inter-sectoral relations and raising the awareness of the population, 5) activation of scientific research initiatives, knowledge management and staff development. In these five areas, the Ministry of Agriculture is considered one of the main players and is viewed as responsible (https://www.e-gov.am/protocols/item/580/).

34. **On the approval of an Exemplary Programme for the Implementation of Forest Fires Early Warning, Rapid Response and Firefighting**, 19 December 2013 – describes the performance principles and types of action to be introduced by the authorised agencies in combating forest fires, including the organization of early warning, rapid response and fire-control activities. Unfortunately, the clause on early warning does not define the subject, nor does it provide an understanding of the early warning system or management procedure. On the contrary, it creates a misunderstanding, using the term "early warning" within the context of "monitoring" (http://www.irtek.am/views/act.aspx?aid=74474).

35. **On the approval of Procedure for the Reforestation Aimed Logging in the Forests of Industrial Value**, 16 October 2006 – sets logging regulations in order to ensure the reforestation of industrial forests. The Ministry of Agriculture is responsible with regard to the timely release of a Logging Technology Card. Special measures are defined and included to prevent erosion of forested land after logging (https://www.arlis.am/DocumentView.aspx?DocID=54049).

36. **On the approval of the Republican Target Programme on the Improvement of Forest Security and the List of Complex Measures Aimed at Improvement of Forest Security in the Forest and Other Vegetation Covered Areas**, 29 May 2013 – this is the first comprehensive document describing the situation and issues related to forest/wildfires, management gaps in the fire security framework, addressing the causes of forest/wildfires, including those induced by climate change and prescribing actions for the improvement of fire security in the forest and other vegetation-covered areas. Unfortunately, any reference to Armenia policies and commitments related to climate change or climate-change adaptation is missing. In addition, it lacks the use of terms such as "hazard", "disaster risk", and "disaster risk reduction/mitigation or management", which does not allow placing the initiated measures within the context of the disaster risk reduction/management framework (http://www.nature-ic.am/Content/Projects/14/Gov't%20Decision_563-A_29%20May%202013.pdf).

37. **On the approval of Fire Management Policy, its Implementation Strategy and the List of Actions in the Vegetated Areas of Forest Lands, Specially Protected Nature Areas, Agricultural Plots and Settlements**, 22 January 2015 – this document clearly highlights anthropogenic and climatic risks as the main causes of fires in forests and in other vegetated areas in order to stimulate the implementation of actions to address these risks. It envisages the risk reduction, mitigation and response actions along with improvements in the related legal and institutional frameworks. The document underlines the complete lack of fire monitoring and early warning system, while the issue is not properly reflected in the plan of action. Although special provisions dedicated to fire monitoring and the establishment of unified information data base are included, the related actions do not address the existing gaps. Among other problems, early warning is not reflected at all, apart from the mentioning of the need to study international experience. The overall approach is rather weak in terms of introducing clear fire management procedures. Moreover, coordination is not prioritized at all, although the document plans to establish an inter-agency commission. In addition, neither the policy or strategy refer to other policies already in place, particu-

larly to international climate-change treaties and related Armenia commitments. It creates serious constraints in following the realisation of various related policies, in avoiding duplications and introducing an integrated approach. Five ministries are assigned to implement the policy, among them the Ministry of Agriculture. The Ministry of Defence also plays a key role and is responsible for preventive measures with regard to reducing landmine risks (https://www.arlis.am/DocumentView.aspx?docID=95474).

38. **On the introduction of a forest monitoring system**, 28 July 2005 – refers to the establishment of the Forest Monitoring Centre under the authority of the Ministry of Environment. The aim of the centre is to perform assessments which will support the prevention of illegal logging, wood transportation and sale, and other illegal activities in the forests. Initially the centre was established within the Ministry of Agriculture. On 17 January 2019, the centre was transferred to the Ministry of Environment (http://www.irtek.am/views/act.aspx?aid=30893).

39. **On the approval of Forestry Sector Improvement Concept, Strategy and the List of Events**, 30 November 2017 – this concept covers forestry sector reform, including the establishment of the Forest Committee of the Ministry of Environment, followed by the consolidation of all forest-related agencies/entities under the authority of the Forest Committee. According to this decision, the *Hayantar* SNCO and the Forest Monitoring Centre were transferred to the Ministry of Environment. The decision defines a three-year reform in the forestry sector in line with the set strategy and related list of events, aimed at optimization of the forestry sector. The main strategic activities refer to the improvement of the forest related legal and institutional frameworks, education of staff, introduction of modern approaches in forest management, use of forests, and in particular the establishment of a unified information management system (http://www.irtek.am/views/act.aspx?aid=92963).

40. **On the approval of National Forest Programme of the Republic of Armenia**, 20 August 2005 – the programme aimed at the protection of forest ecosystems, restoration of degraded forest ecosystems, continuation of productive use of forest stocks, and ensuring the implementation of the forest sustainable management strategy. The programme contains forest protection and defence measures, accounting issues of biodiversity preservation, prevention and mitigation of negative consequences caused by disastrous hazards (including forest fires) and climate change. Risk monitoring and early warning currently do not exist at all. There is a small clause encouraging the development and introduction of mechanisms for the effective use of agricultural plots located in the areas not covered by forests. The main implementer of the programme is the Ministry of Agriculture (Ministry of Economy) (https://www.arlis.am/DocumentView.aspx?DocID=14277).

41. **On the approval of the National Forest Policy and Strategy of the Republic of Armenia**, 30 September 2004 – is aimed at the restoration of degraded forest ecosystems, sustainable use of forests, and the further development of forest benefits. It focuses on three main strategic directions to ensure the:

   - creation of the evidence base for long-term sustainable forest management;
   - improved legal and institutional frameworks to support sustainable forest management;
   - introduction of forest international standards, forest certification and evaluation quality criteria for sustainable forest management.

Among the strategic priorities, the strategy considers climate-change effects and the strengthening of forest adaptation to climate change as a solution. There are also references to international agreements to which Armenia is a party, namely on climate change, biodiversity and desertification. Through this decision, the ministries of agriculture and environment are responsible to develop and submit to the government a national programme for the implementation of the given policy and strategy (http://www.irtek.am/views/act.aspx?aid=27497) (http://www.irtek.am/views/act.aspx?aid=27498).

42. **On the approval of the Strategy of the Specially Protected Nature Areas, the State Programme and the List of Events for their Protection and use**, 25 September 2014 – within the existing context of climate change and desertification, the strategy aimed at the identification and protection of biodiversity rich areas and areas vulnerable to climate change, establishment of new protected areas, and setting up a national ecological framework. Related activities cover the following areas: improvement of the legal base, improvement of management system, and the continuous development of protected nature

areas. The programme also envisaged the establishment of a special reserves management unit in the *Hayantar* SNCO of the Ministry of Agriculture to deal with its own reserves, while the development of the agroforestry sector is also encouraged (https://www.arlis.am/DocumentView.aspx?DocID=93166).

43. **On the approval of the Action Plan of the Republic of Armenia – Obligations Emanating from a Number of International Environmental Conventions**, 10 November 2011 – by this decree, the government approved the list of actions to be taken, which particularly includes the development of the climate-change mitigation action plan, national adaptation programme of action (National Adaptation Plan), national programme to combat desertification, on biodiversity protection and biological security, and on the reduction of forests' vulnerability to climate change. (https://www.arlis.am/DocumentView.aspx?docid=75959). This decree was amended through a new decree that was adopted in 11 April 2015. The climate-change mitigation action plan was replaced by the Development of Intended Nationally Determined Contributions (INDC) including actions on mitigation and adaptation with application of ecosystem approach (http://www.nature-ic.am/Content/Projects/14/GOV%20Decree_397_eng.pdf).

44. **On approval of the nationally determined contribution 2021-2030 of the Republic of Armenia to Paris Agreement**, 22 April 2021 – in its updated NDC, Armenia adopts a ten-year NDC implementation period (2021–2030) unlike its INDC, which proposed a timeframe of 2015–2050. Armenia maintains its 2050 mitigation goal of reducing its greenhouse gas emissions to at most 2.07 tonnes of carbon dioxide equivalent per capita, to be reflected in its Long Term – Low Emission Development Strategy (LT-LEDS). The new mitigation target to be achieved in 2030 equals a 40 percent reduction below 1990 emissions levels (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Armenia%20First/NDC%20of%20Republic%20of%20Armenia%20%202021-2030.pdf).

45. **On approval of the national action programme of adaptation to climate change (NAP) and the list of measures for 2021–2025**, 13 May 2021 – Armenia's NAP process guides achievement of adaptation objectives and serves to combine the efforts of the government, regional administration and local self-government authorities, civil society and academic institutions, businesses and the international community, in strengthening the country's capacity to climate-change adaptation between 2021 and 2025. The general objective of the NAP process is to promote the reduction and management of climate risks in Armenia. This will occur by addressing the impacts of climate change, by taking full advantage of emerging opportunities, by reducing socioeconomic vulnerabilities, and avoiding losses and damage due to climate change (https://www.arlis.am/DocumentView.aspx?docID=152612).

46. **On the approval of the Concept and the Programme of Activities arising from the Concept on the Introduction of Water Saving Technologies,** 17 January 2019 – the aim of the concept is the efficient use and preservation of national water resources, including through effective management of usable water resources, meeting the needs of citizens and economy, ensuring environmental stability, use, and preservation of national water resources, as well as improvement of the related legal and institutional framework (https://www.e-gov.am/gov-decrees/item/31363/).

The legal acts listed above represent part of the overall framework for disaster risk reduction/management in Armenia, which is relevant to the subject of this study as it refers directly or indirectly to agriculture and other related sectors. In addition, there are laws which tackle agriculture-specific issues, such as the safety and security of plants, seeds, food and food production, agricultural land, livestock, pests, diseases/epidemics, etc. In many cases, this law does not apply the term "disaster management" or "disaster risk reduction/ management", but rather sets the requirements to ensure the security of agricultural subjects to various threats, which actually define preventive, preparedness and response measures against possible hazards, including those induced by hydrometeorological events.

LEGISLATION ADDRESSING AGRICULTURAL RISKS

Laws

47. **On Seeds,** 20 May 2005 – sets the regulations on the registration of plant varieties, seed production, reproduction, certification, transportation, storage, sale, and use. The establishment of the effective seed production and reproduction system is one of the main objectives of

the law, including intensive cultivation of plants that are well adapted to Armenia's climatic conditions. There are special provisions dedicated to the packaging and transportation of chemically and biologically processed seeds to ensure the security of people, animals, and environment (http://www.parliament.am/legislation.php?sel=show&ID=2320&lang=arm).

48. **On Melioration of Agricultural Lands,** 20 May 2005 – regulates relations pertaining to the melioration of agricultural land to ensure the maintenance and improvement of soil fertility, protection of land from salinisation and erosion, as well as the use of scarce fertile lands. Climate change and its possible negative impact on land fertility is not mentioned, which requires relevant strategic solutions for melioration (http://www.irtek.am/views/act.aspx?aid=29970).

49. **On Phytosanitary,** 14 June 2014 – regulates relations concerning the implementation and management of the sphere of phytosanitation, fixes mandatory phytosanitary requirements and the main phytosanitary principles in the process of growing, storing, transportation or marketing of plants, plant products and other regulated articles, as well as responsibilities of physical and legal persons engaged in soil cultivation. The law does not possess provisions with regard to the consequences of climate change on plant health, which may affect, for instance, the agricultural productivity through changing pressures related to food safety, animal diseases, and plant pests (https://www.arlis.am/DocumentView.aspx?docID=95053).

50. **On Organic Agriculture,** 8 April 2008 – regulates the production, preservation, processing, transportation and sale of agricultural products and materials as well as the storage of wild plants. This law also defines the principles of and legal grounds for the management of organic agriculture, its main circulation demands, directions of state support, and the duties of the authorised body. In this law, organic agriculture is described as "a special type of agricultural activity that is generally in harmony with agricultural ecosystems and implemented in compliance with the requirements of relevant technical regulations and other normative documents". Article 4 of the law defines the main principles for organic agriculture, including the "establishment of a favourable environment for the preservation of biodiversity, as a result of selective breeding of plants and livestock, as well as the reduction of risks caused by human activity. Other principles include the improvement of the soil's physical, chemical and biological qualities, and the maintenance of fertility by natural means (crop rotation, organic fertilization, creation of forested zones to combat erosion, etc.); selection of methods and technologies of agricultural food processing that will ensure maximum preservation of their biological value; elimination of environmental pollution – terminating the use of synthesized chemical substances, using environmentally friendly technology in agricultural activities; harmonisation of plant growing and cattle farming; elimination of the use of hormones, hormonal preparations, as well as genetically modified living organisms, genetic engineering, or other modern biotechnologies and ionic x-ray methods." (https://members.wto.org/crnattachments/2008/tbt/arm/08_2072_00_et.pdf). Unfortunately, the law does not possess any provisions on organic agriculture and the possible impact on the reduction of greenhouse gas emissions, or on agriculture resilience to climate change.

51. **On Bee-Farming,** 19 March 2009 – sets a legal framework for bee-farming management, regulation of relations in bee-farming production, activities ensuring honeybees breeding and care, the use of these bees for the pollination of agricultural entomophile plants, the acquisition of bee products, and the preservation of honeybees and provision of veterinary services. The law provides certain preventive measures against various threats, such as the maintenance of bee colonies under unfavourable climatic conditions (additional artificial feeding), protection of infectious diseases, ensuring the safety of bee colonies, while implementing plant protection measures, timely informing the bee farmers about environmental threats. Although the generic term "environmental threats" may also presume climatic hazards, there is no direct reference to such hazards, climate change or risk reduction/adaptation measures (http://www.parliament.am/legislation.php?sel=show&ID=3565&lang=arm).

52. **On Food Safety,** 21 June 2014 – regulates relations pertaining to the safety of food, substances in direct contact with food, safety in the food chain and service provision stages of trade and the public food sector, as well as the establishment of human health protection envisaged by the state against the harmful and unsafe effect of food and substances in direct contact with food. This law applies to all the parties involved in food safety issues throughout the food chain (https://www.arlis.am/DocumentView.aspx?DocID=121915).

53. **On Feed,** 21 June 2014 **–** regulates relations pertaining to the safety of feed and feed chain, including assessment of various risk factors and the implementation of prevention activities (https://www.arlis.am/DocumentView.aspx?DocID=121906).

54. **On veterinary,** 21 June 2014 – regulates legal relations in the veterinary area between the authorised state governing body and the institutions, enterprises, organizations, sole entrepreneurs, as well as the citizens. There are provisions in the law on the maintenance of zoo-hygienic norms and environmental protection. The negative effects of the climate change are not considered, such as the implementation of adaptation measures ensuring that **climate change** does not adversely **affect** food safety via increasing drug residues (https://www.arlis.am/DocumentView.aspx?DocID=121581).

Government decisions

55. **On the approval of Rural and Agriculture Sustainable Development Strategy 2010–2020 of the Republic of Armenia and the List of Actions required for the Strategy implementation,** 4 November 2010 – the strategy envisages implementation of preventive measures to reduce the vulnerability of agriculture to climate change. It contains provisions on the prediction, reduction, prevention and mitigation of risks of natural hazards, such as drought, flooding, mud flow, hail, erosion. However, the strategy lacks any connection to Armenian climate-change policies and strategies (http://minagro.am/public/uploads/2014/02/agstrategy_arm3.pdf).

56. **On the approval of Strategy of the Main Directions Ensuring Economic Development in the Agricultural Sector of the Republic of Armenia for 2020–2030 and Action Plan 2020–2022 for the implementation of the Strategy,** 19 December 2019 – the strategy envisages the implementation of preventive measures to reduce the vulnerability of agriculture to natural hazards and climate change as well as the mitigation of risks and adaptation of Armenia's agriculture to climate change and the introduction of agricultural insurance. It highlights the increasing urgency for a stronger focus on adapting Armenia's agriculture to climate change. This should be based on coherent governmental programmes and actions focused on:

   • preserving and improving agricultural sector competitiveness, including long-term production system and livelihood diversification programmes for high-risk farmer populations, and;
   • developing more systemic programmes on climate-change adaptation, including the integration of climate-change data and forecasts into resource planning and allocation decisions, incorporating the setting of geographic priorities for specific crop commodities and value chains https://www.e-gov.am/gov-decrees/item/33178/.

57. **On the approval of Strategy and National Programme to Combat Desertification in the Republic of Armenia,** 27 May 2015 – defines complex measures aimed at the improvement of the socioeconomic situation, which may include:

   • improvement of legislation and management system;
   • improvement of natural resources use mechanisms;
   • expansion of research activities and improvement of monitoring system;
   • improvement of education system;
   • ensuring public awareness;
   • implementation of joint activities within the scope of Rio conventions;
   • insuring international cooperation.

This system of complex measures completely reflects the nature of the international obligations of Armenia by sectors, including those regarding environmental UN conventions such as biodiversity, climate change, and combatting desertification (http://www.epiu.am/wp-content/uploads/2017/12/anapat_eng-1.pdf).

58. **On the approval of the Programme of Activities Ensuring the Implementation of the Concept on Prevention of Agricultural Damages Caused by Climatological Disasters,** 30 November 2017 – envisages the implementation of programmes on:

   - seed farming and nursery development;
   - plant protection;
   - plants' agro-chemical assessment and increase of fertility;
   - GIS application;
   - facilitation and piloting of the drip irrigation system;
   - subsidising the interest rates of agricultural loans;
   - subsidising the interest rates of loans for the establishment of intensive orchards;
   - subsidising the interest rates of loans for the introduction of anti-hail nets;
   - introduction of agricultural insurance system;
   - piloting a new rocket based anti-hail system.

The programme duration is seven years, which will cover 2017–2024 (https://www.e-gov.am/protocols/item/831/)**.**

59. **On the approval of the Programme on Subsidising the Interest Rates of Loans Provided for the Introduction of Anti-Hail Nets in the Agricultural Sector of the Republic of Armenia**, 31 August 2017 – due to the intensification of hailstorms, the programme is aimed at raising farmers' income and improving gardening effectiveness through supporting the introduction of anti-hail nets in orchards and vineyards (http://www.irtek.am/views/act.aspx?aid=91410).

60. **On the approval of the Programme on the Co-financing of the Modernization of Irrigation System**, 7 March 2019 – is aimed at the implementation of two strategic objectives:

   - saving and effective use of water resources;
   - increasing land users' income.

It is envisaged that it will facilitate the introduction of modern irrigation systems, such as drip and sprinkler irrigation (http://www.irtek.am/views/act.aspx?aid=151132).

61. **On the approval of the Programme on State Support for Construction or Reconstruction of small and medium "smart" Barns and Their Technological Maintenance**, 4 April 2019 – aimed at raising animal productivity through the introduction of innovative technologies, such as the construction of "smart" barns. The elimination of risk factors to cattle breeding in order to increase milk productivity is the main purpose of this technology (https://www.arlis.am/DocumentView.aspx?DocID=129757).

62. **On the approval of the Programme on Cattle Breeding Development 2019–2024,** 29 March 2019 **–** aimed at the intensification of cattle breeding, introduction of more productive cattle breeds, improvement of the quality of meat and milk products, thus contributing to the enhancement of food security and safety (http://www.irtek.am/views/act.aspx?aid=98986).

63. **On the approval of the Programme on State Support for the Establishment of Vineyards, Modern Technologies Applied Intensive Orchards and Berry Farms in the Republic of Armenia**, 29 March 2019 – aimed at facilitating the application of innovative technologies by Armenian farmers. Long-lasting winter freeze, early spring frost, and storms are identified as the largest risks threatening the plants and productivity of farms in Armenia (http://www.irtek.am/views/act.aspx?aid=99030).

Ministerial decrees

64. **On the approval of Fire Security Rules of Agricultural Lands**, 3 June 2016 – is a decree of the minister of agriculture, which defines fire security rules for burning of agricultural land. The decree contradicts the provisions of the Law on Atmospheric Air, which prohibit burning of vegetated areas, including of agricultural land (http://minagro.am/public/uploads/2014/06/Hraman-hrdeh.pdf).

Annex III.
National and sub-national development policies, strategies, plans, projects and programmes relevant for DRR in agriculture

DRR/M – Disaster risk reduction/management
CCA – Climate-change adaptation
RD – Rural development
AD – Agricultural development

STRATEGIES, POLICIES AND PLANS	DRR/M	CCA	RD	AD
National level				
Armenia Development Strategy for 2014–2025 (Government of Armenia, 2014a)	×	×	×	×
Action Plan of the Government of the Republic of Armenia for 2019–2023 (Government of Armenia, 2019b)	×	×	×	×
Armenia Country Strategic Opportunities Programme 2018–2024 (IFAD, 2018)	×	×	×	×
National Disaster Management Strategy and Action Plan (Government of Armenia, 2017c)	×	×	×	×
Armenia-United Nations Development Assistance Framework 2016–2020 (UNDP, 2015)	×	×	×	×
National Programme and Comprehensive Action Plan for Improving Fire Safety in Forests and Other Vegetation Areas (Government of Armenia, 2013)	×	×	–	×
National Fire Fighting Policy, its Implementation Strategy and Action Plans in Forest Lands, Specially Protected Areas, Agricultural Lands and Settlements (Government of Armenia, 2015)	×	×	–	×
Forest Sector Improvement Strategy and Action Plan (Government of Armenia, 2017e)	×	×	–	–
National Forest Policy and Strategy (Government of Armenia, 2004)	×	×	×	×
Strategy and State Programme of Conservation and Use of Specially Protected Nature Areas of the Republic of Armenia (Government of Armenia, 2014b)	×	×	–	×
Sustainable Agriculture and Rural Development Strategy of the Republic of Armenia 2010–2020 and its Action Plan (Government of Armenia, 2010)	×	×	×	×
Strategy of the Main Directions Ensuring Economic Development in Agricultural Sector of the Republic of Armenia for 2020–2030 (Government of Armenia, 2019c)	×	×	×	×
National Programme on Combating Desertification in Armenia (Government of Armenia, 2002)	×	×	–	×
National Strategy and Action Programme to Combat Desertification in the Republic of Armenia (Ministry of Nature Protection, 2014)	×	×	×	×
Concept for the Prevention of Agricultural Damages caused by Natural and Climatological Disasters (Government of Armenia, 2017a)	×	×	×	×
Environmental Protection and Natural Resource Use Management Strategy and Action Plan (Government of Armenia, 2018c)	×	×	–	×
Related legal act drafts pending approval/adoption				
On the approval of Disaster Early Warning System Formation Concept (Government of Armenia, 2018a)	×	–	–	–
Law of Republic of Armenia on Disaster Risk Management and Population Protection (MoES, 2019b)[28]	×	×	–	–

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[28]Although the draft law does not refer directly to the agricultural sector, it establishes a unified disaster risk management platform that is applicable to all socioeconomic sectors and respective development plans.

STRATEGIES, POLICIES AND PLANS	DRR/M	CCA	RD	AD
Sub-national level **Marzes development strategies 2017–2025 (Government of Armenia, 2017d)**				
Aragatsotn Marz Development Strategy 2017–2025	×	×	×	×
Ararat Marz Development Strategy 2017–2025	×	×	×	×
Armavir Marz Development Strategy 2017–2025	×	×	×	×
Tavush Marz Development Strategy 2017–2025	×	×	×	×
Vayots Dzor Marz Development Strategy 2017–2025	–	×	×	×
Lori Marz Development Strategy 2017–2025	×	×	×	×
Kotayk Marz Development Strategy 2017–2025	–	×	×	×
Shirak Marz Development Strategy 2017–2025	–	×	×	×
Gegharkunik Marz Development Strategy 2017–2025	–	–	×	×
Syunik Marz Development Strategy 2017–2025	×	×	×	×

Relevant projects and programmes for DRR, EWS, agrometeorology services

There is also a wide range of international partner/donor organizations, which are widely supporting and contributing towards sustainable agricultural development in Armenia, including sectoral resilience building for various risks posed by hydrometeorological hazards. The table below provides information on the programmes that are being implemented in different sectors (including agriculture) and that include DRR/M or CCA elements and contribute indirectly to the prevention and mitigation of agricultural risks.

N	Donor	Implementer	Year	Amount in USD
NATIONAL PROGRAMMES				
1	**Development of Armenia's Fourth National Communication to the UNFCCC and Second Biennial Report** (UNDP and MoEnv, 2016). To assist Armenia in the preparation of its Fourth National Communication report and its Second Biennial Report for the implementation of the obligations under the UNFCCC.			
	Global Environmental Facility (GEF)	UNDP, MoENV	2016–2020	1.4 million
2	**Addressing climate change impact through enhanced capacity for forest and wildfire management in Armenia** (UNDP, MoENV, and MoES, 2017). Project's efforts are aimed at: • revising and updating of policy and legislation documents, normative acts and/or standards related to forest and wildfire management; • developing forest and wildfire fighting community-based rescue team and regional administrative capacities (including volunteers) aimed at the prevention and mitigation of forest and wildfire risks; • developing and supporting alternative entrepreneurship-based activities for the prevention and mitigation of wildfire risks; • establishing sustainable mechanism for the promotion of innovations and replication of technological solutions with regard to climate change adaptation and mitigation activities related to agriculture and forestry subsectors.			
	Government of Russian Federation	UNDP, MoENV, MoES	2017–2020	Required: 3.27 million Contributed: 1,014,960
3	**Mainstreaming Sustainable Land and Forest Management in Mountain Landscapes of North-Eastern Armenia** (UNDP and MoEnv, 2015). Sustainable land and forest management in the North-Eastern Armenia ensures continued flow of multiple ecosystem services, such as water provision, land slide control and carbon storage and sequestration as well as the conservation of critical wildlife habitats.			
	GEF, UNFCCC REDD+, UNDP	MoENV, *Hayantar*	2016–2020	17 million
	Green Climate Fund (GCF), Government of Armenia, UNDP	UNDP, MoENV	2016–2036	29.8 million
4	**Enhancing Human Security in Communities of Armenia** (UNDP *et al.*, 2018). The goal of the project is to support the achievement of the SDGs in the targeted Alaverdi, Amasia, Berd and Tumanyan communities of Armenia by strengthening community resilience, social protection and inclusiveness to improve human security, and address economic and food insecurity through strengthened livelihoods, creation of sustainable economic opportunities and capacity development.			
	UN Trust Fund	UNDP, UNICEF, UNIDO, FAO, WFP, IOM	2018–2021	2 million

N	Donor	Implementer	Year	Amount in USD
5	**Second Community Agriculture Resource Management and Competitiveness Project** (MoE, ADF, and MoF, 2014). The objective is to improve productivity and sustainability of pasture and livestock systems in targeted communities and increase the marketed production from selected livestock and high value agrifood value chains. The project consists of four components: **1.** Community/Pasture Livestock Management System, which aims to continue the implementation of an efficient and sustainable community managed pasture/fodder based livestock production system in communities. **2.** Value Chain Development to increase the ability of the Armenian agricultural producers and processors to meet domestic demand and access to international market opportunities in food value chains of forage-based milk and meat. **3.** Strengthening public sector institutions to increase the capacity of public sector institutions to facilitate business development and enable market access in the selected value chains supported under components 1 and 2. **4.** Project coordination and management through the existing Agriculture Projects Implementation Unit State Agency (APIU) of the Ministry of Agriculture.[29]			
	World Bank	Agriculture Development Fund (ADF), MoE, Ministry of Finance (MoF)	2014–2020	42.67 million
6	**Advanced Science and Partnerships for Integrated Resource Development Project** (ASPIRED) (ME&A, Inc., 2016). The purpose of the ASPIRED project is to support sustainable water resource management and sustainable practices of water users in the Ararat Valley through the use of science, technology, innovation and partnership initiatives. The ultimate goal is to reduce the rate of groundwater extraction in the Ararat Valley up to sustainable levels. To this end, the project will be focused on several critical areas, including water resource data, technology, water regulation and enforcement, coordination between partners.			
	USAID	Mendez England & Associates, Inc. for the MoENV	2016–2020	4.99 million
7	**National Adaptation Plan (NAP) to advance medium and long-term adaptation planning in Armenia** (UNDP, 2019). Funded by the GCF, the National Adaptation Plan (NAP) to advance medium and long-term adaptation planning in Armenia project, will support the government to develop a national plan for climate-change adaptation through an iterative process focused on strengthening institutional capacities to ensure that they are sustained in the long run. The project aims to address existing barriers, support the prioritization of climate-change adaptation investments in priority sectors, including water resources, agriculture, energy, health, tourism and human settlement, and increase the identification of finance options.			
	GCF	National government, Non-government organizations, Private sector partners UNDP	Ongoing, duration 18 months	2.99 million
9	**Second Community Agricultural Resource Management and Competitiveness (CARMAC2) project** (MoE, 2015). The project development objectives include: • improve the productivity and sustainability of pasture and livestock systems in targeted communities; and • increase the marketed production from selected livestock and high-value agri-food value chains. With as project outcomes: • increased livestock productivity, as measured by milk productivity and an increase in daily animal weight gain; • increased efficiency of communal pasture management, as measured by increased communal budgetary revenues from the lease of pastures; • increased farm sales from livestock; • increased pasture management effectiveness.			
	IDA Credit IBRD Loan Ministry of Agriculture	MoE	2014–2020	42.67 million
10	**Irrigation System Enhancement project and Additional Financing** (MTAI, MoE, and MoF, 2019). The project development objectives are to: • reduce the amount of energy used and to improve irrigation conveyance efficiency in targeted irrigation schemes; • improve the availability and reliability of important sectoral data and information for decision makers and other partners.			
	IBRD Loan, Armenian Government	MTAI, MoE, MoF	2013–2019	39.5 million
11	**Local Economy and Infrastructure Development project** (MoE et al., 2019). The project development objective is to improve infrastructure services and institutional capacity for an increased contribution from tourism to the local economy in five selected regions of Armenia.			
	IBRD Loan, rmenian Government	MoE, MoESCS, MoENV, MTAI Armenia Territorial Development Fund	2015–2021	69.41 million
12	**Lifeline Road Network Improvement project** (MTAI, 2019). The project development objective is to improve the access of rural communities to markets and services through the upgrading of selected lifeline roads and to strengthen the capacity of the Ministry of Transport, Communication and Information Technology (MOTCIT) to manage the network.			
	IBRD Loan, Armenian government	MTAI, Roads Directorate State Non-Commercial Organization	2013–2019	106.25 million

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[29]After the integration of the Ministry of Agriculture into the frames of Ministry of Economy the exact status of the APIU needs to be justified.

N	Donor	Implementer	Year	Amount in USD
13	**ENPARD Technical Assistance to the Ministry of Agriculture of Armenia.** One of the four specific objectives (outputs) of the technical assistance provided under this project was set as follows: support capacity development on DRR. In the framework of the project, country-specific guideline and methodology for disaster needs assessments in the agriculture sector based on international standards was prepared and approved by the order of MoA. Nine demonstration fields on conservation agriculture, 12 demonstration fields on anti-hail nets, and eight on drip irrigation, were established. Extension manuals titled the Guidelines on risk reduction of key natural and man-made hazards that negatively impact agriculture in Armenia, and The Principles of Irrigation Scheduling for Agricultural Crops, were developed and published.			
	EU	FAO (participating organizations MoA, SCRA)	2015–2019	2 201 826 million
INTERNATIONAL PROGRAMMES				
14	**EU4Climate in Eastern Partnership countries** (MTAI, MoE and MoENV, 2018). The programme supports the development and implementation of climate policies by the Eastern Partnership countries, contributing to low-emission and climate-resilient development, and to their commitments to the 2015 Paris Agreement. The programme's seven areas of action envisage the elaboration of long-term low greenhouse gas emissions development strategies, establishment of a strong monitoring, reporting and verification system, establishment of concrete sectoral guidelines for the implementation of the Paris Agreement, adoption of national and sectoral adaptation plans with strong attention to sustainable agriculture and agroforestry.			
	EU	Actions are clustered around the achievement of seven priority results	2018–2022	EUR 8.8 million, EU investment: EUR 8 million
15	**EU4Environment in Eastern Partnership countries** (UNIDO *et al.*, 2019). The EU4Environment initiative integrates, into a single strategic framework, activities that have been carried out in the past under several projects. The initiative is aimed to help deliver policy and legislative changes, make planning and investment greener, stimulate the uptake of innovative technologies, adopt new business models, and create green jobs. It will also promote better environmental governance, improved management of protected areas and forests, and sustainable trade. Actions will be implemented to support ecosystem services and livelihoods, including support to community actions for forest conservation and sustainable use; increase in non-timber goods production and energy efficiency related to biomass; actions to limit the trade in illegal timber; and support for the identification and development of innovative financing schemes for the sustainable management of ecosystem services.			
	EU	Implemented by various agencies according to actions clustered around four priority results: 1. UNECE, UN Environment, and UNIDO (coordinator) 2. UN Environment and UNIDO (coordinator) 3. World Bank (tbc) 4. OECD in cooperation with all partners	2019–2022	EUR 20 million, EU investment: EUR 19.5 million
REGIONAL PROGRAMMES				
16	**Integrated Biodiversity Management, South Caucasus** (GIZ, 2019). This regional programme aims to support the sustainable management of biodiversity and ecosystem services across sectoral and administrative boundaries based on robust data. There are four main components/directions relevant and related to disaster risk reduction: **1.** Demonstration of sustainable biodiversity management in pilot regions in Aragatsotn, Shirak and Sisian – to support municipalities in piloting an integrated pasture management approach designed to prevent soil degradation in the long term. **2.** Improvement of frameworks and support to capacity development – to support political partners in establishing inter-sectoral biodiversity management coordination structures, as well as advising the Ministry of Nature Protection on establishing an information system for the integrated management of biodiversity and ecosystem services. An IT-based information system, focused on forest management diversity for a better future, has been developed. The government forest enterprise (*Hayantar*) and the State Forest Monitoring Centre are using this system. **3.** Education for sustainable development – to advise the Environmental Education Network (an association of more than 30 local and international organizations) and the ministries in charge on the important of sustainable development. **4.** Regional exchange and dialogue on urgent environmental issues in the region.			
	German Federal Ministry for Economic Cooperation and Development (BMZ)	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	2015–2019	EUR 20.95 million
17	**Enhancing locust management and prevention.** The project covered Caucasus, Central Asia, Russian Federation and Afghanistan, and aimed to improve national and regional locust management, to reduce the occurrence and intensity of locust outbreaks; as well as to protect human health and biodiversity through the reduction of risks associated with obsolete and useable pesticides.			
	United States Agency for International Development (USAID)	Ministry of Agriculture and National Locust Control Unit	2011–2017	USD 1 660 000