

**DISASTER RISK REDUCTION AND EMERGENCY MANAGEMENT  
IN ARMENIA**

**GLOBAL FACILITY FOR DISASTER REDUCTION AND RECOVERY  
“ARMENIA: INSTITUTIONAL ARRANGEMENTS FOR DISASTER RISK  
MANAGEMENT AND REDUCTION”**

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**Europe and Central Asia Region**



## ACRONYMS AND ABBREVIATIONS

AMD	Armenian Dram
ARCS	Armenian Red Cross Society
ARS	Armenian Rescue Services
CAT DDO	Catastrophic Deferred Drawdown Option
CBA	Central Bank of Armenia
CCM	Center for Crisis Management
CPR	Country Performance Rating
ECA	Europe and Central Asia
ECLAC	Economic Commission for Latin America and the Caribbean
EEWS	Earthquake Early Warning System
EU	European Union
EWS	Early Warning System
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographic Information System
IBRD	International Bank for Reconstruction and Development
ICRC	International Committee of the Red Cross
IDA	International Development Association
IMF	International Monetary Fund
ISO	International Organization for Standardization
JICA	Japanese International Cooperation Agency
MCC	Millennium Challenge Corporation
MoE	Ministry of Economy
MoES	Ministry of Emergency Situations
MoF	Ministry of Finance
MoNP	Ministry of Natural Protection
MoA	Ministry of Agriculture

MoTA	Ministry of Territorial Administration
MoUD	Ministry of Urban Development
NCTS	National Center for Technical Security
NATHAN	Natural Hazards Assessment Network
NFSAT	National Foundation of Science and Advanced Technologies
NGO	Non-Governmental Organization
NMHS	National Meteorological & Hydrological Service
NSSP	National Survey for Seismic Protection
O&M	Operation and Maintenance
OSCE	Organization on Security and Cooperation in Europe
PGA	Peak Ground Acceleration
PIC	Public Information Center
PIM	Participatory Irrigation Management
PPE	Personal Protective Equipment
SAR	Search and Rescue
SACM	State Academy of Crisis Management
SCWM	State Committee of Water Management
SDCA	Swiss Development Cooperation Agency
SECE CRIF	Southeast and Central Europe Catastrophe Risk Insurance Facility
SINT	State Inspectorate for Nature Protection
SMEs	Small and Medium Enterprises
TM	Technical Monitor
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
US	United States
USAID	United States Agency for International Development
USGS	United States Geological Survey
USSR	Union of Soviet Socialist Republics

WFP	World Food Programme
WMO	World Meteorological Organization
WRMA	Water Resources Management Agency
WUAs	Water Users Associations

## CONTENTS

Executive Summary .....	1
Introduction .....	3
1. Risk of Natural Hazards In Armenia .....	8
2. Social and Economic Impact of Natural Disasters in Armenia .....	12
3. Institutional Framework and Capacity to Manage Risk and Respond to Emergencies .....	17
4. Challenges and Opportunities for Risk Reduction and Emergency Management .....	26
5. Options Going Forward.....	37
6. Conclusion.....	44

### Tables:

<i>Table 1. Key Economic Indicators, 2003-09.....</i>	6
<i>Table 2. Hazard Matrix by marzes and Yerevan city .....</i>	9
<i>Table 3. Potential Economic Loss .....</i>	15
<i>Table 4. Role of Organizations in Risk Reduction and Emergency Management.....</i>	18

### Figures:

Figure 1: Population at Risk of of Exposure to Catastrophic Events, by Country* .....	8
Figure 2: Potential Economic Loss from Catastrophic Events.....	14

### Annexes:

Annex1: List of people met during assessments in May, June, and September 2008.....	45
Annex2:Legal and Regulatory Framework and Processes for Seismic Risk Mitigation .	46
Annex3: Organizational Charts .....	49



## EXECUTIVE SUMMARY

Earthquakes, floods, hail, landslides, mudflows, drought, erosion, and desertification have caused vast social upheaval and economic damage to Armenia. In the 2005 report “Natural Disasters Hotspot – A Global Risk Analysis,” the World Bank lists Armenia in the top 60 countries exposed to multiple hazards. A 2004 United Nations Development Programme (UNDP) report on reducing natural disaster risk revealed that during 1980-00, Armenia averaged about 325 deaths per million inhabitants due to disasters—ranking third behind the Democratic Republic of Korea and Mozambique.<sup>1</sup> In fact, more than 80 percent of Armenians are at risk of exposure to catastrophic events.

This ongoing vulnerability to natural disasters has led Armenia to appreciate the advantages of developing a comprehensive strategy to help minimize ensuing fiscal exposure because the national budget will never be adequate to mitigate, respond, and recover from these recurrent but unavoidable crises. For example, the 1988 Spitak earthquake killed more than 25,000 people, injured 19,000, damaged over 515,000 homes, and caused some US\$15-20 billion in damages—more than two times Armenia’s 2007 Gross Domestic Product (GDP).<sup>2</sup>

Since the Spitak earthquake, Government has reorganized its emergency management system and established many seismic mitigation activities and must be commended for creating a Ministry of Emergency Situations (MoES) and establishing a cabinet-level Minister responsible for disaster response. Government may wish to build on these achievements by continuing to bolster existing institutional structures, response and mitigation programs, and overall capacity to prepare and respond to the potential magnitude of disasters, because in their current state, they would be insufficient to counteract the effects of any large-scale disaster. Resolving some of the outstanding issues that remain could boost overall response and mitigation efforts; Government may want to consider tackling these now to build on achievements through the following actions.

First, Government has established multiple mitigation programs, involving multiple ministries. The investment in these mitigation programs would be more efficient and effective if Government now develops a comprehensive national plan, which would include strategies to coordinate inter-Ministry activities. This would reduce or eliminate overlapping responsibilities and duplication of duties and increase Government’s ability to prioritize activities and allocate scarce resources. A comprehensive approach might include reviewing existing legislation, policies, and regulations to ensure cohesive mitigation programs among Ministries; and, given the

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<sup>1</sup> United Nations Development Programme, Reducing Disaster Risk: a Challenge for Development (New York, 2004).

<sup>2</sup> 2007 Armenia GDP was US\$9.2 billion.

considerable risk of earthquake and flooding, could include a strategy that prioritizes funding to retrofit at-risk infrastructure and buildings.

Second, now that Government has established MoES, it should invest in improving its capacity to respond to disasters. A comprehensive national response plan is essential to coordinate interactions among MoES, partner Ministries, regional services, and local emergency response forces, to overcome remaining deficiencies and consolidate gains. The national emergency response forces require additional training and basic equipment; and emergency communications and the national emergency operations center must be upgraded to conform to modern specifications. The comprehensive national plan must include strategies for coordinated actions among local, regional, national, and non-governmental organizations (NGOs) during a disaster; and an overall communications strategy that includes public education campaigns and establishing a national emergency call number to use during a crisis.

Third, Government needs to reduce its fiscal exposure to both common and catastrophic events because Armenia does not have adequate budget to mitigate, respond and recover from recurrent crises. The World Bank has predicted that more than a quarter of Armenia's GDP will be spent on common disasters;<sup>3</sup> and that Armenia will spend seven times its GDP on catastrophic disasters—those that have a 0.5 percent chance of occurring.<sup>4</sup> To reduce fiscal exposure from both types of events, Government could consider accessing a range of financial mechanisms such as catastrophic insurance facilities or contingent loan facilities. Armenia has established many improvements to disaster response since the 1988 Spitak Earthquake but major institutional and budgetary emergency management challenges remain. This report outlines potential natural disaster risks and their social and economic impacts, discusses opportunities for strengthening Armenia's response ability, and provides recommendations going forward.

This report is based on a study carried out in Armenia under the Global Facility for Disaster Reduction and Recovery (GFDRR)<sup>5</sup> project, which analyzed disaster risks, assessed existing systems, mechanisms, and institutional capacities, and made recommendations for developing a comprehensive national disaster reduction and preparedness agenda, which could form the basis for a natural disaster reduction project.

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<sup>3</sup> Disasters that have a 20 percent probability of occurring.

<sup>4</sup> Christopher Pusch, *Preventable Losses: Saving Lives and Property through Hazard Risk Management - A Comprehensive Risk Management Framework for Europe and Central Asia*. Disaster risk management working paper series, no. 9. (Washington, DC: World Bank, 2004).

<sup>5</sup> The GFDRR is a partnership of the World Bank, the International Strategy for Disaster Reduction (ISDR), and bilateral donors, to support implementation of the Hyogo Framework for Action (HFA). The GFDRR was established to help developing countries enhance their capacity for disaster prevention, emergency preparedness, and recovery. The GFDRR promotes awareness of technical expertise, risk-reduction technologies, and best practice in disaster risk reduction and management.



## INTRODUCTION

### GEOGRAPHY

Armenia is a landlocked country in the South Caucasus region, sharing borders with Georgia, Azerbaijan, Iran, and Turkey. The geography is primarily mountainous, relieved by the Ararat Valley, the country's agricultural breadbasket. The main rivers are Araks, Hrazdan and Debed.

Armenia lies in the seismically active crescent that stretches from the Alps through the Caucasus and



<https://www.cia.gov/library/publications/the-world-factbook/geos/am.html>

Central Asia to the Russian Federation, along with Turkey and other earthquake-endangered countries. The substantial earthquake hazard is due to interactions of major tectonic plates: Indian and Arabian plates are moving north, colliding with the Eurasian plate and resulting in thrust faulting—the ongoing process that created the major mountain ranges from the Caucasus to the Himalayas. The collision zone stretches from eastern Turkey and the Caucasus to the west of the Caspian Sea, causing associated lateral faulting on its western and eastern sides, as the earth's crust is extruded along regional fault zones. To the south, strike-slip faulting occurs along the eastern end of the North Anatolia fault and along the East Anatolian fault, which runs near Turkey's southern border up to Armenia. Other strike-slip faults between the Caspian and Black Seas make this an area prone to high and very high earthquake hazard.

### ECONOMY

Armenia is divided into 10 marzes plus the capital, Yerevan. Armenia has 3.2 million people—more than one-third of whom live in Yerevan. The National Statistical Service data classified 25 percent of the 2007 population as “poor” and about 4.0 percent as “extremely poor.”

Armenia incurred significant losses due to the economic shock of early 1990s, similar to other transition economies. The combined effects of the devastating

earthquake, the collapse of the Soviet Union, and regional conflicts, resulted in the worst-ever economic depression among the CIS countries. However, since 1994, Armenia had maintained steady economic progress. Moderate economic growth during the initial years of recovery accelerated during 1995-00—averaging 5.4 percent per year, driven by private sector productivity gains as macroeconomic stability took hold, and private markets expanded rapidly. The public sector remained small as a share of the total economy and Government adopted institutional measures to ensure free price formation, liberal trade in goods, services, and investments; private ownership of assets (including land), and industrial restructuring.

During 2001-07, economic growth jumped to an average of 12.6 percent per year, driven by steadily increasing private investment in the construction industry, substantial remittances, and a strong donor-financed development program. Armenia maintained impressive growth rates by consistently reducing the negative balance on external accounts and budget deficits, keeping inflation low, and substantially reducing its debt burden. External current account deficits were fully financed through grants and escalating private remittances.

Armenia introduced the national currency in 1993; initially the dram experienced significant inflation but since the late 1990s, annual inflation averaged only 3.4 percent. Since 2005, the dram has appreciated against the dollar—458 drams in 2005 to 342 in 2007.

Historically, Armenian imports have exceeded exports significantly, but during the late 1990s, this gap was successfully mitigated by the rapid growth in the processing industry—primarily rising exports of processed diamonds. However, preconditions were insufficient to develop the main export-driven industries and products—local currency began to appreciate in 2005, barriers remained to a competitive private sector environment, and the cost of doing business was high— exports fell, and during 2007-08, the trade deficit rose.

Recently, Armenia's economic growth has been based on an expanding services sector, agriculture (19 percent in 2006) and industry (16 percent in 2006), but the primary source of growth was the construction industry (29 percent of GDP in 2006), specifically housing. As a result, during 2007-08, externally funded construction became the single largest contributor to the economy, creating risks for further economic growth and sustainable employment.

During 2008, the Armenian economy suffered from the regional conflict between Russia and Georgia, and the global economic crisis. The first wave of the global financial crisis was less damaging because Armenia's financial and banking sector is relatively small and weakly integrated. However, the crisis manifested in plummeting

remittances from abroad,<sup>6</sup> reduced budget revenues,<sup>7</sup> rising unemployment,<sup>8</sup> a mining industry paralyzed by falling metal prices in international markets, and a dramatic collapse of the construction industry, among other impacts.

High economic growth rates, unprecedented levels of private remittances<sup>9</sup> and sound state social assistance programs aimed at social protection helped Armenia reduce poverty levels from 49 percent in 2002 to 25 percent in 2007. Due to the Poverty Family Benefit program funded by the National Budget, extreme poverty levels fell from 17 percent in 2002 to 4.0 percent in 2007. A household survey reveals strong decreases in urban and rural poverty, and income inequality.<sup>10</sup>

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<sup>6</sup> A 35 percent reduction reported January-May, 2009, compared to the same period of the previous year.

<sup>7</sup> Almost 20 percent reduction reported January-May, 2009, compared to the same period of the previous year.

<sup>8</sup> A 10 percent reduction reported in January-May, 2009, compared to the same period of the previous year.

<sup>9</sup> Private transfers grew by 36 percent annually during 2003-06.

<sup>10</sup> During 2002-05, poverty in Yerevan declined from 45 to 24 percent, in other urban areas from 60 to 38 percent, and in rural areas from 45 to 28 percent. The income inequality index declined from 0.45 to 0.36. The methodology was revised in 2004, but the downward trend is seen even after adjusting for this.

*Table 1. Key Economic Indicators, 2003-09*

	2003	2004	2005	2006	2007	2008	2009 (proj)
Real GDP growth, %	14.0	10.5	13.9	13.2	13.8	6.8	-15.6
End of period CPI inflation, % change	8.6	2.0	-0.2	5.2	6.6	5.2	4.0
Current account balance, % of GDP	-6.7	-0.5	-1.1	-1.8	-6.4	-11.6	-13.0
Fiscal deficit (consolidated), % of GDP	-1.3	-1.5	-1.7	-1.3	-1.5	-0.7	-7.0
External public debt, % of GDP	38.8	32.9	22.4	18.9	15.7	13.2	34.8
Gross international reserves, % months of imports	4.4	4.2	4.3	5.1	5.5	3.6	7.5
Total public expenditure (consolidated), % of GDP	22.4	20.6	21.8	21.4	23.7	22.7	28.8
Public investment, % of GDP	5.2	3.9	4.1	4.0	5.2	5.3	6.1
Private investment, % of GDP	19.5	20.0	24.1	26.4	32.6	35.5	25.9
Foreign investment, % of GDP	4.3	6.9	4.7	7.0	7.6	7.8	4.5
Average exchange rate, annual % change	0.9	-7.8	-14.2	-9.1	-17.8	-10.6	19.3
GNI per capita (\$,atlas based)	950	1150	1470	1920	2570	3350	3000
Tax Revenues to GDP **	14.0	14.0	14.4	14.5	16.1	17.0	16.4

*Source: World Bank \*\* - includes state and local budget duties*

Indicators for the first five months of 2009 reveal a deep impact on Armenia from the crisis. For example, the construction industry declined 56 percent compared with the first five months of 2008. Industry declined 10.5 percent; agriculture 2.9 percent; and services, 0.2 percent. The combined effects of economic recession and a precipitous decline in remittances from abroad have worsened Armenia's social situation. Almost one-third of the labor force is unemployed, according to recent surveys. Gains in poverty reduction are at risk of being reversed—experts predict that poverty could increase by five percent during 2009-11, rising to 27-28 percent.

Prospects for overcoming the crisis and reviving the economy depend on successful implementation of balanced countercyclical policies and comprehensive reforms. The short-term focus should be on socially vulnerable groups and efforts to increase national competitiveness; the long-term goal is increased self-reliance. Growth will depend on a competitive economy that includes productivity improvements; economic and trade diversification; strengthened corporate governance; property rights enforcement; streamlined tax and customs administrations; strengthened anti-corruption efforts; improved competition; and enhanced human capital.

## INFRASTRUCTURE

Armenia's critical infrastructure passes through regions of high seismicity, making it extremely vulnerable to physical hazards, especially earthquakes. Natural hazards that pose risks to national infrastructure are analyzed below, along with potential impacts and mitigation policies.

**Electrical network:** Most generating plants are near Yerevan. The two largest thermal plants are in Yerevan and Hrazdan cities and fueled by natural gas. There are dozens of 10-megawatt hydroelectric plants that feed the national grid.

A nuclear power plant, built in the 1970s, is at Metsamor City, some 40km from Yerevan. A 1993 geological study, conducted by the Armenian AtomSeismoEnergyProject in collaboration with an Italian company, confirmed that the location was safe, and funds from the European Union (EU) have increased its safety.

The transmission power operations center is in Yerevan and its seismic vulnerability is unknown but transmission towers are old and require upgrading. Within the Country Partnership Strategy (CPS), Government and the World Bank are discussing potential for rehabilitating sections of the high-voltage network.

**Gas network:** The main gas supply arrives by pipeline through Georgia from Russia. By end-2009, a new pipeline from Iran is expected to reach near Yerevan from the south for connection to the Yerevan thermal generating plant. The Georgia pipeline carries 2.0 billion cubic meters per year and fuels 35 percent of Armenia's electric generating capacity.

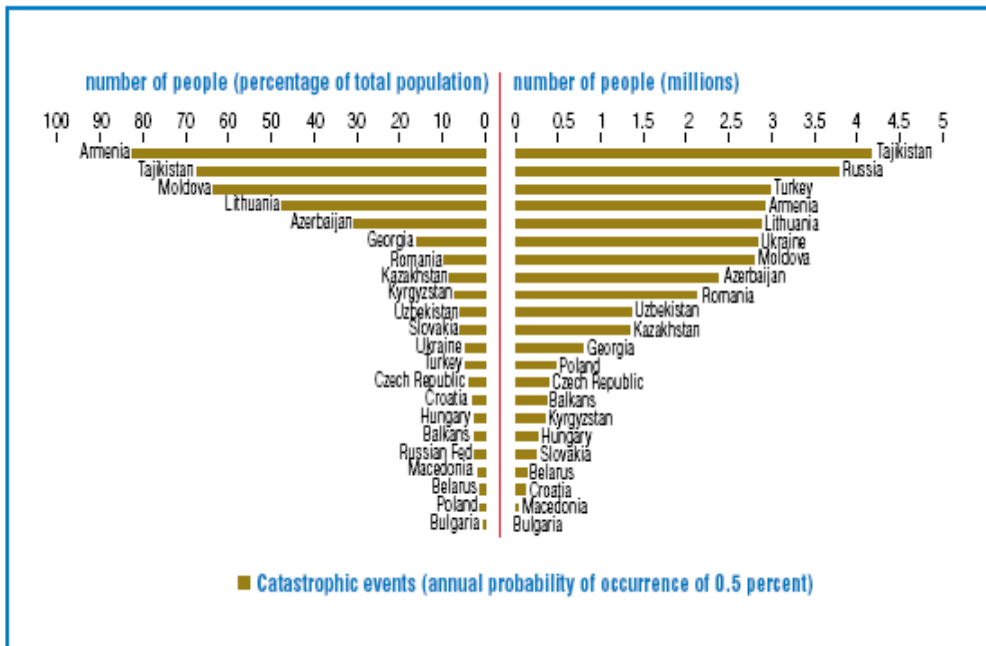
**Railroad network:** Rail lines run from the south through Yerevan to the Georgian border via Western Armenia, Gyumri, Spitak and Vanadzor. Another line runs from Yerevan to the northern shore of the Lake Sevan. The Georgia rail line is a critical economic link relied upon by most bulk imports and about two-thirds of Armenia's exports—half of which require time-sensitive transport to be competitive. This includes massive cement contracts with Russia for some of the infrastructure associated with the 2014 Sochi Winter Olympic Games. Bridges between Vanadzor and the border must be rehabilitated or rebuilt to achieve acceptable safety standards and lower the risk of seismic damage. Rail freight is currently under-loaded to reduce risk of collapse, which raises operational costs. According to a bridge survey and information from the Armenian railway, twelve bridges are in critical condition and require at least US\$25 million for repair. A concession with the Russian State Railroad calls for increasing average network speed, but does not support the required strengthening of bridges.

# 1. RISK OF NATURAL HAZARDS IN ARMENIA

## 1.1 OVERVIEW OF RISKS

Armenia faces major risks from earthquakes, drought, floods, hail and landslides. In the 2005 report “Natural Disasters Hotspot – A Global Risk Analysis,” the World Bank lists Armenia in the top 60 countries exposed to multiple hazards. Figure 1 shows that more than 80 percent of Armenians are at risk of exposure to catastrophic events.

Figure 1. Population at risk of exposure to catastrophic events, by country\*



\*Preventable Losses: Saving Lives and Property through Hazard Risk Management, Christopher Pusch

The Armenian Rescue Service (ARS) and State Academy of Crisis Management (SACM) have developed a hazard matrix for Armenia’s 10 marzes and Yerevan city. Each marz is assigned a rating: 0 indicates “no possibility”; 1 indicates “dangerous”, to rate the potential for losses from each hazard (see Table 2).

Table 2: Hazard Matrix by marzes and Yerevan city

Marz	HAZARD											
	Earth quake	Hail storm	Flood	Land slide	Chem. waste	Snow	Flash flood	Cold	Swamp	Wind	Dro ught	Ave rage
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
<b>Average</b>	<b>0.6</b>	<b>0.6</b>	<b>0.53</b>	<b>0.5</b>	<b>0.5</b>	<b>0.49</b>	<b>0.47</b>	<b>0.31</b>	<b>0.28</b>	<b>0.25</b>	<b>0.19</b>	<b>--</b>

This matrix shows that every marz is exposed to significant risk of earthquakes, hailstorms and floods. In fact, according to the Natural Hazards Assessment Network (NATHAN), 100 percent of Armenia is prone to earthquakes; 98 percent is at risk of drought; and 31 percent, flooding. The following sections discuss specific natural hazards in Armenia.

## 1.2 EARTHQUAKES

Some 2,541,200 people in 48 cities in Armenia are located in seismically active areas.<sup>11</sup> Historically, earthquakes have reached magnitudes (M) of 7.1 and the average recurrence interval of earthquakes with magnitudes of at least 5.5 is 30 to 40 years.<sup>12</sup> In 1839, after traveling around the Caucasus region, the French geographer F. Duba de Monpere wrote, “Armenia underwent and undergoes frequent and severe ground shaking.” According to historical data, the following destructive earthquakes have taken place in Armenia:

- 1679, Garni: M<sup>13</sup>=7.0;                      1937, Parakar: M=4.7;
- 1827, Tsaghkadzor: M=6.5      1972, Talin-Arouch: M=6.5;
- 1840, Ararat: M=6.7;                      1988, Spitak: (M=7.0)
- 1893, Dvin: M=6.5

A 2004 UNDP report on reducing disaster risk noted that during 1980-00, Armenia ranked first in the world for vulnerability to earthquakes—relative vulnerability is

<sup>11</sup> Armenian Red Cross Society, Contingency Planning Process, Final Document (Yerevan: Red Cross, 2007).

<sup>12</sup> Mikayel Melkumyan, Seismic Risk Assessment and Mitigation Strategy in Armenia

<sup>13</sup> M - magnitude according to the Richter scale

calculated as number of persons killed per million exposed—which was 7,653.<sup>14</sup> In comparison, Turkey also experienced a devastating earthquake during these years but its relative vulnerability was only 346. In part this is explained by population differences; in Armenia some 155,560 people per year are exposed; in Turkey, the number is 2,745,757. However, in Armenia, average annual death toll due to earthquake is extremely high at 1,190; in Turkey, the average is 950.

The UNDP study was based on 1980-00 figures, but future projections for vulnerability are no better. Yerevan, home to 40 percent of Armenians, is in one of the highest seismic risk areas; a recent analysis of Yerevan building stock revealed that an earthquake with a magnitude of 7.0 or greater would destroy most buildings, potentially killing some 300,000 people.<sup>15</sup>

### **1.3 LANDSLIDES AND MUDFLOWS**

Landslide sites in the Republic of Armenia cover about 122,000 hectares, which is 4.1 percent of country's total territory; some 35 percent of settlements are located on landslide-prone areas. 233 communities (about 25 percent) are affected by landslides, according to a recent study by the Japan International Cooperation Agency (JICA). Landslides are active in more than 100 communities and have affected hundreds of residential buildings, communication infrastructure, and vital facilities, including 1,744 hectares—5.2 percent of total residential space; 240 kilometers of roads/highways—3.2 percent of the total; and 4.8 kilometers of railways—0.5 percent of the total. Landslide destruction has incurred direct social and economic costs amounting to some US\$43 million according to 2004 landslide inventory data. Typically, landslides are triggered by heavy precipitation, but rainfall in Armenia is insufficient to be the sole cause and the JICA study theorized that leakage from domestic and irrigation water supply systems may contribute. Furthermore, the United Nations Environment Program (UNEP) reported that irrigation, water supply, and sewage systems that are poorly built and maintained have contributed to landslide conditions in Yerevan and surrounding towns.<sup>16</sup> Over half of Armenia is susceptible to mudflow, especially in medium-altitude mountainous areas and mudslides are a threat to the cities and surrounds of Yerevan, and Kapan.<sup>17</sup> During 2004-07, mudflows damaged some 200 settlements and 600 sites on main transportation routes.

### **1.4 FLOODS**

Armenia does not have abundant flowing surface water, but some 55-70 percent of annual discharge occurs in the spring due to melting snow. This can increase water volume in some river basins by ten times and trigger seasonal flooding that severely

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<sup>14</sup> United Nations Development Programme, Reducing Disaster Risk a Challenge for Development (New York: UN, 2004).

<sup>15</sup> Mikayel Melkumyan, Seismic Risk Assessment and Mitigation Strategy in Armenia

<sup>16</sup> United Nations Environment Programme, Caucasus Environment Outlook (CEO) (Tbilisi: United Nations, 2002).

<sup>17</sup> Armenian Rescue Services, September 14, 2008 <<http://www.ema.am/En/ax.html>>.



damages property and infrastructure, particularly in the Araks, Hrazdan, and Aghstev river basins.<sup>18</sup> A 2004 UNDP report noted that the population density in watershed areas exposed to flooding is about 80 inhabitants per sq. km, creating relative vulnerability, that is, five or six deaths per million people exposed.<sup>19</sup> Among 117 countries, Armenia falls in the middle of the scale of vulnerability and population density in watershed areas. However, this rating fails to capture damage to crops and farmland—Armenia has an average number of people living in watershed areas but the magnitude of lands at risk for flooding is high—estimated at 20-30 percent.<sup>20</sup>

## 1.5 HAIL

Hailstorms are among the greatest natural hazards for the agricultural sector—average annual losses are US\$30-40 million.<sup>21</sup> Some 368 villages are located in hailstorm hazardous areas<sup>22</sup> and an estimated 15-17 percent of Armenia's agricultural area suffers from hail damage.<sup>23</sup> Most recently, 2002 hail damage was so extensive in northern Armenia that the American government provided emergency wheat seed.

## 1.6 DROUGHT, EROSION, AND DESERTIFICATION

Over the past thirty years, Armenia has seen an increase in mean temperature; in hot winds, especially in the Ararat valley, Vayk, and Syunik; and decreased precipitation and humidity.<sup>24</sup> About 15 percent of agricultural territory is prone to drought.<sup>25</sup> In the Ararat valley, hot winds blow for 120-160 days per year and these combined climatic changes have resulted in longer droughts, especially in Ararat lowland and foothill zones. Desertification has increased due to climate changes and increased human activity. Lack of forest management and the 1991 energy crisis created a spike in illegal woodcutting that stripped local forests. During 1990-05, Armenia lost close to 20 percent of its forest cover—some 63,000 hectares.<sup>26</sup> Desertification now threatens some 80 percent of Armenia and severe desertification is a threat in 50 percent of the country;<sup>27</sup> half of the country suffers from erosion, according to the Armenian Rescue Service.

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<sup>18</sup> Drought - Management and Mitigation Assessment for Central Asia and the Caucasus (Wash., DC: World Bank, 2006).

<sup>19</sup> United Nations Development Programme, Reducing Disaster Risk a Challenge for Development (New York: UN, 2004).

<sup>20</sup> Armenian Rescue Services, September 14, 2008 <<http://www.ema.am/En/ax.html>>.

<sup>21</sup> UNISDR. National Report on Disaster Reduction in the Republic of Armenia, for the World Conference on Disaster Reduction (Kobe: UN, 2005).

<sup>22</sup> Armenian Red Cross Society, Contingency Planning Process, Final Document (Yerevan: Red Cross, 2007).

<sup>23</sup> Armenian Rescue Services, September 14, 2008 <<http://www.ema.am/En/ax.html>>.

<sup>24</sup> Armenia Ministry of Nature Protection, National Action Programme to Combat Desertification in Armenia (Government of Armenia, 2002).

<sup>25</sup> Armenian Rescue Services, September 14, 2008 <<http://www.ema.am/En/ax.html>>.

<sup>26</sup> Mongabay, September 14, 2008 <<http://rainforests.mongabay.com/deforestation/2000/Armenia.htm>>.

<sup>27</sup> Drought - Management and Mitigation Assessment for Central Asia and the Caucasus (Washington, DC: World Bank, 2006).

## 2. SOCIAL AND ECONOMIC IMPACT OF NATURAL DISASTERS IN ARMENIA

### 2.1 SOCIAL IMPACTS OF DISASTERS

Among the countries of the Europe and Central Asia (ECA) Region, Armenia is the most exposed to natural hazards. In 10 of the 28 countries in the region, 7.0 percent of the population is exposed to natural catastrophic events—those with a probability of occurrence of 0.5 percent or less. In Armenia, Azerbaijan, Lithuania, Moldova, and Tajikistan, more than 30 percent of the population is exposed to catastrophic events. However, even in this at-risk group Armenia stands out because more than 80 percent of the population exposed.<sup>28</sup>

Natural disasters can destroy social networks and economic performance. The immediate aftermath of a disaster includes unbearable human suffering—injury and death of loved ones, lack of shelter, and scarcity of food and water. The longer-term social consequences of economic disruption include the loss of household income, unemployment, and lack of access to health care; school disruptions can harm long-term human development and community welfare; and persistent psychological trauma impairs entire communities.

Twenty years ago, Armenia's northern region suffered one of the most destructive earthquakes of the century around the city of Spitak, damaging housing, factories, community facilities, and infrastructure. More than 20 regional centers and towns and 342 villages incurred damage, some 25,000 people died, 19,000 were injured, and an estimated 530,000 were left homeless; 190 schools collapsed, killing 6,000 children; 917 schools were destroyed.

Years after, the earthquake-affected zone still suffered severe shortages of shelter, basic infrastructure, industrial facilities, and other essential components of a functioning economy. Five years after, unemployment ran as high as 75 percent. Tens of thousands of families continued to live in temporary communities in shelters adapted from rail cars, large fuel tanks, and container-like steel boxes intended for temporary workers that had been supplied by the Soviet Union immediately after the earthquake. Spitak had no piped water; temporary houses, which lacked heating and insulation, had interior temperatures that dropped to below freezing during the harsh winters. Marginal access to sanitation exposed some temporary communities to severe environmental and health risks. Six years later, children whose parents had died in the disaster were still suffering from depression and post-traumatic stress syndrome.<sup>29</sup> The long-delayed reconstruction efforts, high unemployment, weakened

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<sup>28</sup> Christopher Pusch, Preventable Losses: Saving Lives and Property through Hazard Risk Management - A Comprehensive Risk Management Framework for Europe and Central Asia. Disaster risk management working paper series, no. 9. (Washington, DC: World Bank, 2004).

<sup>29</sup> A. Goenjian, D. Walling, A. Steinberg, A. Roussos, H. Goenjian, R. Pynoos. Depression and PTSD symptoms among bereaved adolescents 6.5 years after the 1988 Spitak earthquake. Journal of Affective Disorders, Vol 112, Issue 1, Pages 81-84.

morale, and eroded confidence contributed to increased crime rates in some communities. The dissolution of the Soviet Union exacerbated these grave problems; lacking an effective government response, the social impacts of this large-scale disaster were overwhelming.

Natural disasters have weakened Armenia's social fabric. Over a five-year period, landslides left more than 2,000 families homeless.<sup>30</sup> Drought has destabilized Armenia's food production. In 2000, drought caused extreme crop losses—almost 300,000 people required food aid—45 percent of the population in drought-affected areas. Extreme drought reduced the drinking water supply by 35-40 percent. In 2001, the drought continued and emergency relief operations were necessary to help 140,000 people.<sup>31</sup> In late December 2002, nine consecutive days of unusually harsh frost severely damaged vines and trees on about 10,000 ha of vineyards and more than 13,000 ha of orchards in the Ararat Valley. Following the first winter storm on December 14, temperatures in the Ararat valley fell to minus 16-18°C within two to three days. After a second storm on Dec. 28-29, temperatures dropped to minus 27-32°C and to minus 35°C on the snow surface. Tree, vine, and first-year production losses were valued at almost 15 billion drams (US\$26 million) affecting some 75,000 farmers.<sup>32</sup> In almost every region of Armenia, flash flooding occurs; in some areas, such as the river basin of Meghri and Vedi and near Goris, flooding occurs once every two to three years. Floods occur mainly in the northward forested slopes of Armenia's mountain ridges, and the rest of the country experiences mainly mud flows. Snowmelt accompanied by rainfall is a risk factor for both flooding and mudflows. April to August is typically the most dangerous period for floods, but flooding appears to have increased over the last several decades due to deforestation and urbanization.<sup>33</sup>

## **2.2 POTENTIAL ECONOMIC LOSSES**

A general assessment of the economic impacts of catastrophic and frequently occurring natural disasters appears below. To prioritize use of disaster funds, Government may want to conduct a detailed study of the economic impacts of natural disasters.

### 2.2.1 Economic Loss from Catastrophic Events

Armenia's experiences amply demonstrate that catastrophic events can cause billions of dollars of damage and economic losses. In 1988, the Spitak earthquake created an

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<sup>30</sup> Christopher Pusch, *Preventable Losses: Saving Lives and Property through Hazard Risk Management - A Comprehensive Risk Management Framework for Europe and Central Asia*. Disaster risk management working paper series, no. 9. (Washington, DC: World Bank, 2004).

<sup>31</sup> World Bank. *Drought - Management and Mitigation Assessment for Central Asia and the Caucasus* (Washington, DC: World Bank, 2006).

<sup>32</sup> Report. *Additional Financing for the Agricultural Reform Support Project* (Washington, DC: World Bank, 2003).

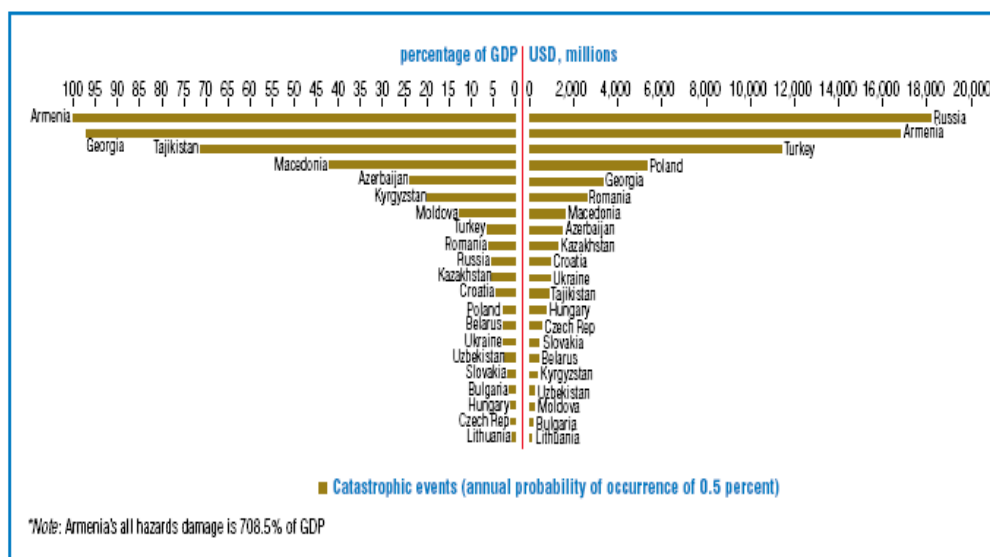
<sup>33</sup> Report. *Flood Forecasting for Armenia, Georgia, Azerbaijan* (Washington, DC: World Bank, 2005).

estimated US\$15–20 billion of economic damage.<sup>34</sup> The earthquake crippled the economy of northern Armenia, primarily industries important to the Soviet Union, including tool-making and large chemical plants. Over 40 percent of the country’s manufacturing capacity was destroyed and the earthquake halted operations of 170 industrial enterprises. The earthquake coincided with the dissolution of the Soviet Union, making economic transition even more difficult for Armenia.

Armenia’s geography almost guarantees future catastrophic events. Earthquakes with magnitudes of at least 5.5 recur on average every 30 to 40 years.<sup>35</sup> Therefore, Armenia’s potential loss from catastrophic events is enormous. A 2004 World Bank report on disaster risk management for Europe and Central Asia noted that anticipated economic loss from catastrophic events with a 0.5 percent annual probability of occurring would exceed 700 percent of national GDP (Fig. 2).<sup>36</sup>

Figure 2. Potential Economic Loss from Catastrophic Events

Figure 2.3: Economic loss potential



### 2.2.2 Economic Loss from Frequent Disasters

Every year natural disasters cost Armenia millions of dollars, in particular, hydro meteorological events such as drought, strong winds, hail, and heavy precipitation.

<sup>34</sup> Christopher Pusch, Preventable Losses: Saving Lives and Property through Hazard Risk Management - A Comprehensive Risk Management Framework for Europe and Central Asia. Disaster risk management working paper series, no. 9. (Washington, DC: World Bank, 2004).

<sup>35</sup> Mikayel Melkumyan, Seismic Risk Assessment and Mitigation Strategy in Armenia.

<sup>36</sup> Numbers are based on a 2002 GDP of US\$2.37 billion. Since then, GDP has grown to US\$9.2 billion in 2007.

For example, the 2004 floods caused an estimated US\$10 million damage and the 2005 floods, around US\$5.0 million.<sup>37</sup>

A recent climate change study reviewed the last 30 years of hydromet events and determined that hydromet disasters have increased by 1.2 cases annually. The World Bank estimated that the annual cost of damages caused by hydromet events was US\$120 million.<sup>38</sup> Specifically, landslides that damage buildings, transportation routes, and agricultural areas, cause about US\$ 11.5-13.0 million. Moreover, mudflow damages are around US\$5.7-7.1 million.<sup>39</sup>

Table 2 shows that 30 percent of Armenians are exposed to “common” disasters—defined as disasters that exceed a probability of 5.0 percent. Damage from these is estimated to be 1.5 times Armenia’s annual GDP. More than a quarter of Armenia’s GDP will be absorbed by disasters that exceed a 20 percent probability.<sup>40</sup>

*Table 3. Potential Economic Loss*

### Economic Loss Potential

Annual Exceedance Probability	Economic Loss (US\$, mln)	Percentage of GDP
0.5%	16,800	708.5%
5%	3,600	153.6%
20%	400	16.4%

#### 2.2.3 Impact of Disasters on Armenia’s Agricultural Sector

In 2008, agricultural production contributed 17 percent of Armenia’s GDP and employed 52 percent of the total labor force. The impact of natural hazards on agricultural production is significant: the World Food Program (WFP), the lead United Nations agency for emergency food relief, lists earthquakes, deforestation, desertification, erosion, winter frosts, floods and droughts as the top risks to food security in Armenia.<sup>41</sup>

<sup>37</sup> Armenian Red Cross Society, Contingency Planning Process, Final Document (Yerevan: Red Cross, 2007).

<sup>38</sup> H. Melkonyan. The results of climate change investigations in Armenia 8th Annual Meeting of the EMS / 7th ECAC, EMS8/ECAC7 Abstracts, Vol. 5, EMS2008-A-00175, 2008.

<sup>39</sup> Armenian Rescue Services, October 1, 2008 <<http://www.ema.am/En/ax.html>>.

Estimated based on 350AMD/1US\$ exchange rate.

<sup>40</sup> Christopher Pusch, Preventable Losses: Saving Lives and Property through Hazard Risk Management - A Comprehensive Risk Management Framework for Europe and Central Asia. Disaster risk management working paper series, no. 9. (Washington, DC: World Bank, 2004).

<sup>41</sup> World Food Programme. 13 Sept 2008.

[http://www.wfp.org/country\\_brief/indexcountry.asp?country=051#Facts%20&%20Figures](http://www.wfp.org/country_brief/indexcountry.asp?country=051#Facts%20&%20Figures)>.

Hailstorms cause tens of millions of dollars of damage for farmers each year and drought is a constant risk.<sup>42</sup> For example, the extreme drought of 2000 caused an estimated US\$67 million damage to agriculture, triggered a seed shortage the following year, and a further US\$43 million loss in agricultural production<sup>43</sup> during a time when agriculture accounted for 42 percent of employment and one-third of GDP.<sup>44</sup> In 2006, a localized drought decreased cereal crop production by more than 35.5 percent from the previous year,<sup>45</sup> which forced Armenia to import cereals to meet their requirement of 597,000 tons.<sup>46</sup>

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<sup>42</sup> Armenian Technology Group, 13 Sept 2008,

<[http://www.atgusa.org/News.64/current\\_category.27/news\\_detail.html](http://www.atgusa.org/News.64/current_category.27/news_detail.html)>.

<sup>43</sup> World Bank. Drought - Management and Mitigation Assessment for Central Asia and the Caucasus (Washington, DC: World Bank, 2006).

<sup>44</sup> Food and Agriculture Organization, Special Report FAO/WFP Crop and Food Supply Assessment Mission to Armenia (2000).

<sup>45</sup> In 2005, Armenia produced 378,000 tons, which dropped to 244,000 tons the following year.

<sup>46</sup> World Food Programme, October 2, 2008.

<[http://www.wfp.org/operations/current\\_operations/project\\_docs/100532.pdf](http://www.wfp.org/operations/current_operations/project_docs/100532.pdf)>.

### **3. INSTITUTIONAL FRAMEWORK AND CAPACITY TO MANAGE RISK AND RESPOND TO EMERGENCIES**

#### **3.1 OVERVIEW OF RISK REDUCTION AND EMERGENCY MANAGEMENT**

Armenia's transition from a Soviet Republic to an independent nation had enormous political and economic implications, including an opportunity to develop new institutions better suited to Armenia's culture, geography, and politics. The country needed to develop a new system that included local accountability and an enabling environment for private development, and abandon the centrally controlled approaches of Soviet-style bureaucratic structures, lines of responsibility, and norms and standards that had been one-size-fits-all among all the Republics.

In 1988, the Spitak earthquake struck in northern Armenia just as the former Soviet regime was unraveling, reducing assistance to the Republics. As a result, Armenia faced this disaster of unprecedented proportions that left thousands of people homeless amidst unfinished reconstruction. The earthquake provided a harsh lesson: Armenia must strengthen its risk reduction and emergency management measures because it had no experience in disaster management and had no management unit for seismic risk reduction.<sup>47</sup>

In the two decades since the 1988 earthquake, Government has passed significant legislation to improve risk reduction and emergency management systems, including laws and measures on risk reduction and emergency management: the Law on Armenian Rescue Service (2005); the Law on Rescue Forces and Status of Rescuers (2004); the Law on Civil Defense (2002); the Water Code (2002); Law on Seismic Protection (2002); the Law on Fire Safety (2001); the Law on Protection of Population in Emergency Situations (1998); the Law on Protection (1997, revised in 2008); Martial Law (1997, revised into the Law on the Legal Regime of the State of Martial Law in 2006); the Law on Internal Troops (1997); and the Law on Local Self-governing (1996). In addition, design and construction codes and standards were revised and updated to reflect the real seismic hazard and to more correctly determine the seismic loads acting on the buildings and structures (specifically, a new seismic zoning map with corresponding peak ground accelerations, the revised shape of earthquake design spectra, a new system of permissible damage coefficients, and soil conditions coefficients, etc. were introduced). In July 1991, using lessons learned from the Spitak earthquake, Government established the National Service for Seismic Protection (NSSP); and in December 1991, the Emergency Management Administration (EMA). In May 2008, Government adopted a Decree to establish the Ministry of Emergency Situations MoES, and approve its charter and structure.

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<sup>47</sup> Mr. Alvaro Antonyan, Lessons Learned From Spitak 1988 Earthquake Armenian National Survey for Seismic Protection, Armenia.

However, these laws also diffused government responsibility for natural disasters and responding to emergencies among multiple agencies. Some roles are clearly defined and others are not, which has created some confusion and duplication of efforts. Table 4 summarizes existing agency responsibilities for primary hazards.

*Table 4. Role of Organizations in Risk Reduction and Emergency Management.*

	OVERALL COOR- DINATION	FLOOD MITIGATION	SEISMIC RISK REDUCTION	LANDSLIDE MITIGATION	HAIL PRO- TECTION	EMERGENCY RESPONSE
MoES	X				X	
<i>MoES/ARS</i>						X
<i>MoES/ASH</i>		X				
<i>MoES/NSSP</i>			X			
MoNP/WRMA		X				X
MoA		X		X		
MoTA/SCWM		X				
Municipality			X			X
MoUD			X	X		
MoE			X			
ARC						X

### **3.2 REVIEW OF INSTITUTIONS RESPONSIBLE FOR RISK REDUCTION AND EMERGENCY MANAGEMENT**

Below is a description of each agency with responsibility for risk reduction and emergency management. Chapter 4 addresses institutional capacity and government challenges.

- **Ministry of Emergency Situations**

In 2008, Government established the Ministry of Emergency Situations (MoES) and outlined three priorities for emergency mitigation, preparedness, and response/recovery: (i) develop a program for risk assessment and emergency preparedness; (ii) respond to and aid recovery from emergencies; (iii) coordinate a government-wide policy on risk mitigation. The MoES will coordinate the development of joint, multi-agency emergency management policies to support these priorities.

Governmental organizations that were formerly independent or under other Ministries' mandates are now under the MoES structure, including the National Survey for Seismic Protection (NSSP); the State Reserves Agency; National Center for Technical Security (NCTS); Armenia State Hydro-meteorology and Monitoring (ASH) SNCOs; and ARS is supervised by MoES.



- **National Survey for Seismic Protection, MoES**

In 1991, Government established the National Survey for Seismic Protection and developed two national programs: “Seismic Risk Reduction in Armenia” and “Seismic Risk Reduction in Yerevan City.” The NSSP coordinates the development and implementation of the Seismic Risk Reduction Strategy, which means monitoring seismic data, assessing seismic risk, determining vulnerability, and developing public awareness.

The national multi-parameter observation network of NSSP includes more than 150 stations integrated into the regional and global networks. The NSSP operates a monitoring system (Armenian Strong Motion Network) of 24 field stations and 30 structure-related stations. Six use modern digital accelerographs, installed since 1991, and another 48 use analog instruments, installed during 1993-02. The “Garni” seismological station is internationally certified and the only station in the region that conducts daily monitoring. The NSSP plans to expand and upgrade the network with Swiss Seismological Service assistance. The system is operated in cooperation with the Consortium of Organizations for Strong Motion Observation Systems (COSMOS, USA) and the Swiss Seismological Service.

The NSSP has planned an Earthquake Early Warning System (EEWS) for Yerevan city; the design is complete, but lack of funding has delayed implementation; the EEWS consists of 14 field seismic stations located in a 30 km radius of the city, with alarms that transmit to the Central NSSP Receiving Station.<sup>48</sup> The NSSP manages monitoring of Armenian building types. Accelerographs have been installed in Yerevan city, which has the highest risk, and Kapan city, the primary industrial center located in the southern Armenia on a 15 degree slope of river canyon. The selected sites include ranges of soil conditions and building structural systems typically found in these cities and throughout Armenia. Seismic monitoring information obtained from buildings is shared among organizations, in particular USGS (USA) and The National Foundation of Science and Advanced Technologies (NFSAT).<sup>49</sup>

- **Armenia State Hydromet, MoES**

Armenia initiated hydro meteorological observations as early as 150 years ago. Armenia State Hydromet (ASH) monitors weather, climate, ozone layer, water resources, and other hydro-meteorological elements; collects, processes, and stores the information; produces projections on dangerous, unfavorable hydro-meteorological phenomena such as floods, storms, extreme rises/drops of atmospheric temperature, hurricanes, thunderstorms, vortexes, dust storms, heavy precipitation, hail, avalanches, freezing, ice-slicks, hard frosts, tempests, heat, hot dry wind, and droughts; and develops weather and hydrological and agro-meteorological projections.

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<sup>48</sup> The EEWS as designed is based on differences of the propagation velocity of electromagnetic waves ( $\approx 300000\text{km/s}$ ) and seismic waves ( $\approx 4\text{km/s}$ ).

<sup>49</sup> Report: Procedure of seismic instrumentation of buildings, Compiled by Dr. Valery Arzumanyan, 2004.

Hydrological activities comprise monitoring water flows in and out of Lake Sevan, water inflow amounts to large reservoirs, 94 observation posts (including four lakes and four reservoirs) of river basin network, daily two-fold monitoring of water elevation, outlets, temperatures, and freezing. An important aspect of agro hydrological information is mass-media public disclosure of projections of heavy frosts and freezing; also, these data are provided to governments, ministries, and agencies. Meteorological observations are made eight times per day by 46 ASH meteorological stations; four stations provide data to international networks, and 20 stations provide information to regional meteorological networks.

Forecasts of dangerous weather and hydro-meteorological phenomena are based on observations of 46 ASH regional meteorological stations and several large weather forecast centers—Meteo-France (France), Met-Office (England), DWD (Germany), RusHydromet (Russia), and analysis of other models, plus local estimation models. The ASH annual funding is about 0.019 percent of GDP, which is insufficient to modernize the system enough to carry out accurate forecasting of dangerous phenomena and predict their intensity so that warnings can be issued in time to decrease potential damage.<sup>50</sup> To be effective, the ASH observation network requires equipment, information systems on meteorology, hydrology and agro-meteorology, a modern radiolocation meteorological system, satellite information, and communication channels.

Data collection and transfer, map generation, communications with difficult-to-access mountainous meteorological stations are now performed using telephones, high-frequency telephones, telegraph communication lines, satellite communication, and the Internet. Shortwave and ultra-shortwave radio communication used to collect and transmit information is established with several meteorological stations that are mountainous and difficult-to-access, including Pushkin Pass, Vorotan Pass, Aragats, and Hamberd, but maintaining these radio stations and equipment in working condition requires constant repairs.

- **Anti-Hail, MoES**

Although hail prevention is now under the Ministry of Agriculture (MoA), it will be transferred to the new MoES. In marzes bordering Turkey, MoA has 30 anti-hail stations that transform hail into rain. The new anti-hail system, used in Brazil, Argentina, and France, employs ignited acetylene to break up hail-bearing clouds. Each station protects about 200 hectares from hail damage. Armenia needs to align its anti-hail efforts with the latest scientific techniques to make sure that the resources are used wisely.

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<sup>50</sup> World Bank, Evaluating Economic Benefits of Hydro-Meteorological Services: WB Pilot Study Findings WMO Regional Workshop on Social & Economic Benefits of NHMS's & Related Services to Society, Zagreb, 2007.

- **Armenian Rescue Service, MoES**

The Armenian Rescue Service (ARS), established in 2005 under the MoES, is now the primary organization responsible for emergency management; ARS replaces the State Emergency Management Administration, established in 1991 under the Ministry of Territorial Administration (MoTA). The ARS is the third-largest organization after the Ministry of Defense (MoD) and Police. It maintains public awareness, trains responders, plans for natural disaster responses, and coordinates emergency response and recovery. The ARS has an annual budget of 3.24 billion AMD, 3,700 employees including firefighters, rescuers, and trainers; it supports eight departments, five sections, and detached and regional subdivisions. (See Annex 2)

*State Academy of Crisis Management.* The ARS maintains a State Academy of Crisis Management (SACM) that has an annual budget of 60 million AMD and is the only emergency management school in the Commonwealth Independent States (CIS). The SACM provides vocational education and training, specialized rescue training, higher education courses for bachelor and master degrees, and emergency management education for teachers and students.

*Public Information Center.* The ARS also manages a Public Information Center (PIC) with a mandate to increase public awareness of emergency preparedness through mass media information campaigns and press conferences.

*Rescue Forces Department.* This department coordinates and supervises 24/7 firefighting and special rescue squad operations using four shifts per day. There are 62 firefighting squads (14 in Yerevan) and 11 rescue squads (one in Yerevan). Each squad comprises six firefighters, who are required to pass SACM exams.

- *Special Rescue Unit.* Assists firefighters using specialized teams such as Rapid Response Rescue Teams for national and international disasters such as the Iranian earthquake.
- *Water rescue teams.* These cover Lake Sevan and Armenia's 83 reservoirs.
- *Mountain rescue teams.* These includes mine rescue.
- *Chemical and bio response teams.* (Radiological response falls under MoD).

The SACM provides regular and periodic search and rescue training, and issues qualifications and certifications. Finland and the United States have also provided international search and rescue training. Rescue services test their emergency preparedness by carrying out eight to ten annual exercises; two exercises are for earthquake responses.

Armenia has volunteer disaster response groups and the Red Cross establishes a Volunteers Recruitment Mechanism when disasters occur.

*Center for Crisis Management.* To manage emergency responses, ARS established the Center for Crisis Management (CCM), which has 51 staff and operates 24/7 under the Department of Operations Management. The CCM has direct, fixed lines to fire stations, administrative agencies, and each marz; dispatching centers in each marz are structurally under the regional services but operationally, they report to CCM.

The CCM is an emergency call center and an emergency operations center that services all calls related to accidents and emergencies; organizes all notification and warnings to administrative bodies and the public; notifies international entities of transborder emergencies, as per international agreements; collects and provides information to public administrative bodies; and dispatches CCM task forces to manage emergencies.

In 2007, Armenia established a telephone number for emergencies but the country still lacks a national emergency call/dispatch system like the European ‘112’ or the American ‘911’ system. Instead, there is a separate number for each service—fire is 101, police 102, and ambulance, 103. Daily, the CCM receives emergency calls and its executive cell selects an appropriate response, then dispatches firefighting, rescue, or other emergency service.

- **Ministry of Nature Protection**

The MoNP is responsible for elements of disaster management and has a role in flood, drought, and landslide mitigation.

- *State Inspectorate for Nature Protection, MoNP.* The SINP supervises implementation of nature protection legislation. Activities include protection, environmental recovery of air, water, land (adherence to restrictions and norms; and implementation of nature protection measures for land to prevent water and wind erosion, swamping, salination, and landslides among others. The SINP also oversees mines, fauna and flora, use of natural resources, safe use of hazardous materials and wastes, and prevention of environmental pollution.

- *Water Resources Management Agency, MoNP*

The WRMA was established in 2003 and is responsible for issuing and enforcing water use permits and establishing water quotas, especially droughts. The WRMA collects data on water flow and intake quantities; monitors groundwater and discharged water quality to detect for contamination from metals or other elements; and estimates the value of

environmental outflows. The WRMA, within its authorities, coordinates development activities—reviewing annual revisions of the national water management plan. The WRMA has five regional branches that monitor water quality, quantity, industrial capacities, water level fluctuations, and capacity of water flow.

- *Landslide Mitigation, MoNP*

The MoNP also has a small role in landslide protection. They assist in the development of landslide mitigation policy.

- **Ministry of Agriculture**

The Ministry of Agriculture is responsible for eight functional areas that include plant cultivation, forestry and management of flooding (see Appendix 2 for organization chart).

- *Landslide Mitigation, MoA*

Landslides that affect water systems such as rivers or canals are the responsibility of MoA. Landslides that affect transportation infrastructure such as roads or railways are the responsibility the Ministry of Transport and Communication (MoTC). The Ministry of Urban Development (MoUD) is responsible for recommendations on resettlement of landslide-prone areas and engineering improvements. The MoA is studying landslide mitigation options, including the possibility of resettling landslide-prone areas, and engineering improvements.

- *Soil Utilization and Improvement Department, MoA*

This unit is responsible for three major functions: policy on agricultural land use and reclamation; coordinating activities to improve fallow land use, agricultural lands and pasture management; coordinating programs to prevent submergence, saturation, and flooding of agricultural land. Government has authorized the MoA to mitigate and prevent flooding to protect communities and valuable economic zones, specifically by strengthening river banks. To accomplish this in the medium term (two years), the MoA has set aside 2.53-3.5 million AMD, and 29 billion AMD for 2008-14.

## **Ministry of Territorial Administration**

- *State Committee of Water Management, MoTA*

The SCWM regulates drinking water, irrigation, and land reclamation/drainage. For irrigation, SCWM regulates discharge of water from reservoirs and receives an annual budget transfer of 5.0 billion AMD from the central government to clean the canals, which is insufficient. The SCWM has ongoing projects to rehabilitate Armenia's dams and irrigation canals, implemented with World Bank support. These Bank-financed projects

(Dam Safety Projects I and II), are installing early warning systems in villages around the dams and reservoirs, and developing evacuation plans for local people. During an overflow, the SCWM would coordinate with the Armenian Rescue Service (ARS) on preventive measures such as evacuation. In a dam or reservoir emergency, SCWM staff contacts ARS directly. The Water Supply Agencies under the SCWM are responsible for dam operation and maintenance; the SCWM does not intervene operationally in serious emergencies, except to inform the ARS so they can intervene.

- **Ministry of Urban Development**

The MoUD is responsible for the Law on Urban Development, and normative acts regulating issues for development, expert review, coordination and approval processes for spatial and architectural planning, and implementation/construction. The Ministry is responsible for spatial planning—a critical function for an area with disaster risks. The existing system includes about 1000 normative documents for codes, standards, regulations for planning and developing residential areas, design and construction of buildings and facilities, and technical requirements for construction—most of these specify Soviet standards, which do not conform to international standards and need to be streamlined and harmonized

The MoUD is responsible for improving urban development legislation, including building codes for earthquake-resistant construction, which are crucial to reduce seismic risks.<sup>51</sup> Following the 1988 Spitak earthquake, nationwide seismic reassessment was conducted and new seismic maps were developed, resulting in upgrading seismic impact intensity by 1-2 points over the territory and buildings and facilities. Then, new national building codes for earthquake-resistant construction were developed to incorporate specifications for rubber/metal layered structures for seismic protection. Normative technical documents were also developed; in 2007, the “National Standard on Rubber-Metal Base Structures,” HST261-2007, and “Guidelines for Design and Construction of Buildings with Rubber/Metal Base Structures,” were approved. The MoUD is responsible for nationwide landslide management, including providing information and technology to entities concerned with landslides. However, an ARS report noted that the many programs on the prevention of landslides lack funding.<sup>52</sup>

- **National Institute of Metrology, and National Institute of Standards, MoE**

The National Institute of Metrology, and National Institute of Standards, CJSC, are responsible for issues linked to developing standards, and metrology, covering products and materials, including building materials. The National Institute of Standards belongs to the International Organization for Standardization (ISO) and CEN, the European Committee for Standardization. Some 25 testing firms are now certified in Armenia for materials testing.

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<sup>51</sup> See Annex 2 for a discussion of seismic mitigation issues and details of regulatory and legal procedures.

<sup>52</sup> Armenian Rescue Services, October 1, 2008 <<http://www.ema.am/En/ax.html>>.

- **Armenian Red Cross**

The ARCS has a nationwide structure for disaster management that includes 13 ARCS disaster coordinators for 10 marzes, Yerevan city, and two territorial centers. The ARCS is considered a governmental auxiliary organization, and in 1998, the ARCS and ARS signed a Memorandum of Agreement specifying cooperating roles for each organization during emergencies.<sup>53</sup> During emergencies, the ARCS director is on the National Committee of Emergencies and at the regional level, the ARCS Regional Director is on the Regional Commission on Emergencies. There are 12 rapid response teams with about 170 staff and volunteers in the ARCS disaster preparedness and response structure, which includes alarm systems established at national and regional level. The ARCS develops and delivers training on basic rescue, logistics, and needs assessments, and has stockpiled sufficient emergency relief goods to serve 2,500 people.

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<sup>53</sup> The Armenian Red Cross Society (ARCS) was established on March 19, 1920. In 1992, Government declared the ARCS the only Red Cross National Society acting in Armenia.

## **4. CHALLENGES AND OPPORTUNITIES FOR RISK REDUCTION AND EMERGENCY MANAGEMENT**

Government created the MoES with a mandate that encompassed developing a program for risk assessment and emergency preparedness, carrying out emergency response and recovery, and coordinating government-wide policy on risk mitigation. Government transferred existing emergency management organizations such as NSSP, ASH, ARS, NCTS, anti-hail, and the State Reserves, to MoES, with the intention of improving coordination. However, amalgamating multiple organizations creates challenges for programmatic issues such as equipping and training emergency response forces, and developing a nationwide strategy for mitigation and response. The MoES now needs to review its overall organization to detect responsibilities and activities that overlap among Ministries and determine whether these can be merged to save scarce resources, and then prioritize activities to guarantee budget coverage for the most important.

The following chapter discusses strategic challenges and areas for improved risk reduction and response in the country.

### **4.1 CHALLENGES AND OPPORTUNITIES FOR RISK REDUCTION**

#### **4.1.1 Developing an Integrated Mitigation Framework**

In Armenia, risk reduction has faced some major obstacles. For example, until the MoES was established, no central agency existed to coordinate cross-sectoral, government-wide mitigation measures. Now that MoES is operating, it is prudent to consider strengthening the agency's capacity to develop and coordinate a government-wide policy on risk mitigation needs.

Existing overlap and duplication in responsibilities and mitigation actions across government agencies should now be rationalized and consolidated. For example, Armenia needs to develop a centralized database for hazards and risks and a comprehensive nationwide all-hazard map, and a national risk-reduction platform that identifies countrywide risks, assesses vulnerability, determines priorities, and assigns tasks to mitigate the risks based on these priorities. These would be essential elements of a national comprehensive disaster risk management strategy that would include short-term and long-term mitigation policies and measures.

#### **4.1.2 Harmonizing Building Codes**

Since 1992, some former Soviet-era building regulations have been updated to reflect Armenian conditions, and modern methods and technologies. However, the MoUD believes the regulations, while technically sound, need to be revised and harmonized with international standards, notably those of the European Union. Existing urban development standards and norms in Armenia comprise a patchwork of documents that include some former USSR standards and some updates. The MoUD



recommends a thorough review to update and consolidate norms to international standards, adapted to Armenia, through the following steps:

- Evaluate, compare, and analyze Armenian normative and technical frameworks and best practice in several European countries to develop an overall concept to adopt.
- Elaborate and implement a comprehensive reform program for Armenian normative/ technical systems.
- Develop an implementation plan for comprehensive programs to address environmental issues that emerge during construction projects.

#### 4.1.3 Strengthening Enforcement of Buildings Codes

In most countries, enforcing building codes is often the weakest link in the regulatory chain and this is true for Armenia. During the building design process, adherence to building regulations is monitored through a series of expert design reviews, including by private entities certified by the MoUD. Municipalities/ Governor's offices carry out site inspections and issue completion certificates, with MoUD oversight. Technical Monitors carry out inspections to ensure structural integrity and safety and recent changes to the Law on Licensing allow the MoUD to issue for this activity. The MoE is responsible for certifying products and materials. However, frequently the inspections are superficial and construction does not conform to the approved design. This requires a review of the entire construction process to detect weak links—from design approval to technical monitoring and inspections. To improve construction quality, additional building code training is recommended for everyone in the construction process—designers, construction company engineers, and technical monitors.

#### 4.1.4 Strengthening Supervision of Design and Construction.

The independence and competence of technical monitors are crucial to seismic mitigation as is the rigor and transparency of inspection procedures. The processes of training and licensing of technical monitors should be reviewed and any remedial training needs identified. Armenia requires a state, technical, and authors' (designer') construction-quality monitoring, but according to an MoUD Inspection Department official,<sup>54</sup> enforcement of these requirements needs strengthening in the following four areas:

- reduce duplication and increase clarity of legal requirements
- clarify responsibilities of the State Urban Development Inspectorate and governors
- simplify the construction permit process and make it more transparent
- create a division between the authority of governors and local officials.

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<sup>54</sup> Musegh Havhannisyanyan, Deputy Chief of the State Urban Development Inspectorate, MUD: "Outline of Building Codes and Control Systems in Armenia—Features and composition of the building code, administrative provision, and building confirmation process."

To improve construction quality and inspection, the MoUD should develop and implement detailed qualitative and quantitative technical specifications for building components and assembly, including the construction sequence, based on existing codes and standards for each type of construction—a quality assurance system that is widely practiced around the world but almost entirely lacking in Armenia. These standard technical specifications then become legally binding and mandatory for developers and builders, and reduce arbitrary decisions regarding construction inspections, permits, or licenses.

#### 4.1.5 Seismically Vulnerable Construction and the High Cost of Retrofitting.

After the 1988 Spitak earthquake, seismic hazard assessment and building codes were revised. The Peak Ground Acceleration (PGA) accepted for design purposes on most of the territory of Armenia was equal to 0.4g, while for buildings constructed before the Spitak earthquake the PGA was equal to 0.1-0.2g.<sup>55</sup>

Construction methods based on Soviet standards and technical norms—a “one-size-fits-all” concept—never sufficiently accounted for Armenia’s high seismicity—and consisted of traditional masonry in local stone or heavy industrially produced prefabricated elements assembled on site. The elements’ quality was satisfactory but site assembly was prone to human error that produced seismically unreliable joints. Although many of these buildings, mainly residential, are still used, this “one-size-fits-all” construction system is no longer permitted and has been replaced by cast-in-place reinforced concrete. The influence of private investment and international construction firms and methods has improved construction techniques and quality.

Government is aware of the need for a strategy to strengthen existing buildings, develop a comprehensive, prioritized list of critical facilities, and the technical and administrative framework to carry out structural interventions. Given Armenia’s budget constraints and evolving institutional environment for disaster management, assistance is needed to develop the framework necessary for seismic retrofitting.

Other countries in the region, such as Romania and Turkey, have developed administrative and technical strategies to strengthen existing critical public facilities—schools, hospitals, government administration facilities, particularly disaster management offices and other public safety command centers. Armenia’s prioritization criteria are not yet developed but the MoTA has begun to coordinate inputs, including expert recommendations from the MoUD and MoES.

Schools are an obvious priority because they also serve as emergency shelters, temporary hospitals, and dormitories after a disaster. Similarly, hospitals are crucial and must be accessible by road and helicopter. Therefore, priority selection criteria should target high-risk public facilities with maximum live-saving potential, and facilities crucial to emergency management in the disaster response plan.

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<sup>55</sup> Melkumyan, *Seismic Risk Assessment and Mitigation Strategy in Armenia*.

Schools and hospitals under State rehabilitation through the MoUD are receiving only “seismic upgrading,” which is not equivalent to current seismic requirements. Existing building codes require school buildings, and hospitals with fewer than 100 beds, to meet requirements that were in force when they were constructed, and for hospitals with more than 100 beds, “seismic upgrading” is essential but insufficient to protect buildings from serious damage or collapse during a powerful earthquake. Therefore, these investments are at best ineffective, and at worst, wasteful of scarce resources and offer little protection to schools and hospital occupants.

MoES and a private firm have been working together on a GIS system to build a database of critical information for disaster risk reduction and response. Despite the modest cost, lack of funds has prevented completion and testing.

#### 4.1.6 Cost-Effective Seismic Resistance Design

In earthquake-prone countries, structural soundness is generally achieved through excessively conservative design and overbuilding, which is neither cost-effective nor appropriate. A better option is to adopt more refined concepts and innovative technologies to mitigate seismic effects on buildings and structures, which is increasingly the preferred solution. However, innovative technologies are often mistakenly branded with a reputation for being more expensive, which has constrained their use. Knowledge of modern, cost-effective anti-seismic engineering technologies among Armenian decision makers varies—some are fully aware of advances and Armenia’s role in developing them, but more needs to be done to expand their numbers and increase their awareness.

For example, seismic isolation is an innovation that has been used successfully in several countries, including Armenia. The concept is to simultaneously reduce floor accelerations (seismic forces acting on a structure) and inter-storey drifts, rather than designing the structure to resist the large seismic impact. Armenia has used this technology with the application of seismic isolation laminated rubber steel bearings (SILRSB) manufactured in the country. This technology offers significant cost savings over conventional construction methods for bearing structures—up to 35-40 percent in new construction, and as high as 2.5-3.0 times in retrofitting.

Armenian design and construction norms are reputed to be technically correct. However, reviewing these norms could identify potential cost savings for seismic mitigation measures, including introducing risk management concepts, and performance criteria such as “permissible maximum damage” for different types of structures; cost-benefit analysis during the design process; and design-review mechanisms for newly constructed and retrofitted structures (i.e., more innovative and cost-effective designs).

Risk management could define acceptable damage levels for types of structures and relate them to costs. Preventing structural collapse that causes injuries and deaths to citizens is paramount, but protection against *all* damages might be affordable *only* for

facilities and other structures that must continue to function during a disaster, such as hospitals, schools, and disaster response units. Using more cost-effective designs would meet acceptable risk-management criteria and conserve resources so more structures could be retrofitted.

As Armenian design and construction norms undergo professional development, it should become routine to assess and include alternative technical devices and design concepts and use cost-benefit analyses to select the most appropriate state-of-the-art and cost-effective solutions for retrofitting or new construction. Innovative seismic isolation designs can be used to preserve architectural features of historic structures.

#### 4.1.7 Developing a legal framework to regulate building use and maintenance.

One structural safety concern is the lack of a comprehensive legal framework or regulations for building use and maintenance, including public facilities and multi-apartment buildings, and in particular, for seismic isolated buildings, to ensure their seismic isolation systems remain uncompromised. At present, several commonplace threats exist to building structural integrity. First, is the widespread practice of multi-apartment building tenants carrying out arbitrary changes to building structural elements. Second, is the scarcity of funds for regular building maintenance that leads to deterioration of bearing structures. Both of these commonplace phenomena compromise seismic reliability and radically increase building vulnerability.

#### 4.1.8 Rehabilitating Irrigation Systems

Following the dissolution of the Soviet regime (1991), the Armenian irrigation system appeared to be on the brink of collapse due to lack of operation and maintenance, insufficient state funding, and the insolvency of new owners of small land plots.<sup>56</sup> However, the World Bank and the Millennium Challenge Corporation (MCC) funded rehabilitation projects for dams and reservoirs, and in 2002, Armenia adopted a Water Code to regulate water management. However, a recent UNDP study notes that except for Lake Sevan, annual operations and maintenance (O&M) are yet to be integrated with long-term plans.<sup>57</sup>

Recently, the irrigation sector completed a reform program that increased knowledge among users of the irrigated area, irrigation needs, and cost-recovery rates. The reform program introduced Participatory Irrigation Management (PIM) principles and mechanisms through Water Users Associations (WUAs); decreased overall system O&M costs (primarily reduced energy usage); and improved irrigation infrastructure to increase system efficiency.

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<sup>56</sup> Armenia's irrigation infrastructure comprises 81 reservoirs, some 3,000 km of main and secondary canals, 18,000 km of tertiary canals, 400 medium and large pumping stations, 2,220 tube wells and artesian wells, and 2,000 km of drainage-collectors.

<sup>57</sup> World Bank. Drought - Management and Mitigation Assessment for Central Asia and the Caucasus (Washington, DC: 2006).

Nevertheless, much remains to be done. Nearly 80 percent of the irrigated area is supplied through open channels and the remaining 20 percent through pipelines. Major sections of the irrigation water delivery system are in an advanced state of deterioration. The tertiary systems, originally designed to serve large farms irrigating 50 to 400 ha from a single headgate or canal outlet, have not been retrofitted for the current situation—now a single outlet may serve 300+ farmers, each irrigating less than 1.5 ha, on average.

Although Government rapidly privatized and liberalized most aspects of the agricultural economy, irrigation-related issues remain among the primary and difficult-to-address issues facing the sector. Major issues require urgent attention—policy support, institutional development, and investments. The canals suffer from major build-up because the channels are neither maintained nor cleaned annually and businesses and houses constructed near and over canals obstruct canal cleaning equipment.

Overall, these irrigation system challenges increase costs and natural hazard risks. Neglected irrigation systems and high operational costs have contributed to reducing the cultivated land area by 85,000 ha, about 16 percent, from 1986 to 1994. In addition, water losses from poorly maintained canals can lead to flooding and underground saturation, increasing the risk of landslides, mudflows, and collapsed roads and canals. As mentioned above, JICA theorizes that leakage from domestic and irrigation water supply systems may contribute to landslides. The UNEP reports that improperly built and maintained irrigation, water supply, and sewage systems have created favorable landslide conditions in Yerevan and surrounding towns.<sup>58</sup>

#### 4.1.9 Strengthening Land Use Plan and Regulations

To regulate development, the law mandates communities to prepare two urban development documents—a community master plan that sets forth the main principles for community spatial development, and a zoning map. These documents are critical to avoid undesirable development, construction in unfavorable sites, or deforestation, among other exclusions. Lack of spatial planning documents undermines development, zoning, and construction regulation enforcement.

Community spatial planning documents can prevent the proliferation of development that fails to conform to normative and technical requirements, construction without permits, or violations of sanitary protection zone regulations for water reservoirs and water pipelines that endanger water supply security, and cause erosion, desertification and mudflows.

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<sup>58</sup> United Nations Environment Programme. *Caucasus Environment Outlook (CEO)*. Tbilisi, Georgia, 2002.

## 4.2 CHALLENGES AND OPPORTUNITIES FOR EMERGENCY PREPAREDNESS AND RESPONSE

### 4.2.1 Urgent Need for Comprehensive National Strategy on Disaster Risk Management

Several organizations are implementing emergency management measures in Armenia but so far, the country lacks a *comprehensive* disaster risk management strategy that includes prevention, response, recovery and adaptation measures. While the ARS has response plans for a nuclear incident and earthquakes, there is no overall national response plan that clearly outlines how Government declares a disaster; how state reserve funds are accessed; who leads the national response; and how national and local level governments coordinate emergency response services. Moreover, Ministries with emergency responsibilities report that they have yet to participate in a national exercise to test response plans.

### 4.2.2 Establishing Meteorological and Hydrological Services for Early Warning System

A precondition for a high-quality comprehensive early warning operations system is to provide ASH with state-of-the-art equipment and instruments. Most ASH equipment is now beyond its useful life expectancy, reducing the frequency of hydro-meteorological observations. A 2006 World Bank study noted that since 1991, hydro-meteorological surveys (precipitation, hydro-meteorological measurements of river flows, lakes and reservoir levels) have been cut.<sup>59</sup> To improve early warning system effectiveness, ASH divisions must have state-of-the-art equipment and software to provide quality daily information and increase lead time for warnings to the public, government officials, institutions, and other stakeholders in disaster management.

### 4.2.3 Training the Emergency Response Force

Before assuming employment, a firefighter must take three months of classroom training at SCMA, but most training is on-the-job. Although SCMA has focused training on management, hands-on firefighting, and rescue techniques, a recent Swiss Development Cooperation Agency (SDCA) assessment reported that *most* of Armenia's firefighters had not received training in basic firefighting skills for the past twenty years. Furthermore, firefighters who were trained had to resort to using derelict buildings because SCMA lacks training sites and laboratory facilities for hands-on training. All Emergency Response Force training should be strengthened. Basic train-the-trainer courses are provided through SCMA, but more in-depth training is needed. Similarly, although the CCM participates in SCMA annual training, no courses are designed specifically for CCM duties. Instead, training specific to CCM duties occurs on the job, but CCM would like to establish procedures for training, and require employees to pass examinations.

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<sup>59</sup> Drought - Management and Mitigation Assessment for Central Asia and the Caucasus (Washington, DC: World Bank, 2006).

#### 4.2.4 Equipping the Emergency Response Force

The ARS annual budget is limited to US\$300,000 for all equipment and training of Armenia's emergency response force, which is completely inadequate. Ninety percent of fire vehicles are over 30 years old and need to be replaced; fire stations need to be renovated and seismically reinforced; personal protective equipment needs to be purchased for the safety of responders. A recent visit to a Yerevan firefighting and rescue station revealed that the two fire trucks—a 1978 French vehicle and a 2007 Russian vehicle—are not inter-operable because of different hose connections on each truck; firefighters have to adjust water hoses to use them on both trucks. Personal protective equipment is in short supply and although all firefighters have uniforms, these uniforms are not fire resistant. In fact, there are only three fire resistant uniforms and only three breathing apparatus among 45 firefighters. These breathing apparatus run on compressed air and can be used for only one hour at a time. The firefighters' helmets date to the 1960s, and their boots have not been replaced for over a year due to lack of funding.

The circa 1947 building that houses the firefighters and all of their communications equipment, trucks, and personal protective equipment needs repairs, which is typical of many fire stations. Larger contemporary fire trucks do not fit well in small older buildings. In fact, at one Yerevan fire station, a structural beam was cut to accommodate the height of a fire truck, thus weakening the structure, which was already vulnerable since it has not been retrofitted for seismic events, which could jeopardize emergency rescue operations.

Similarly, the Special Rescue Unit is underequipped. It has only five trucks—all from the 1980s—to transport Rapid Response Teams and only enough equipment for one truck. This means that if the Teams need to switch trucks, all of the equipment—hydraulic pumps, hydraulic scissors, a generator, a hard jack, a hydraulic flat jack, a stretcher and tools—must be moved from one truck to another. The team lacks special personal protective equipment for search and rescue; there are breathing filters (for smoke only), eight fire retardant suits, and one first aid kit.

International donors have helped to equip and train emergency services; the Swedes (SIDA) have pledged a fire truck and equipment to fire and rescue services; SDCA has been working closely with ARS to provide basic training and rescue equipment; ARS is working with the SDCA to establish containers of basic rescue equipment and personal protective equipment in each marz. However, fire stations are still lacking basic requirements.

#### 4.2.5 Establishing Emergency Communications and 112 System

Armenia's 112 system and emergency communications are unable to link responders during an emergency because each emergency service has a separate number. The need for a well-functioning emergency call system such as the European '112' or the American '911' system is urgent—since 2005, calls to CCM have increased ten-fold.

Recently, the Minister of Emergency Situations, committed the Ministry to undertake a 112 Special Services System.<sup>60</sup> Although designs for 112 were prepared in 2003 and upgraded in 2008, challenges to establishing the system include the following: (i) inadequate funding; (ii) the CCM-HQ office only has only three dispatchers and telephones, one computer, and one switchboard; (iii) the office lacks hardware and software to record incoming calls; (iv) a software system is needed that includes GIS to allow the CCM to manage multiple emergencies; (v) four of the automatic phone stations are not digital (all phone stations are expected to be digitalized during 2010); (vi) legislation is needed to implement a 112 system; and (vii) the CCM building is in poor condition and poorly located for uninterrupted telecom connections.

Emergency service communications equipment is needed. Operationally, the CCM owns four vehicles equipped with portable radio lines; one vehicle is a mobile management center that transports command staff and equipment. Firefighters have a direct line from the fire station to CCM and two portable radios per truck; the Special Rescue Unit has portable radios and a direct line to CCM; ARS is working with SDCA to establish shortwave communications among marzes, however, more needs to be done to equip first responders adequately.

#### 4.2.6 Modernizing the Center for Crisis Management

The CCM is the emergency operations center for a national crisis and a dispatch center for daily emergencies. Although both could be housed under one roof, discussions are under way to separate dispatch duties from executive decision making. During a disaster, the CCM is expected to notify Ministries of emergencies, collect and disseminate information to these administrative bodies, and the agencies are expected to gather at the CCM. However, in practice, the CCM has no functioning emergency operations center to fulfill these duties. The existing building lacks a meeting space for Ministry representatives to gather and manage the emergency, and lacks hardware, software, telephones, and furniture.

#### 4.2.7 Increasing Funding for Public Awareness

Ordinary citizens are often the first line of public defense in an emergency—not the police or firefighters. Therefore, public awareness campaigns can provide crucial information on preparing for emergencies. Over the last two decades, the ARS and the NSPP have invested in public awareness, including ARS, NSSP, and Red Cross campaigns that target schoolchildren. In 1997, PIC began broadcasting public awareness messages through television and radio programs called the 'Emergency

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<sup>60</sup> Panorama.am. 2 Oct 2008. <<http://www.panorama.am/en/society/2008/06/10/ain/>>.



Channel,' but lately, lack of funding has curtailed public information campaigns because the technical equipment no longer functions, therefore, the Emergency Channel ceased broadcasting around 2002.

In 2008, with OSCE support, weekly television broadcasts recommenced. Technical assistance was received from OSCE, the UN, and the Swiss Cooperation office in Armenia. A donation of a mobile information center with satellite connection is expected from Kansas, an American State. Weekly Public Radio broadcasts are planned, in cooperation with other radio companies. Over the long term, adequate government funding is needed to sustain the broadcasts.

### **4.3 CHALLENGES AND OPPORTUNITIES FOR FINANCIAL SECTOR**

#### **4.3.1 Offering Disaster Insurance Products**

If Armenia's citizens had more opportunities to purchase disaster insurance products, Government financial risk from disasters would be reduced. However, the country's insurance market is weak. Nine years ago, Armenia's insurance market ranked 10 out of 11 CIS countries.<sup>61</sup> In 2004, Armenia's insurance penetration (gross premiums as a percentage of GDP) was estimated at less than 0.2 percent.<sup>62</sup> In 2005, the International Monetary Fund (IMF) reported that premiums as a percentage of GDP amounted to as little as 0.1 percent, explaining that the insurance sector was underdeveloped and compulsory insurance had not yet been introduced.<sup>63</sup> In 2006, Armenia improved its insurance market by placing the insurance supervision authority under the Central Bank of Armenia (CBA) and rewriting the law on "Insurance and Insurance Activities," which came into force in September 2007. The 2007 net profit of local insurance companies was 743.9 million AMD, according to the CBA.<sup>64</sup> Of these contracts, 37 percent insured automobiles and, 8.0 percent, property.<sup>65</sup> In June 2008, the CBA forecast that 2008 net profit increases for insurance companies would be up to 1.1 billion, up to 1.6 billion AMD in 2009, and 2.0 billion AMD in 2010—a 38.6 percent increase in four years.<sup>66</sup> Despite projected growth, Armenia's insurance market still has major obstacles.

Executive Director of Gosstrakh-Armenia, one of the larger insurance companies in Armenia, outlines four major issues that confront the insurance market. First, although CBA has begun to establish insurance market norms, the country lags other CIS countries by at least 4-5 years. Second, although the middle class supports

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<sup>61</sup> Mu Yibin, Ramin Shojai, Serap Oguz Gonulal, and Lia Aghamyan, "Armenia Banking and Insurance Sector: Key Issues and Recommendations for Development," Working Paper for the Second International AIPRG conference, January 17-18, 2004.

<sup>62</sup> European Bank for Reconstruction and Development. 14 Sept 2008. <<http://www.ebrd.com/projects/psd/psd2005/35839.htm>>.

<sup>63</sup> Ibid.

<sup>64</sup> Arka News Agency. 10 Sept 2008. <http://www.arka.am/eng/economy/2008/06/12/9820.html>.

<sup>65</sup> ArmInfo. 10 Sept 2008. <<http://felist.com/archive/media.arminfo/200711/09115129.text>>.

<sup>66</sup> Arka News Agency. 10 Sept 2008. <http://www.arka.am/eng/economy/2008/06/12/9820.html>.

Armenia's insurance market, a large portion of affluent Armenians has not yet integrated into the insurance system and poorer people do not consider purchasing insurance at all. Therefore, public awareness needs to be raised about Government inability to provide total replacement value or, for small and medium enterprises (SMEs), provide assistance for lost income during recovery. Third, years of unregulated insurance market has destroyed consumer trust, which must somehow be regained. Fourth, there is no policy coordination among insurers; an Association of Insurers has adopted this role, but membership is insufficient to be beneficial.<sup>67</sup> Prime Minister Tigran Sargsyan remarked that, "Development of the insurance and securities markets falls behind that of the banking system, and active reforms are necessary in these spheres."<sup>68</sup>

#### 4.3.2 Addressing State Reserve Fund Shortfalls

The World Bank predicts that Armenia will spend more than a quarter of GDP on common disasters (defined as a 20 percent probability of occurring) and seven times GDP on catastrophic disasters (0.5 percent chance of occurring).<sup>69</sup> Based on 2007 GDP, US\$9.2 billion, Armenia could spend US\$2.3 billion on common disasters and US\$64.4 billion on catastrophic disasters.

Since typical annual allocations to the Government Reserve Fund are five percent of total expenditures envisaged in the budget—obviously insufficient to cover common or catastrophic disasters—Government needs to explore mechanisms to reduce their financial exposure and address funding gaps.

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<sup>67</sup> ArmInfo. 10 Sept 2008. <<http://www.arminfo.info/banks-issue21.htm>>.

<sup>68</sup> Khosq. 2 Oct 2008. <[http://khosq.com/en-us/article/2008/07/12/arab\\_states\\_may\\_move\\_financial\\_center\\_to\\_armenia\\_from\\_lebanon](http://khosq.com/en-us/article/2008/07/12/arab_states_may_move_financial_center_to_armenia_from_lebanon)>

<sup>69</sup> Christopher Pusch, Preventable Losses: Saving Lives and Property through Hazard Risk Management - A Comprehensive Risk Management Framework for Europe and Central Asia. Disaster risk management working paper series, no. 9. (Washington, DC: World Bank, 2004).

## **5. OPTIONS GOING FORWARD**

Government has completed substantial work in emergency management and risk reduction. Over the past decade, Government has worked with international development partners to develop, finance, and implement multiple disaster risk management projects. For example, modern, cost-effective, anti-seismic technologies were introduced and successfully implemented under the World Bank-financed Earthquake Zone Reconstruction project, the Bank's first emergency operation in Armenia in 1993. These seismic isolation technologies have been applied in new construction and retrofitting, financed by donors and the private sector.

Government and the World Bank have worked together to strengthen Armenia's irrigation system by rehabilitating dams and protecting downstream populations from potential dam failure. Early warning systems introduced under World Bank Irrigation Dam Safety Projects I and II, included evacuation plans for populations at risk. Recently, Government worked with the SDCA to provide training to first responders, and Armenia and UNDP collaborated to develop community disaster preparedness projects through public awareness campaigns about disaster risks and how to respond to them.

To maximize the benefits of these accomplishments, Armenia should look at feasible regional approaches such as sharing hydromet data with neighboring countries, capacity transfer on modern cost-effective anti-seismic technologies, and disaster-risk insurance pools, among others. Many areas of disaster risk reduction and emergency management would benefit from closer attention and improvements, which can be phased, initially focusing on priorities that are achievable in the short term, then moving into the medium- and long-term actions that require more investment and preparatory work. The following sections identify areas that could be strengthened, starting with formulating a national disaster risk management strategy to elaborate priorities, based on intersectoral consensus. Obviously, detailed cost estimates for interventions would form part of any future Disaster Risk Management Strategy and associated plans. To assist decision making, this report offers some initial broad cost estimates.

### **SHORT-TERM ACTIONS**

#### Develop National Mitigation Strategy

To ensure a more comprehensive approach to risk reduction, Government could develop a comprehensive national disaster risk reduction and management strategy/platform that identifies short- and long-term goals and measures. Government should develop a strategy to assess nationwide risks (incorporating completed work on seismic and landslide risks) to assess population vulnerability to each risk and prioritize mitigation and emergency management measures. Government should assign responsibilities, budget, and a timeframe to complete each measure, and include these parameters in the medium term expenditures framework

and based on the consultations and agreement of key institutions relevant to disaster risk management.

*Estimated cost: US\$50,000 - US\$100,000.*

#### Strengthen Emergency Response Forces

To respond to any emergency, firefighters need additional training and equipment. First, the SACM facilities/bases should be improved, a site/field for hands-on training exercises should be established with facilities equipped for specific disciplines to conduct vocational education programs and train firefighter/ rescuers. Second, search and rescue equipment and training should be provided so that Armenia has at least one SAR team capable of responding to collapsed buildings or earthquakes. Third, fire vehicles and PPE should be purchased and older vehicles rehabbed.

*Estimated cost: US\$1.0 million-US\$3.0 million*

#### Develop Response Plans

To ensure that national, regional and local administrative bodies and the public know their roles and responsibilities before and during an emergency, Government should consider drafting a national response plan that outlines authorities and actions during a national emergency. This would include protocols for declaring a disaster, use of state reserve funds, and Government continuity. Within the national preparedness system framework, plans should be developed and introduced to identify the rights, roles and responsibilities of stakeholder agencies in emergencies, and complete a joint action plan for agency responders at the site.

*Estimated cost: US\$100,000-US\$300,000*

#### Support Public Awareness

The public should be aware of what to do to help prevent disasters and how to prepare for emergencies. Government should reinvigorate its public information campaign through ‘Emergency Channel’ radio and TV broadcasts and print materials. School programs should be developed and broadcast regularly.

*Estimated cost: US\$100,000-US\$300,000.*

#### Assess Seismic Vulnerability

Risk mapping and vulnerability assessments should be complete for high-priority regions. A program of evaluating seismic risk of existing structures needs to be coordinated, prioritized, and implemented. Armenia should update its 1998 national seismic map and complete micro-zone maps of urban areas to determine which are high-risk. Mapping can be followed by vulnerability assessments of the building stock in selected high-priority regions or cities.

*Estimated cost: US\$500,000-US\$2.0 million*

### Prioritize Seismic Risk Mitigation Investments

Armenia could adopt a strategy and program to prioritize retrofitting among key public facilities such as schools and hospitals to minimize deaths and injuries. Some initial work in identifying the criteria for prioritizing and selection has begun under MoUD and MoES and coordinated by MoTA, assisted by an international consultant, and should continue until an overall strategy and a program for prioritization and retrofitting is completed. This strategy might include assistance to MoES to develop a database on a GIS platform to help determine which facilities are most critical for disaster response operations.

*Estimated cost: US\$200,000-US\$500,000*

### Raise Awareness of Cost-Effective Measures for New Construction and Retrofitting

Government could reduce the financial burden on private and public builders of seismic-resistant construction, by establishing an information program on alternative approaches for modern engineering and construction methods. Since these methods need to be better understood in Armenia, the program might target government officials and construction professionals and include: (a) alternative strategies for seismic design, including techniques of base isolation, energy dissipation, response control systems, etc.; (b) new materials for strengthening; (c) development and use of performance-based criteria; (d) examples of designs for strengthening schemes in use in Armenia and examples of using non-conventional strengthening techniques; and (e) the development and use of Probable Maximum Loss estimates. The program could support workshops and seminars on new retrofitting methods, and provide assistance to develop curricula for engineering universities and other institutions.

*Estimated cost: US\$200,000-US\$1.0 million*

### Launch a Retrofitting Program

After a vulnerability assessment, a program to retrofit critical public buildings is needed. The large scale and high cost of such a program will require cooperation with international development partners and local and international private sectors. The program can start with the most vulnerable schools, hospitals, and emergency response units in selected vulnerable areas.

*Estimated cost: US\$15 million US\$20 million*

### Create a Catastrophe Insurance Facility

The World Bank has considerable experience in helping countries develop catastrophe insurance products. Most recently, the Bank developed a framework for a Southeast and Central Europe Catastrophe Risk Insurance Facility (SECE CRIF), owned by participating countries of the region, each with a representative on its Board of Governors, and managed by a private insurance services company selected through competitive bidding. Distribution and claims settlements will be carried out through locally licensed insurance companies that will be compensated for their services through insurance commissions. It is envisioned that SECE CRIF insurance products will be priced competitively due to its regional risk diversification,

economies of scale, and cost-efficient operations. The SECE CRIF earnings will be used to build catastrophe reserves, thereby increasing financial resilience.

The SECE CRIF framework could be a model for countries that would like to develop catastrophic insurance products. Ultimately, whatever structure is developed for Armenia, the goal will be to tender low-cost, catastrophe insurance products to homeowners and SMEs, which do not exist in Armenia's traditional insurance market. Therefore, the SECE CRIF framework could enable Government to reduce its fiscal exposure to natural disasters by transferring its implicit financial responsibility for private losses to the private insurance market.

Low-cost, catastrophe insurance coverage could include:

- A policy for damages to property and contents from natural hazards such as earthquakes and floods that could be purchased from locally licensed insurance companies participating in the program to supplement homeowners' policies.
- A policy for financial losses sustained by SMEs due to business interruption; damaged business equipment and privately owned business premises, or due to natural hazards such as earthquakes and floods.

To establish a facility, Government will need to help develop an institutional framework, which may require an inter-ministerial group on disaster insurance consisting of CBA, Ministry of Finance (MoF), and other government agencies. Government would also draft laws to establish an insurance facility, analyze existing legislation and, depending on the facility's structure, Government may need to develop new legislation and bilateral agreements with other nations.

Government would also have to develop, adopt, and implement a policy framework for operations. Policies could include: (i) requests to mortgage lenders to require borrowers to purchase catastrophe insurance for the full value of financed properties in disaster-prone areas for the duration of the loans; (ii) insurance for all government-owned housing stock against the risk of natural disasters; and (iii) introducing catastrophe insurance products into the local insurance market.

Finally, Government would have to participate in extensive technical feasibility studies, including a country-specific risk assessment, which would be the basis for pricing actuarial risks. A feasibility study could include collecting and digitizing seismic data, updating seismic maps, and multi-hazard risk mapping for landslides and floods.

*Estimated cost: US\$1.0 million- US\$3.0 million*

## **MEDIUM-TERM ACTIONS**

### Review Building Code

Government has initiated a review of building regulations to harmonize them with international standards and reconcile old and new regulations. This process needs technical assistance to ensure timely completion and international cooperation.

*Estimated cost: US\$200,000-US\$700,000*

### Strengthen building code enforcement.

To overcome enforcement issues, weak links in the inspection and enforcement process must be reviewed—streamlining the roles of national and local authorities, considering legislative changes, training and certifying building structural safety professionals. Using technical specifications will clarify construction activities and processes, facilitate construction monitoring and inspection, and minimize arbitrary construction practices.

*Estimated cost: US\$500,000-US\$1.0 million*

### Develop and adopt a legal framework to regulate building use and maintenance.

A comprehensive legal framework and regulations on building use and maintenance is essential to improve enforcement of building safety standards, in particular for public facilities and multi-apartment buildings, and seismically isolated buildings.

*Estimated cost: US\$100,000-US\$300,000*

### Train Technical Monitors.

Qualified technical monitors are essential for effective code enforcement and public safety. International development partners and the private sector can help develop training programs.

*Estimated cost: US\$50,000-US\$200,000*

### Upgrade Center for Crisis Management

National institutions require a center to meet and make decisions during national emergencies. Government should consider upgrading the CCM to include hardware, software, and communications equipment, and ensure accommodation for multiple ministry representatives.

*Estimated cost: US\$500,000-US\$1.5 million*

### Upgrade Hydromet Observation Posts and Equipment

To ensure that hydromet stations and observation posts can collect and disseminate data for early warning systems, Government should consider re-equipping AHS with state-of-the-art measurement devices, automatic and semi-automatic meteorological stations; communications equipment with new software and hardware; advanced weather and climate monitoring models, with increased modeling capacity and improved regional information sharing.

*Estimated cost: US\$1.0 million-US\$2.0 million*

## LONG-TERM ACTIONS

### Develop and Enforce a Land-Use Program

To combat harmful and or illegal land-use practices such as deforestation, and building in landslide-prone and seismically vulnerable areas, Government should consider developing a land-use program that takes into account multiple hazards and human activities that have triggered them. Local communities should develop community master plans and zoning maps, although they have limited financial resources and institutional capacities. The Government of Armenia might consider implementing a project complement spatial planning documents to ensure sustainable community development, construction safety, negative impact reduction for land-use and the spatial environment.

*Estimated cost: US\$200,000 - US\$300,000*

### Design Nation-wide Irrigation System.

To reduce irrigation and drinking water losses due to poor irrigation, Government should consider designing a nation-wide irrigation system that reflects current pattern of land ownership and incorporates efficient irrigation methods to reduce the demand for water. In 2002, the MoNP reported that by using advanced ‘drip’ irrigation methods instead of surface irrigation, Armenia could double its area of irrigated land using only available water resources.<sup>70</sup> To improve water use and reduce demand, drip irrigation and other methods should be studied for adoption.

*Estimated cost: US\$1.0 million - US\$3.0 million*

### Survey Water Retention Methods.

Republic of Armenia National Water Program legislation provides for collecting water resources, therefore Government should consider developing a concept for a program of water reservoirs. Government might consider conducting a survey on how best to improve water collection and usage using structural and landscape options. The survey would help Armenia decide whether to build water retention structures to increase soil moisture and replenish groundwater.

*Estimated cost: US\$300,000 - US\$500,000*

### Establish 112 and Emergency Communications System

Government should consider a feasibility study on establishing an integrated emergency call system, similar to the European “112,” and create an emergency communications system so emergency responders in the field can communicate with one other and the dispatch unit.

*Estimated cost: US\$1.0 million - US\$2.0 million*

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<sup>70</sup> Ministry of Nature Protection, National Action Programme to Combat Desertification in Armenia, 2002.



### Continue Seismic Retrofitting Program.

After launching the key public facilities retrofitting program for schools, hospitals, emergency response centers, and so forth, Government should continue this effort for prioritized investments, and consider developing a strategy for financially and socially feasible options to strengthen privately owned buildings.

*Estimated cost: US\$50 million - US\$300 million*

### Launch Community-level Programs

In disaster-prone areas, Government may wish to launch community-level initiatives that involve all key partners, including local governments, NGOs, and the private sector. Community-level initiatives are typically launched with central government seed funds and technical assistance and aim to reduce disaster risk through public/private partnerships that foster locally based natural hazard mitigation and preparedness activities. This empowers communities to define and respond to their own needs and priorities. Below is an example of a successful community-based disaster risk management program in the United States.

*Estimated cost: US\$50,000 - US\$1.0 million*

#### **Building a Disaster Resistant Community**

In 1997, the U.S. Federal Emergency Management Agency launched “Project Impact” to help communities take proactive measures toward greater resistance to the effects of natural disasters, including the following: (i) identifying hazards and community vulnerability; (ii) building community partnerships and leveraging resources; (iii) prioritizing and implementing disaster risk-reduction actions; and (iv) communicating successes to foster further actions.

To launch community-based strategic partnerships in disaster mitigation, FEMA provided small grants to participating communities and served as a partner and a facilitator to help inspire and empower local people to manage disaster risk. FEMA grants were augmented by local resources such as volunteers, private donations, business contributions, and in-kind goods and services. An important program feature was exchanging knowledge and lessons learned among the communities and building peer-to-peer alliances among nationwide partners.

In 2001, the FEMA grants were discontinued because the new administration shifted priority to anti-terrorism, but Project Impact results and activities continue in many communities; in Seattle, project volunteers help identify and remove earthquake hazards, retrofit schools and help homeowners with nonstructural earthquake mitigation measures.

## 6. CONCLUSION

Armenia faces multiple natural hazards that have caused substantial social and economic damage over the past few decades and will continue to absorb vast sums of scarce resources unless Government takes proactive measures to mitigate and prepare for these hazards.

Although the Government has reorganized its emergency management system and established many seismic mitigation activities, existing institutional structures, responses, mitigation programs, and overall capacity to prepare and respond to catastrophes are insufficient to overcome a large-scale disaster. First, multiple mitigation programs and inter-agency activities could be more effective if they were coordinated under a comprehensive national mitigation strategy, which could help eliminate overlapping responsibilities and boost the effectiveness of scarce funding. Most likely, this will require an in-depth review of current legislation, policy, and regulations. Government needs to develop a mitigation strategy to prioritize actions and funding, beginning with retrofitting at-risk infrastructure and buildings.

A single national plan would explain how Government would coordinate local, regional, national, international, and NGO partners during a disaster. To ensure effective responses during a crisis, Government also needs to fund, equip, and train emergency response services; develop a national emergency call number; provide updated communications equipment; and establish a modern functioning operations center.

Government's budget to mitigate, respond and recover from a crisis is inadequate. To reduce fiscal exposure to both garden-variety and catastrophic events, Government should consider catastrophic insurance facilities. Government could also empower and encourage communities to take action to reduce disaster by providing information and supporting local-level initiatives—including public-private partnerships.

Overall, Armenia has been steadily moving in the right direction since the 1988 Spitak Earthquake but institutional and budgetary challenges remain. However, these challenges provide opportunities for concerted, phased, inter-sectoral, and multi-sectoral actions to be taken at all levels of government.

## **Annex 1: List of People Met During Assessments in May, June, and September 2008**

Ms. R. Alavedyan, Deputy Minister, Ministry of Urban Development  
Ms. N. Antadze, Disaster Reduction Advisor, UNDP  
Dr. A. Antonyan, President, National Survey for Seismic Protection  
Mr. A. Avagyan, Director, Geocom LTD  
Mr. E. Azaryan, Head, Armenian Red Cross, Disaster Mgmt & Pop. Movement Dept  
Mr. A. Barsam, DRMO, USAID  
Mr. A. Barseghyan, Asian Development Bank  
Mr. E.S. Barseghyan, Director, Armenian Rescue Services  
Mr. R. Dayan, Head of Standardization and Certification Department, Ministry of Economy  
Mr. S. Galstyan, Deputy Minister, Ministry of Agriculture  
Mr. M. Gasparyan, Head of Melioration Dept, Ministry of Agriculture  
Mr. K. Gevondyan, Deputy Minister, Ministry of Urban Development  
Ms. G. Ghazinyan, Senior Environmental Assistant, OSCE  
Mr. N. Grigoryan, Director of “Emergency Channel” Information Centre, Ministry of Emergency Situations, Armenian Rescue Service  
Mr. M. Harutyunyan, Colonel, Armenian Rescue Services, Operative Management Department, Head of the Crisis Management Center  
Dr. M. Hovhannisyian, Deputy Head, Inspection Department, Ministry of Urban Development  
Mr. S. Hayrapetyan, Head of Inspection Department, Ministry of Urban Development  
Mr. C. Hofstra, Political/Military Officer, OSCE  
Mr. S. Hovhannisyian, National Program Officer, Swiss Agency for Development and Cooperation SDC  
Mr. G. Kamalyan, Head of School Construction Department, Min. of Education and Science  
Mr. Karapetyan, Head of Inspection Department, Municipality  
Maj. E. Keller, SPP Lead, USAID  
Mr. G. Khachatryan, First Deputy Chairman, State Committee of Water Management, Ministry of Territorial Administration  
Ms. O. Khachatryan, Head of Health Department, Armenian Red Cross  
Mr. A. Kontakchyan, General Director, GIS LLC  
Ms. M. Lazyan, Senior Assistant P/M, OSCE  
Mr. A. Manoukyan, Lt. Colonel  
Mr. G. Manucharyan, Head of Dept, Ministry of Agriculture  
Ms. L. Margaryan, Head of Data Safety and Processing Dept, Ministry of Nature Protection, Monitoring Center  
Mr. H. Matevosyan, Rector of the Crisis Management State Academy, Ministry of Emergency Situations, Armenian Rescue Service  
Mr. E. Morosin, Deputy Regional Director for the South Caucasus, Swiss Agency for Development and Cooperation  
Mr. A. Muradyan, Head of Air Pollution, Ministry of Nature Protection, Nature Resource Management Department  
Mr. A. Nersisyan, Head, Ministry of Nature Protection, Water Resources Management Agency  
Mr. E. Pirumyan, Head of Division, Water Resources Policy and Analysis Division, Ministry of Nature Protection, Water Resources Management Agency  
Dr. S. Sargsyan, Energy and Water Programs Specialist, USAID  
Mr. M. Shahgeldyan, Minister, Ministry of Emergency Situations  
Mr. D. Shahverdyan, Cooperation Programmes, ICRC  
Mr. A. Tananyan, Head of Rescue Services, Ministry of Emergency Situations  
Mr. V. Terteryan, Deputy Minister, Ministry of Territorial Administration  
Mr. L. Vardanyan, Director, Ministry of Nature Protection, Hydromet  
Mr. V. Vardanyan, Minister, Ministry of Urban Development  
Dr. M. Vardanyan, Natural Resources Management Specialist, USAID  
Mr. A. Vardanyan, President/ CEO, Shincertificate Ltd.  
Ms. C. Vidal, UN Resident Coordinator UNDP Resident Representative  
Mr. A. Voskanyan, Lt. Colonel  
Mr. H. Yeritsian, GIS Analyst, Geocom LTD

## **Annex 2. Legal and Regulatory Framework and Processes for Seismic Risk Mitigation**

Seismic risk mitigation requires participation from a wide range of disciplines and government functions. Effective mitigation requires (a) detailed spatial assessment of the country's seismic exposure; (b) identification of existing vulnerable buildings and a framework for prioritized strengthening; (c) cost-effective design and construction standards for new construction and retrofitting; (d) enforcement of design, construction, and planning regulations; and (e) public information programs. These activities are multi-sectoral, which requires coordination. In Armenia, responsibility for most of these critical functions is spread among agencies, and the recently established MoES is challenged to manage and establish a seismic mitigation program.

Until 2008, three state agencies were responsible for major aspects of seismic risk reduction in Armenia—NSSP, MoUD, and MoE, through its Department of Administration, Standardization, Metrology and Conformity Assessment. The NSSP is now under the MoES, and municipalities now have a role in construction inspection. The MoES now has overall coordination responsibilities for all government bodies with policy and operational responsibilities in seismic safety, however, since the MoES is new, these bodies continue to function as before.

### **Building Standards: the role of the Ministry of Urban Development**

The MoUD is responsible for drafting, implementing, and enforcing design and construction standards for buildings. Standards and enforcement are governed by laws, regulations, and government acts, rather than a uniform code. Prior to Independence, Armenian regulations were Soviet-based—a one-size-fits-all approach that was not appropriate for Armenia, especially for earthquake engineering. Since then, Armenia has been reworking standards to tailor them to national needs, which has improved structural design and construction laws and regulations..

### **Evolution of Building and Planning Standards**

The Law on Urban Development, which governs spatial planning, is updated every 2-3 years (most recently in 2005); structural engineering standards have been updated less regularly since Independence. Seismic structural safety norms were updated in 1995 and 2006. In 1995, the MoUD confirmed the first National Standards of Seismic-Resistant Construction. The last update included 10-12 critical revisions, including engineering standards for applying base isolation seismic mitigation. These post-Soviet revisions reflect more closely the Armenian conditions.

Most professionals agree that the existing code system is technically sound, but much remains to be done to clarify and harmonize building standards with international, notably EU, standards, and to enforce them. This will mean developing a conceptual

approach, based on assessment and comparative analysis of Armenian norms and best practice in several European countries.

More specifically, with regard to inspection and enforcement, a MoUD Inspection Department official notes four issues that require attention.<sup>71</sup>

Separate the authority of state-appointed marz governors and elected community leaders. Remedy duplication and clarify legal acts.

- Separate State Urban Development Inspectorate responsibilities from the Governors’.
- Simplify and shorten the construction permit process and make it more transparent.

### **Implementation of Licensing and Building Regulations and Standards**

Construction design drawings must bear the stamp of a licensed structural engineer—the first link in the chain of accountability. In Armenia, a structural design engineer’s license requires a diploma from a state or state-accredited university, a minimum of three years professional experience under a licensed organization, and a list of design works undertaken in this organization. The process is the same for architects. There are no professional examinations; the MoUD regulates the process, which is deemed generally satisfactory.

The quality control process for a completed design consists of a series of reviews by private licensed professional organizations, according to their discipline—structural engineering, urban development, among others. Earlier in the process a community leader approves the architectural and planning. When all aspects are approved, a construction permit is issued. This process is typically very time-consuming because each specialist reviews the design in sequentially, rather than in parallel.

Construction quality supervision is addressed by: (i) state inspection; (ii) technical inspection; and (iii) author’s (designer’s) inspection. The first is implemented by the authorized body through state inspection to ensure compliance with legislative requirements, the second is performed by a contracted technical monitor that provides supervision throughout the construction project to ensure compliance to design, and construction techniques and methods and quality of construction materials, and the third is performed by the designer to ensure author’s participation in implementation of the project and is performed in cases defined by legislation or by contract.

By law, the owner is required to hire Technical Monitors. According to the recent amendments of the Law of RoA on Licensing technical inspection is an activity

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<sup>71</sup> Musegh Hovhannisyanyan, Deputy Chief of the State Urban Development Inspectorate, MoUD: “Outline of Building Codes and Control Systems in Armenia—Features and composition of the building code, administrative provision, and building confirmation process.”

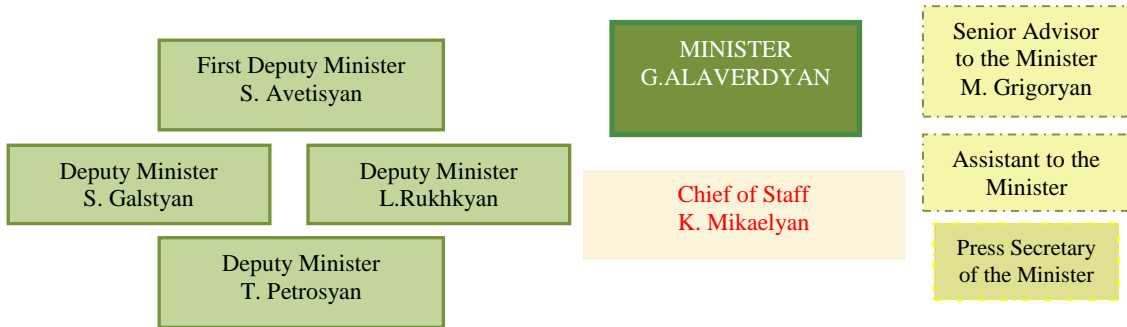
subject to licensing by the MoUD. The quality of the TM depends upon the quality and seriousness of the developer. There are reliable people and firms that do this work but untrained monitors are sometimes hired by cost-cutting developer/builders. This current system, where private firms provide inspection expertise, is appropriate but can be effective only with rigorous licensing procedures and serious government oversight.

Developing technical specifications is a precondition for construction quality assurance. This system is widely used in international practice of quality assurance, and includes qualitative and quantitative specifications that guide construction.

### Annex 3: Organizational Charts

- Ministry of Agriculture
- State Committee of Water Management
- Armenian Rescue Service
- Armenian State Hydrometeorological and Monitoring Service

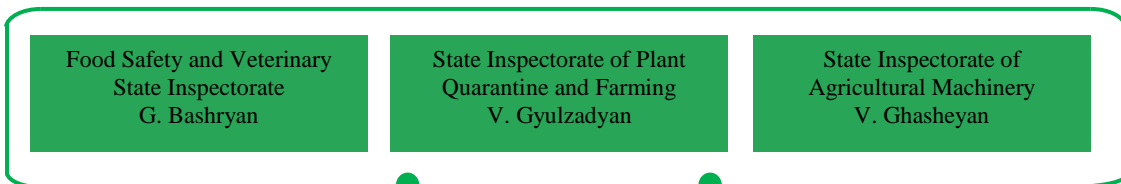
### MINISTRY OF AGRICULTURE



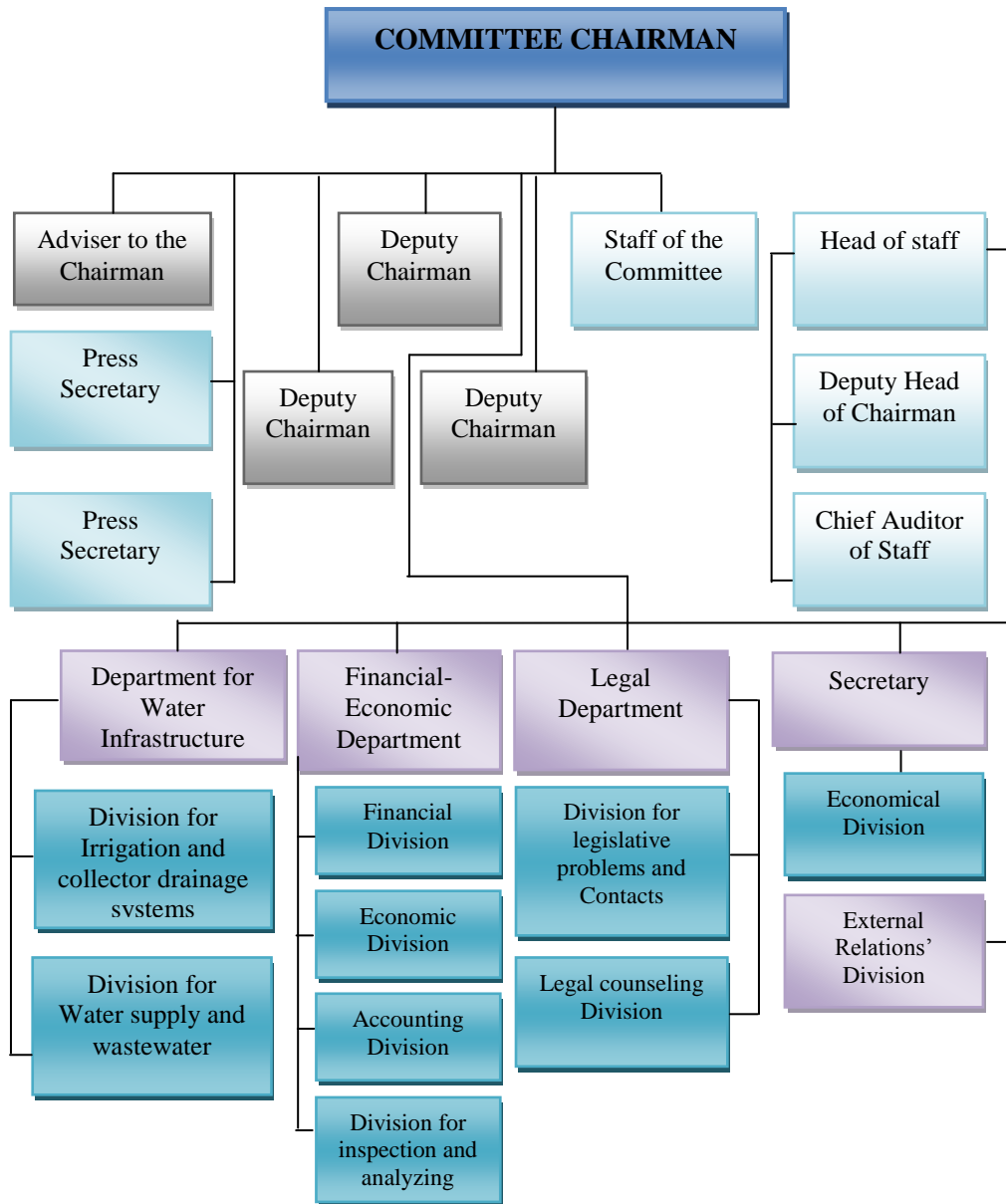
Structural Subdivisions of the Ministry



Separate Subdivisions of the Ministry

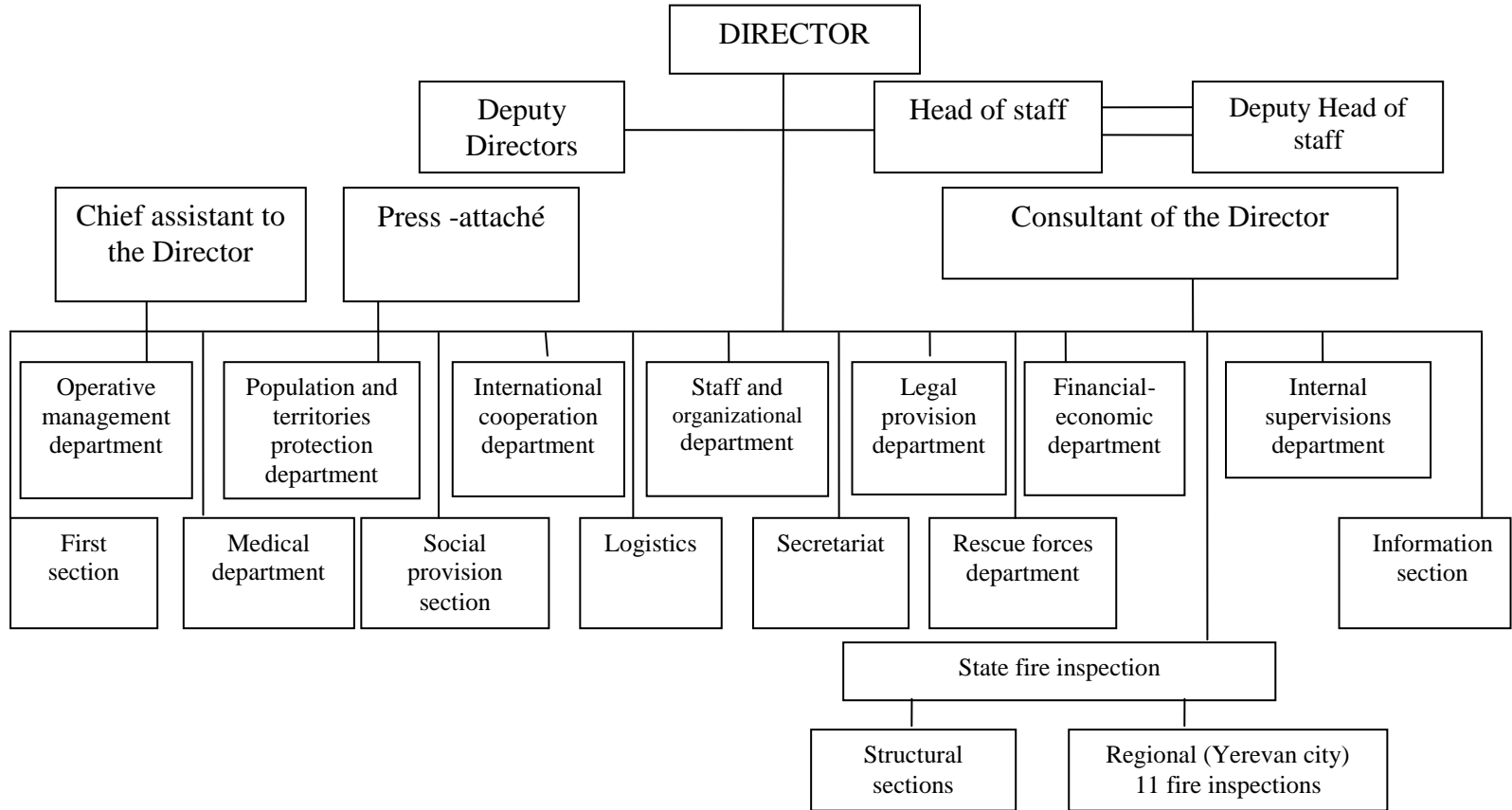


# STATE COMMITTEE OF WATER MANAGEMENT



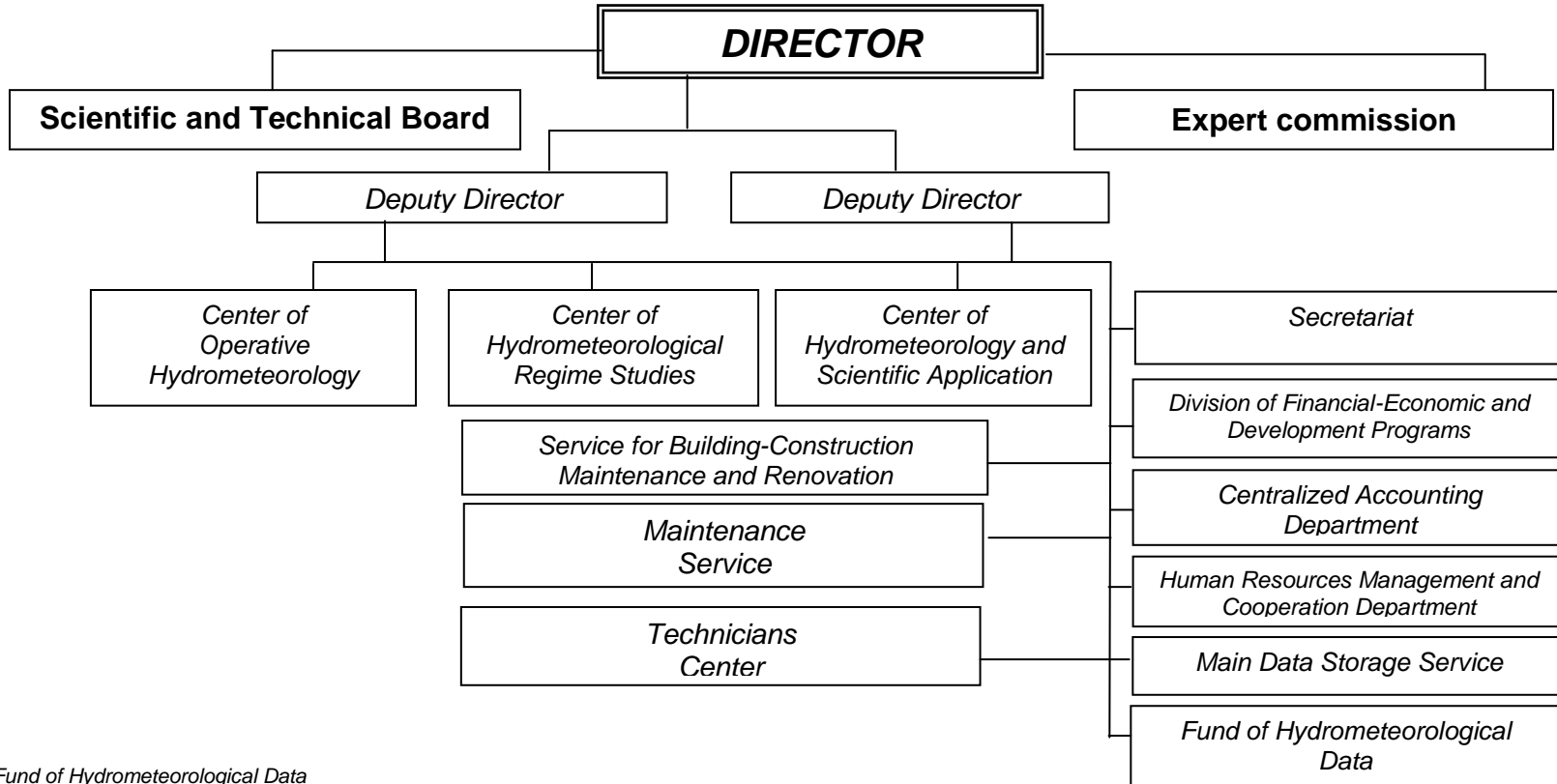


# ARMENIAN RESCUE SERVICE



# STRUCTURE

## “ARMENIAN STATE HYDROMETEOROLOGICAL AND MONITORING SERVICE” STATE NON-COMMERCIAL ORGANIZATION



Fund of Hydrometeorological Data

*Special thanks to the partners who support GFDRR's work to protect and improve lives: ACP Secretariat, Australia, Belgium, Brazil, Canada, Denmark, European Commission, Finland, France, Germany, India, Italy, Ireland, Japan, Luxembourg, The Netherlands, Norway, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, UN International Strategy for Disaster Reduction, and the World Bank.*