ARMENIA FLOODS

MAY 2024

POST DISASTER NEEDS ASSESSMENT

UNDP

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October 2024

Disclaimer

The views, interpretations, and conclusions in this report are those of the author(s) and do not necessarily represent those of the United Nations (UN), and the European Union (EU).

Acknowledgment

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All URL links referenced in this report were last verified on August 30, 2024.

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Abbreviations

AADT ..... Annual Average Daily Traffic
ADB ..... Asian Development Bank
AGBU ..... Armenian General Benevolent Union
AIDS ..... Acquired Immune Deficiency Syndrome
AMD ..... Armenian Dram (currency)
AOI ..... Area of Interest
ARMSTAT ..... Statistical Committee of the Republic of Armenia
AWS ..... Automatic Weather Station
BBB ..... Build Back Better
BCP ..... Business Continuity Plan
BIOFOR ..... Biodiversity and Forest Conservation
CC ..... Climate Change
CCA ..... Climate Change Adaptation
CEP ..... Civil Emergency Plan
CERTIT ..... Centre for Remote Sensing and Image Processing
CJSC ..... Closed Joint Stock Company
CMC ..... Crisis Management Center
CMSA ..... Crisis Management State Academy
CNG ..... Compressed Natural Gas
COVID ..... Coronavirus Disease
CSA ..... Climate Smart Agriculture
DRM ..... Disaster Risk Management
DRR ..... Disaster Risk Reduction
EAEU ..... Eurasian Economic Union
ECTS ..... European Credit Transfer and Accumulation System
EE ..... Energy Efficiency
EEE ..... Environmental and Epidemiological Evaluation
EIB ..... European Investment Bank
EMS ..... Emergency Medical Services

EPR ..... Environmental Performance Review

ERCC ..... EU Emergency Response Coordination Centre

EU ..... European Union

EWS ..... Early Warning System

FAO ..... Food and Agriculture Organization

FEMA ..... Federal Emergency Management Agency

FFPI ..... Food and Feed Product Inventory

FGD ..... Focus Group Discussion

FPI ..... Food Price Index

GBV ..... Gender-Based Violence

GDP ..... Gross Domestic Product

GEE ..... Green Economy and Environment

GHG ..... Greenhouse Gas

GIS ..... Geographic Information System

HFC ..... Hydrofluorocarbon

HH ..... Household

HIV ..... Human Immunodeficiency Virus

HMC ..... Hydrometeorology and Monitoring Center SNCO (Armhydromet SNCO)

HO ..... Head of Office

HPP ..... Hydropower Plant

HVEN ..... High Voltage Electric Networks

IASC ..... Inter-Agency Standing Committee

IHR ..... International Health Regulations

INSARAG ..... International Search and Rescue Advisory Group

IOM ..... International Organization for Migration

IQC ..... Individual Quality Control

IT ..... Information Technology

IUCN ..... International Union for Conservation of Nature

LAG ..... Local Action Group

LD ..... Land Degradation

LLC ..... Limited Liability Company

LSG ..... Local Self Government

M6 ..... Main Interstate Highway M6 (Armenia)

MAB ..... Multi-Apartment Building

MESCS ..... Ministry of Education, Science, Culture, and Sports

MFA ..... Ministry of Foreign Affairs

MH ..... Ministry of Health

MHPSS ..... Mental Health and Psychosocial Support

MHTI ..... Ministry of High-Tech Industry

MIA ..... Ministry of Internal Affairs

MIRA ..... Multi-Sector Initial Rapid Assessment

MLSA ..... Ministry of Labor and Social Affairs

MoE ..... Ministry of Environment

MOF ..... Ministry of Finance

MOFA ..... Ministry of Foreign Affairs

MOH ..... Ministry of Health

MOIA ..... Ministry of Internal Affairs

MoLSA ..... Ministry of Labor and Social Affairs

MS ..... Medical Services

MT ..... Metric Ton

MTAI ..... Ministry of Territorial Administration and Infrastructure

MW ..... Megawatt

NAC ..... National Airspace Control

NCDC ..... National Center for Disease Control and Prevention

NDC ..... Nationally Determined Contribution

NEAP ..... National Environmental Action Plan

NFI ..... Non-Food Items

NGO ..... Non-Governmental Organization

NPP ..... Nuclear Power Plant

PD ..... Post-Disaster

PDNA ..... Post-Disaster Needs Assessment

PJSC ..... Public Joint Stock Company

PSS ..... Psychosocial Support Services

PV ..... Photovoltaic

RA ..... Republic of Armenia

RBA ..... Red Book of Animals

RC ..... Reinforced Concrete

RDF ..... Road Development Fund

RFD ..... Road Fund Directorate

RRT ..... Rapid Response Team

SCR ..... South Caucasus Railway

SDC ..... Swiss Agency for Development and Cooperation

SERTIT ..... Service Régional de Traitement d'Image et de Télédétection

SFH ..... Single Family Home

SJSC ..... State Joint Stock Company

SME ..... Small and Medium Enterprises

SMECA ..... Small and Medium Enterprises Cooperation Association

SNCO ..... State Non-Commercial Organization

SNOC ..... State Nuclear Operations Corporation

SOP ..... Standard Operating Procedure

SRH ..... Sexual and Reproductive Health

SS ..... Social Services

STAR ..... Strategic Toolkit for Assessing Risk

TEN-T ..... Trans-European Transport Network

TPP ..... Thermal Power Plant

TU ..... Technical Unit

UCPM ..... Union Civil Protection Mechanism

UCPT ..... Union Civil Protection Team

UDC ..... Urban Development Committee

UN ..... United Nations

UNAIDS ..... United Nations Programme on HIV/AIDS

UNDP ..... United Nations Development Programme

UNEP ..... United Nations Environment Programme

UNFPA ..... United Nations Population Fund

UNHCR ..... United Nations High Commissioner for Refugees

UNICEF ..... United Nations Children's Fund

USAID ..... United States Agency for International Development

USD ..... United States Dollar

WB ..... World Bank

WFP ..... World Food Programme

WHO ..... World Health Organization

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EXECUTIVE SUMMARY

On May 25 2024, Armenia's northern Lori and Tavush regions were hit by a catastrophic flood event caused by relentless rains. Between May 25 and 26, heavy rainfall led to the overflow of the Debed, Aghstev, and Tashir rivers, which severely impacted these areas.

The floods caused substantial damage and resulted in four fatalities. Many affected families were evacuated to ensure their safety.

At the request of the Government of Armenia, a Post-Disaster Needs Assessment (PDNA) of the floods in the Lori and Tavush regions was conducted with the involvement of relevant ministries and international support from the United Nations and the European Union. The assessment employed the internationally recognized PDNA methodology, globally endorsed by the UN, EU, and WB. The process was coordinated by the UNDP.

The assessment evaluates the damage to physical assets, the indirect impact on economic activities, additional expenses incurred due to the floods, and quantifies the prioritization of needs for reconstruction and recovery in the affected areas. It also takes into consideration the social and economic needs of the affected communities. Damage and loss estimates were provided for infrastructure and assets across nine affected consolidated communities in Lori and Tavush regions, namely Alaverdi, Dilijan, Gyulagarak, Ijevan, Noyemberyan, Pambak, Stepanavan, Tashir and Tumanyan. The PDNA team gathered data through on-ground investigations, crowd-sourcing, and the analysis of satellite images.

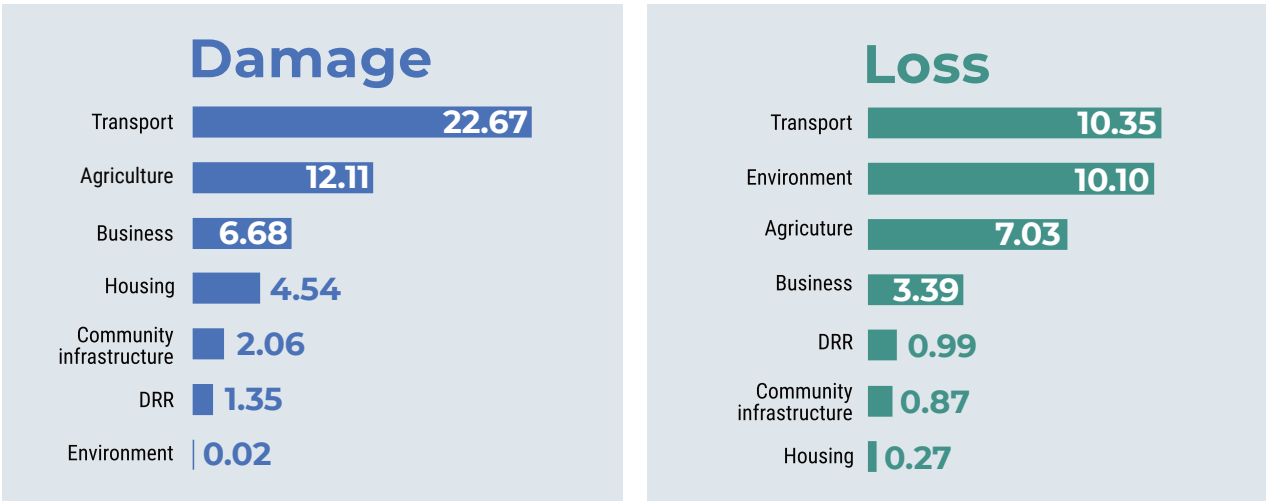
Floods in Lori and Tavush regions caused a total of **49.43 million USD in damage** and **33.00 million USD in loss.** Highest overall effects were recorded in productive and infrastructure sectors (namely agriculture, business and transport) with the environment as a cross-cutting sector additionally contributing to increased losses.

Table 1. Total damage and loss by sector and sub-sector (in USD millions)

Sector	Damage	Loss
Social Sectors		
Housing	4.54	0.27
Productive Sectors		
Agriculture	12.11	7.03
Business	6.68	3.39
Infrastructure Sectors		
Transport	22.67	10.35
Community infrastructure	2.06	0.87
Communications	*0.19*	*0.23*
Energy	*0.93*	*0.25*
Water and Sanitation	*0.56*	*0.13*
Health	*0.19*	*0.25*
Education	*0.19*	*0.00*
Cross Cutting Sectors		
Environment	0.02	10.10
Disaster Risk Reduction	1.35	0.99
Total	**49.43**	**33.00**

Comparing the sectors indicates that most of the damage fell on transport (22.67 million USD), followed by agriculture (12.11 million USD), business (6.68 million USD), and housing (4.54 million USD). In terms of loss, the majority fell on transport (10.35 million USD) and environment (10.10 million USD) followed by agriculture (7.03 million USD) and business (3.39 million USD).

Figure 1. Damage and loss by sector (in USD millions)



In total, transport accounts for 40% of all disaster effects followed by agriculture (23%) and business and environment (12% each respectively).

Related to the geographical distribution of disaster effects the majority is recorded in Alaverdi consolidated community followed by Noyemberyan and Tumanyan communities.

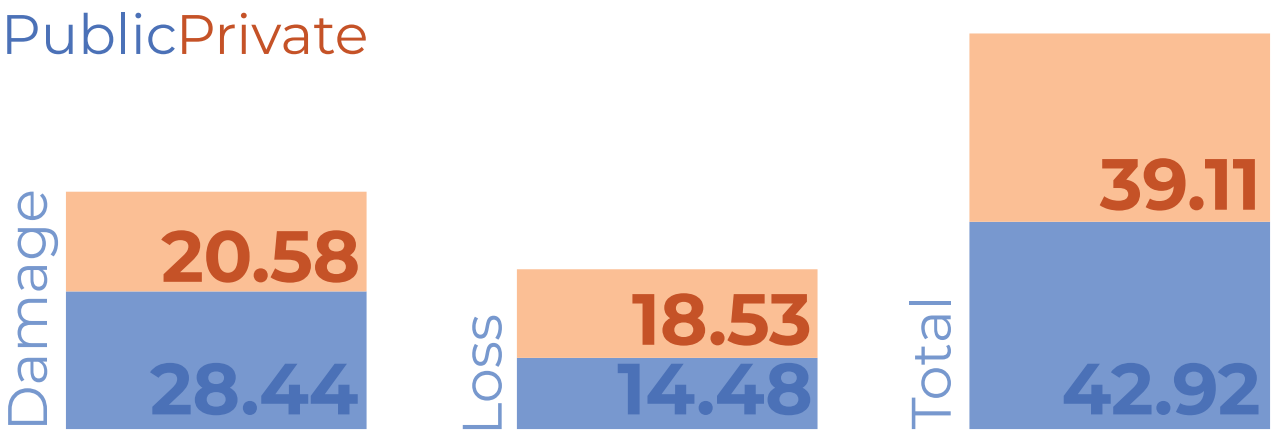
Table 2. Total damage and loss by consolidated community (in USD millions)

Community	Damage	Loss	Total
Alaverdi	21.69	10.78	32.47
Dilijan	2.33	0.28	2.61
Gyulagarak	1.23	1.35	2.58
Ijevan	1.86	0.80	2.66
Noyemberyan	9.41	7.17	16.58
Pambak	2.42	0.61	3.03
Stepanavan	0.82	0.02	0.84
Tashir	3.40	0.73	4.13
Tumanyan	5.16	0.38	5.54
Nationwide (no specific region)	1.11	10.86	11.97
Total	**49.43**	**33.00**	**82.43**

A total of 32.47 million USD in disaster effects is recorded in Alaverdi consolidated community (39% of overall disaster effects). Second hardest hit community is Noyemberyan with 16.58 million USD (20%) in disaster effects. Additionally, 11.97 million USD in disaster effects is recorded across the rivers of Debed, Tashir, and Aghstev[1] mostly related to debris removal costing.

Finally, when it comes to ownership, 52% (42.92 million USD) of total disaster effects are related to public damage and loss whereas 48% are private related (39.11 million USD). When it comes to damage then 58% are connected to public damage mostly because of transport accounting for 19.57 million USD in public damage out of 28.44 million USD. On the other hand, in terms of loss 56% are connected to private ownership mostly due to transport, agriculture and loss of private income in business.

Figure 2. Disaster effects by ownership (in USD millions)



1 Noted in tables as "nationwide" due to inability to preciously allow for distribution between consolidated communities.

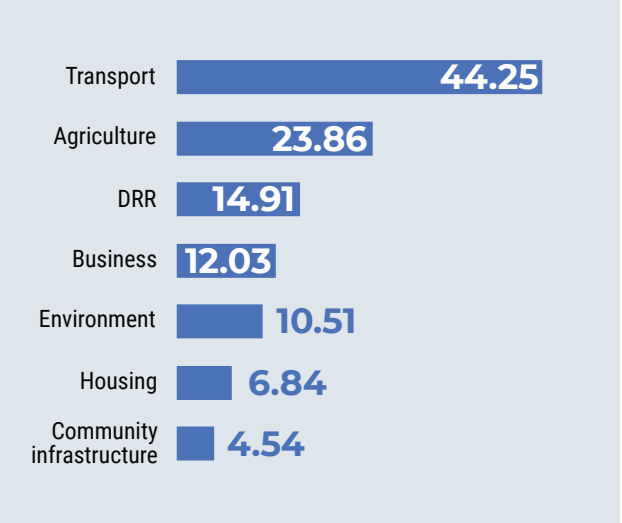
Based on the *Build Back Better* principles, the PDNA estimates, that the total recovery needs for Armenia following the May 2024 floods are estimated at 116.94 million USD across all sectors. Needs costing is estimated over a 5-year period and account for inflation, market conditions, transition towards low carbon energy as well as more resilient, inclusive, and modern design practices.

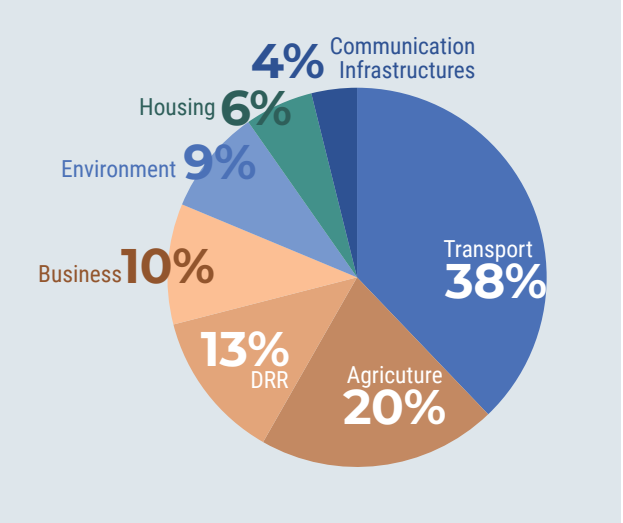
Table 3. Total recovery needs by sector and sub-sector (in USD millions)

Sector	Short-term Needs	Medium-term Needs	Long-term Needs	Total Needs
Social Sectors				
Housing	5.19	1.65		6.84
Productive Sectors				
Agriculture	12.51	11.35		23.86
Business	7.35	4.68		12.03
Infrastructure Sectors				
Transport	3.82	17.38	23.05	44.25
Community infrastructure	2.27	2.26	0.01	4.54
Communications	*0.15*	*0.42*		*0.58*
Energy	*0.42*	*1.51*		*1.93*
Water and Sanitation	*1.17*	*0.12*	*0.01*	*1.30*
Health	*0.42*			*0.42*
Education	*0.11*	*0.21*		*0.31*
Cross Cutting Sectors				
Environment	10.11	0.40		10.51
Disaster Risk Reduction	3.27	7.27	4.37	14.91
Total	**44.53**	**44.98**	**27.43**	**116.94**

The comparative sector analysis shown below indicates that transport has the highest recovery needs at 44.25 million USD (38% of total), followed by agriculture with 23.86 million USD (20%), and Disaster Risk Reduction with 14.91 million USD (13%).

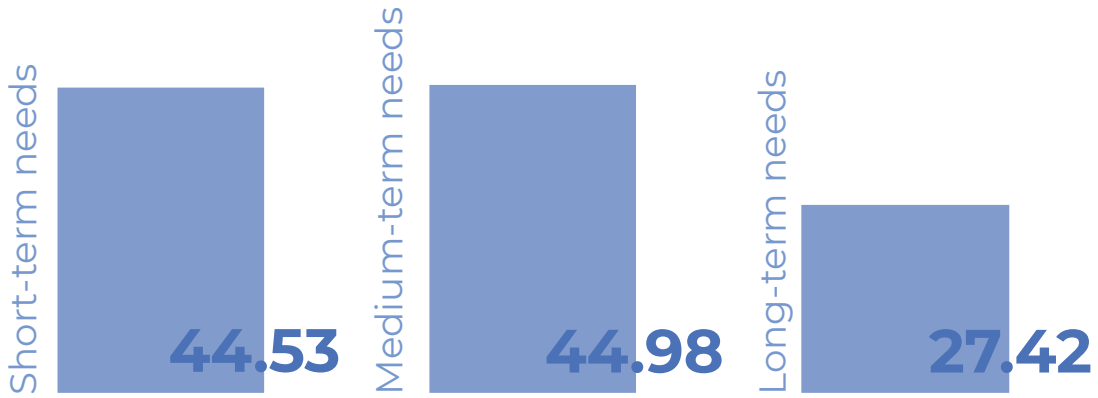
Figure 3. Total recovery needs by sectors (in USD millions and percentage share)





Along the recovery timeline, the short-term and medium-term recovery needs will require the highest investment with 44.53 and 44.98 million USD respectively. As part of the short-term needs biggest investments will have to be made in agriculture (12.51 million USD) and environment (10.11 million USD). During the medium-term recovery, most of the reconstruction needs will have to be invested in transport (17.38 million USD) followed by agriculture (11.35 million USD) and Disaster Risk Reduction (7.27 million USD). Finally, in the long run 23.05 million USD will be required in transport sector and additional 4.37 million USD to ensure disaster risk reduction.

Figure 4. Short, medium and long-term recovery needs (in USD millions)



Toward reconstruction and recovery

Recovery from the May 2024 floods in the Lori and Tavush regions should be an integral component of the Government of Armenia's development strategies. Additionally, it should draw on international best practices for post-disaster recovery and reconstruction. To initiate recovery efforts across the nine affected municipalities, immediate attention must be given to addressing recovery and reconstruction needs across all sectors.

Short-term housing solutions are crucial, alongside the restoration of community infrastructure such as water supply, sanitation, energy, and other municipal services, to facilitate the return of remaining displaced residents. This will help drive the overall reconstruction and recovery process, particularly in the agriculture and business sectors, thereby rejuvenating the economy. Additionally, addressing environmental needs is a key and challenging aspect of recovery, as these issues affect the entire recovery process. Finally, it is essential to consider gender and social vulnerabilities across all sectors and ensure that Disaster Risk Reduction (DRR) measures and principles are integrated and mandatory, especially considering increased frequency and magnitude of the climate change-induced natural disasters.

Addressing the overall estimated needs will be crucial for long-term recovery, though not all needs can be met immediately. The timeline for meeting these needs will depend on the availability of financing and the absorptive capacity of the Armenian budget, line ministries, local authorities at the regional and municipal levels, civil society and community-based organizations, and other implementing agencies. Therefore, balancing limited public and donor funding will be essential. This situation presents an opportunity to develop innovative financing mechanisms that mitigate risks and enable clear, transparent coordination of recovery and reconstruction efforts of the affected communities in Armenia. However, this will also require additional planning and implementation of reforms.

Introduction

On May 25 2024, a devastating flood struck the northern Armenian regions of Lori and Tavush. Persistent heavy rainfall over several days caused the Debed, Aghstev, and Tashir rivers to overflow, resulting in catastrophic damage.

On May 26, continuous intense rainfall caused a sharp rise in the water levels of the Debed and Aghstev rivers, reaching more than two meters higher than the previous day's levels. This rapid increase led to flooding in surrounding riverbank areas, inflicting considerable damage on several settlements. Significant increases in water levels were recorded at key hydrological observation points. At the Debed-Ayrum station, the water output surged from 119 m^3/s on the evening of May 25 to an estimated 884 m^3/s on the morning of May 26, with a water level increase of 2.43 meters. Similarly, the Dzoraget-Gargar observation point recorded a rise from 73.5 m^3/s to 417 m^3/s, with water level increase of 1.74 meters, and at the Tashir-Saratovka station, the water output surged from 16.6 m^3/s to 122 m^3/s, with water level increase of 2.56 meters.

Such extreme water discharges were previously observed in the Debed River basin on May 19, 1959, when the Debed-Ayrum hydrological station recorded a maximum water discharge of 759 m^3/s, Dzoraget-Gargar saw 395 m^3/s, and Tashir-Saratovka measured 112 m^3/s. The discharges recorded on May 26, 2024, were the highest in 65 years, marking the second-largest recorded values since the beginning of observations.

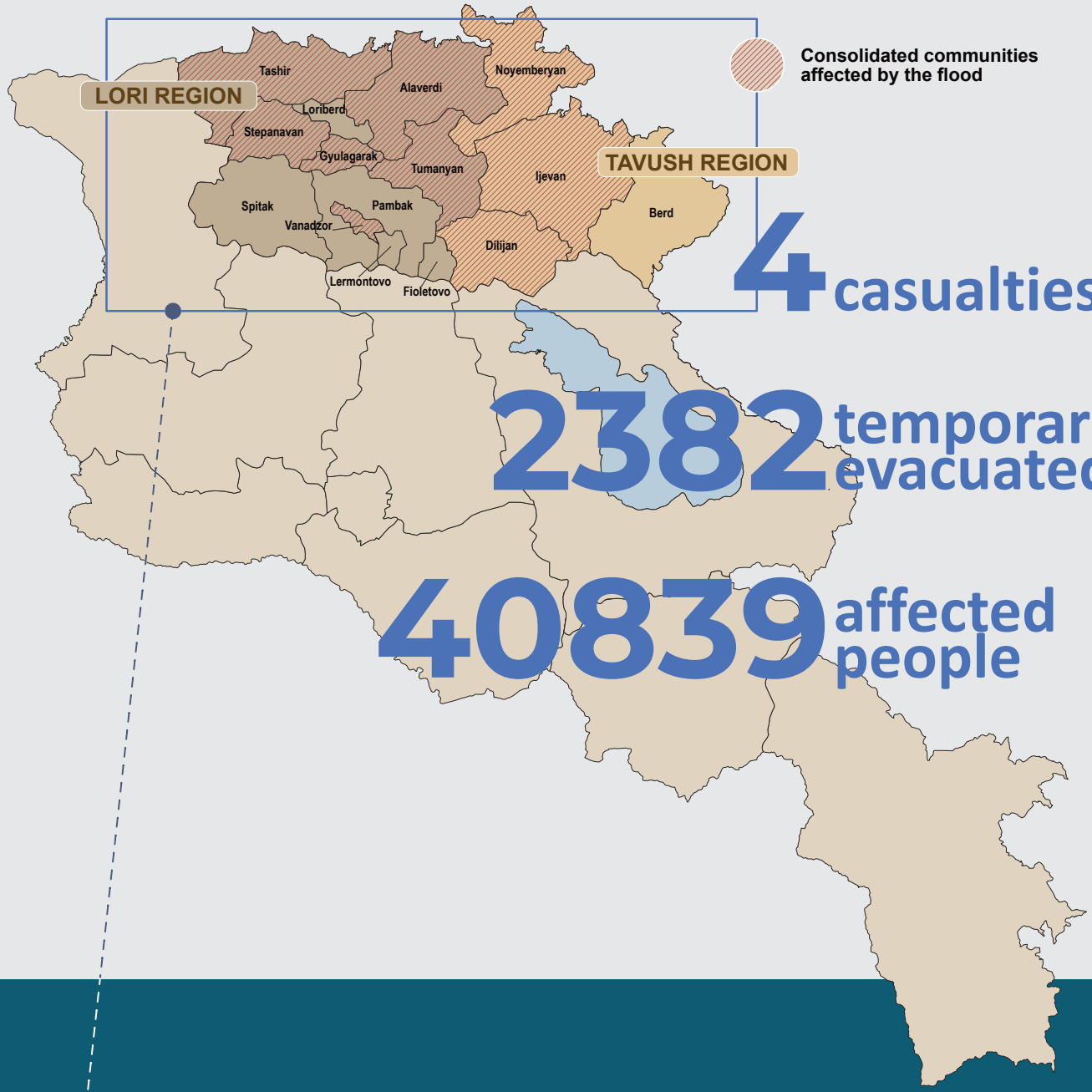
In the Aghstev River basin, similar increases were noted. At the Dilijan observation point, the water output rose from 15.4 m^3/s at 20:00 on May 25 to 51.4 m^3/s by 08:00 the next morning. At the Aghstev-Ijevan observation point, water output surged from 73.5 m^3/s to 157 m^3/s within the same time-frame. Additionally, the Kirants-Acharkut observation point reported a dramatic increase, with water output rising from 5.80 m^3/s to 45.0 m^3/s on May 26. These extreme water discharges reflect the intensity of the flooding, marking a historic hydrological event.

- The severe flooding affected a total of 9 settlements across the two regions, including the communities of Alaverdi, Gyulagarak, Pambak, Tashir, Stepanavan, Tumanyan, Dilijan, Ijevan and Noyemberyan. Four lives were tragically lost, and 2,382 people were temporarily evacuated. The floods led to significant damage to housing, infrastructure, and agricultural land, leaving communities struggling to cope with the disaster's aftermath.

Three flood scenarios were observed:

- **Flash floods** in Alaverdi and Karkop due to mountainous terrain, with water velocities estimated at 3-6 m/sec near Alaverdi and 4-10 m/sec near Akhtala[2] and a significant amount of debris and mud transported by the Debed river. The water lingered for several days.
- **Riverine floods** in Tashir, with water velocities of 1-3 m/sec[3], where the floodwater receded quickly, allowing evacuees to return to their homes the next day.

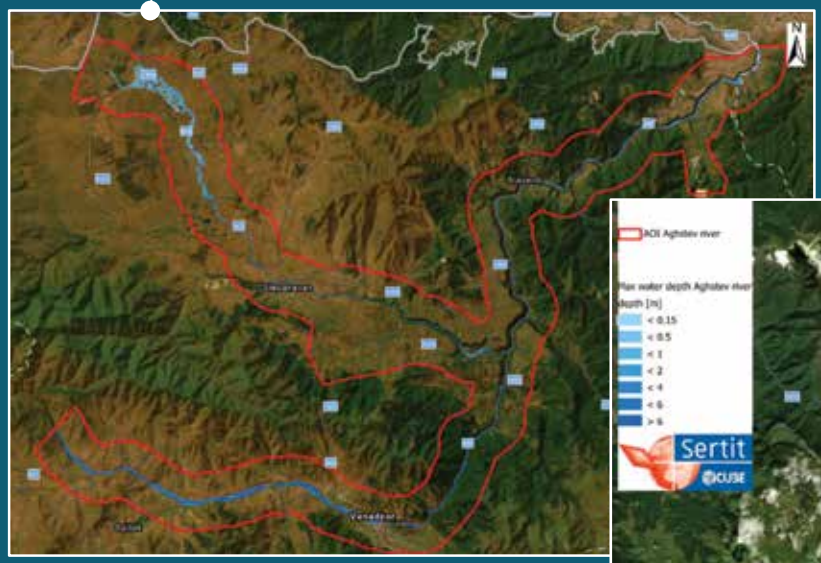
2 Recovery Observatory, PDNA Framework, May 2024 flood event in Armenia
3 Ibid



4 casualties

2382 temporarily evacuated

40839 affected people



Sattelite maps source: CERTIT

- **Pluvial floods** in Ijevan and Dilijan caused by excessive rainfall.

The Government of Armenia declared the affected areas as disaster zones and promptly sought assistance from international partners.

At the request of the Ministry of Internal Affairs, the UN has initiated the multi-sector initial Rapid Assessment (MIRA) to define immediate humanitarian needs and priorities, followed by concerted efforts by UN, EU and the Government of Armenia towards post-disaster needs assessment (PDNA).

The PDNA presented in this report aims to provide a comprehensive analysis of the disaster's impacts across various sectors, outlining the necessary steps to recover and rebuild the affected regions. The PDNA is a joint effort led by the Government of Armenia, in collaboration with the United Nations Development Programme (UNDP), EU, other UN agencies, and international partners. The assessment adheres to globally recognized methodologies, providing a framework for estimating damage and loss, and recovery needs while integrating the *Build Back Better* principles into the recovery strategy.

This report consolidates the findings from multiple sectoral assessments, emphasizing resilience and sustainability in the recovery process. It focuses on the short, medium, and long-term recovery needs, aiming to restore economic stability, infrastructure, and the well-being of the affected populations. The recovery framework is designed to ensure Armenia's preparedness for future disasters, fostering resilience and sustainable development.

PDNA Objectives and Methodology

Objectives

The primary objective of the PDNA is to support the Government of Armenia in evaluating the effects of the floods in the Lori and Tavush regions and to develop a recovery strategy that outlines financial implications, ranging from the restoration of services to the full rehabilitation and reconstruction of infrastructure, livelihoods, and the economy, while also enhancing resilience against future disasters.

The PDNA delivers a comprehensive assessment report that details the damage and loss across all sectors impacted by the disaster, along with the recovery needs highlighted in a strategy that includes recovery initiatives categorized by sector and region.

The objectives are:

- To evaluate the total multi-sectoral impact of the floods on the socio-economic development of the affected municipalities and communities.
- To analyze the multi-sectoral effects and implications of the disaster and create sector-specific Recovery Strategies and Plans that encompass short, medium, and long-term recovery requirements, including associated costs and timelines.
- To incorporate the *Build Back Better* principle into the recovery framework and address cross-cutting issues such as Livelihoods, Gender, Environment and Disaster Risk Reduction.

Methodology

The PDNA in Armenia adopts globally accepted PDNA methodology jointly developed by the international development partners - the European Union, the World Bank and the UN system representing a tool for assessing damage and loss and estimating recovery needs. The PDNA process in Armenia is a comprehensive assessment of the effects and impact of the floods from the community, municipal to the national level, combining social, economic and financial aspects of the effects of the disaster.

The PDNA provides a consolidated assessment report, which includes information on damage and loss in all the sectors affected by a disaster. Along with information on damage and loss,

the report highlights recovery needs. As the recovery needs are consolidated for all the sectors, the report also presents a recovery strategy, which includes a vision, recovery actions for each sector and region, the time-frame and expected cost of the recovery process. The assessment also include the identification of disaster risk management measures designed to mitigate the impact of future disasters.

The methodology includes analytical tools and methods for a consistent application of basic concepts of damage, loss and post-disaster recovery needs across the sectors. Conducted through sector teams, the methodology also includes an analysis of pre-disaster baseline data to compare with post-disaster conditions in order to assess the disaster impact and to determine the overall recovery strategy. It combines quantitative data with qualitative information to analyze and to assess the social and economic impacts of the disaster from the community level to the national level. The assessment applies standard units for cost estimation and include the cost of improved specifications and better resilience.

The assessment is built on initial and detailed sector damage and loss assessments undertaken by the government and the data collected by other partners. It also utilizes findings from the MIRA report developed in June 2024 based on the globally accepted IASC Operational Guidance for Coordinated Assessments in Humanitarian Crises and MIRA assessment guideline adopted in 2017 by the order of the Minister of Emergency Situations of Armenia.

The geographic scope of the PDNA Armenia included nine affected consolidated communities in Lori and Tavush regions namely Alaverdi, Dilijan, Gyulagarak, Ijevan, Noyemberyan, Pambak, Stepanavan, Tashir and Tumanyan. In specific situations when the definition of geographic area was unclear and overcomplicated costing related to effects and needs were associated to the "nationwide – no specific area" category.

The following sectors and sub-sectors were covered by the PDNA:

- **Social Sector:** Housing;
- **Productive Sector:** Agriculture and Business;
- **Infrastructure Sector:** Transport and Community Infrastructure with inclusive sub-sectors of Water and Sanitation, Energy, Communications, Health and Education;
- **Cross-cutting Issues:** Gender, Environment and Disaster Risk Reduction;
- **The Macro-economic Impact and Human Impact and livelihoods**

Each sector assessment was conducted by a sector assessment team, which included experts from government and international leads, and partner agencies. The report for each sector was prepared by the sector assessment team according to a standard template for the sector assessment report whereas all the quantitative sectoral assessments were done as per standard MS Excel calculation sheets.

The sector teams used various damage and loss data collected by the government departments and other stakeholders. Sector teams also used the data available through remote sensing applications, humanitarian assessments, field visits and discussions with affected groups. Wherever possible, the sector teams triangulated the data available and provide realistic and credible estimates, according to the PDNA guidelines.

Key Assumptions for the Assessment

By default, all sectors estimated Damage, Loss, and Needs. Sector-specific approaches to damage, loss, and needs estimation and key assumptions were validated as part of regular weekly PDNA Coordination meetings attended by the Government of Armenia, represented by respective Ministries and International Partners.

Damage Estimation: Damage was referred to as the total or partial destruction of physical assets in the disaster-affected areas and it was measured in physical units (i.e., number of damaged houses, km of roads, hectares of crops, etc.). The monetary value of damage is expressed as the replacement costs according to prices prevailing just before the 26 May, 2024 floods. Damage was estimated for all infrastructure and assets for each affected sector at the level of nine consolidated communities and categorized by public and private ownership. Damage was analyzed and applied to baseline assets, considering three levels:

- **Fully destroyed** (where structural damage or replacement cost of the asset was more than 60% of the original asset);
- **Major damage** (where structural damage or replacement cost of the asset was in between the 15% and 60% of the original asset); and
- **Minor damage** with up to 15% damage level.

Loss Estimation: Loss was referred as to changes in economic flows arising from the May 2024 flood which can occur during or immediately after the flood. It was considered to last until full economic recovery and reconstruction is achieved with various sectors assuming different recovery timeline. Most typical loss includes the decline in output in productive sectors such as agriculture and business.

Needs Estimation: Needs were estimated for **short-term** (2024-2025), **medium-term** (2026-2027), and **long-term** needs for five years (2028-2029). Recovery needs, inter alia, included the reconstruction needs estimated as the requirements for financing reconstruction, replacement or repair of the physical assets that were damaged or destroyed by the floods; financial resources required for the rehabilitation of basic services, reactivation of productive activities, capacity building and operational costs for service delivery, etc. The costing for recovery needs includes adjustments for *Build Back Better* principles to consider quality improvements and risk reduction measures to be implemented to increase resilience against future disasters.

Estimates of damage, loss, and needs were presented in US dollars (USD). The official USD/AMD exchange rate of 387.7 confirmed at the onset of the assessment by the Central Bank of Armenia was applied.

Some sector specific assessments and surveys were conducted as part of the PDNA process, the likes of **Agriculture sector**, where the FAO Agriculture damage and loss methodology was used as basis to understand the impact on the crop, livestock, fishery, forestry and aquaculture sectors. The methodology was adapted to the context of this specific disaster and data was collected through a combination of remote sensing, statistical information, and feedback from central and local self-government sources. Based on the collected data, standard damage and loss indicator values were extrapolated and applied to the overall calculation of damage and loss. In parallel, asset valuations were established based on document reviews and statistics. The damage and loss indicators were correlated to the national and regional level statistical data for the overall impact assessment. As a final step, the values from the asset valuations were used to produce the overall damage and loss valuations.

In **Housing sector** data on the current building stock and population were sourced from the national census at the community level, available on-line. The total floor area and flooded floor area of the affected apartments were derived from local-level damage assessments conducted after the disaster. Mud depth inside buildings, data on the number of volunteer days involved in mud and furniture removal, and temporary shelter costs were all obtained from local authorities through MTAI and cross-checked with field assessments. Debris volume was calculated as per Federal Emergency Management Agency (FEMA)[4] guidelines.

In **Business sector**, due to the very limited data available, UNDP took the initiative to conduct the survey targeting identified 149

4 FEMA 329, Debris Estimating Field Guide, September 2010

affected business in Lori and Tavush regions. Through this effort, UNDP contacted 35% of the listed businesses via email and follow-up phone calls to gather comprehensive and reliable data on the types of enterprises and the extent of the damage and loss. Respondents were requested to provide information on types of businesses, extent and amount of damage suffered, duration of actual and projected layoff, lost monthly income, etc. Based on the collected data, the common trends and patterns related to damage and loss were identified, based on which several assumptions and extrapolations were made for estimating damage, revenue loss, operational disruptions, and necessary recovery investments for all identified businesses. Although these assumptions and extrapolations are inherently subject to uncertainty, they were necessary to provide a broader understanding of the overall impact from the flood on Business sector.

In **Transport sector**, a detailed damage survey of the highways M4 and M6 was conducted by the Road Development Fund (RDF), assessing replacement values for each damaged road element. Swiss Rapid Response Team came up with yet another technical assessment in June 2024[5] The unit rates were based on previous contracts and bidding documents from the ADB financed rehabilitation of the M6, which were adjusted to 2024 prices. Damage to the railway were based on actual costs incurred by SCR for the repairs, and damage to local roads and pedestrian bridges were based on estimates by the regional administrations. Damage to local bridges are based on the damage estimation and description of the bridges by the EU Civil Protection Team assessment report. Revenue loss in the railway sub-sector are based on the reported revenue data by South Caucasus Railway (SCR) and higher vehicle operating costs during the closure of the M6 were estimated based on *(i)* traffic counts before and after the event by RDF, *(ii)* a rapid planning modeling process using machine learning/applied artificial intelligence techniques in conjunction with traditional traffic planning methodologies to rapidly modify a regional and national road traffic network planning model capable of hypothetical scenario evaluation[6]; and *(iii)* vehicle operating costs provided by the ADB transport economist.

The assessment of the **Community Infrastructure sector** was conducted in close collaboration with line ministries, as well as in consultation with the 9 community administrations affected by the flood and private sectors managing the community infrastructure sectors. Data and information were mostly provided by the Ministry of High-Tech Industry, the Ministry of Territorial Administration, Gazprom Armenia CJSC, Veolia Jur CJSC, and Electric Networks of Armenia CJSC. This was followed by desk research for baseline information, quantitative data analysis, and semi-structured interviews with stakeholders including data validation process.

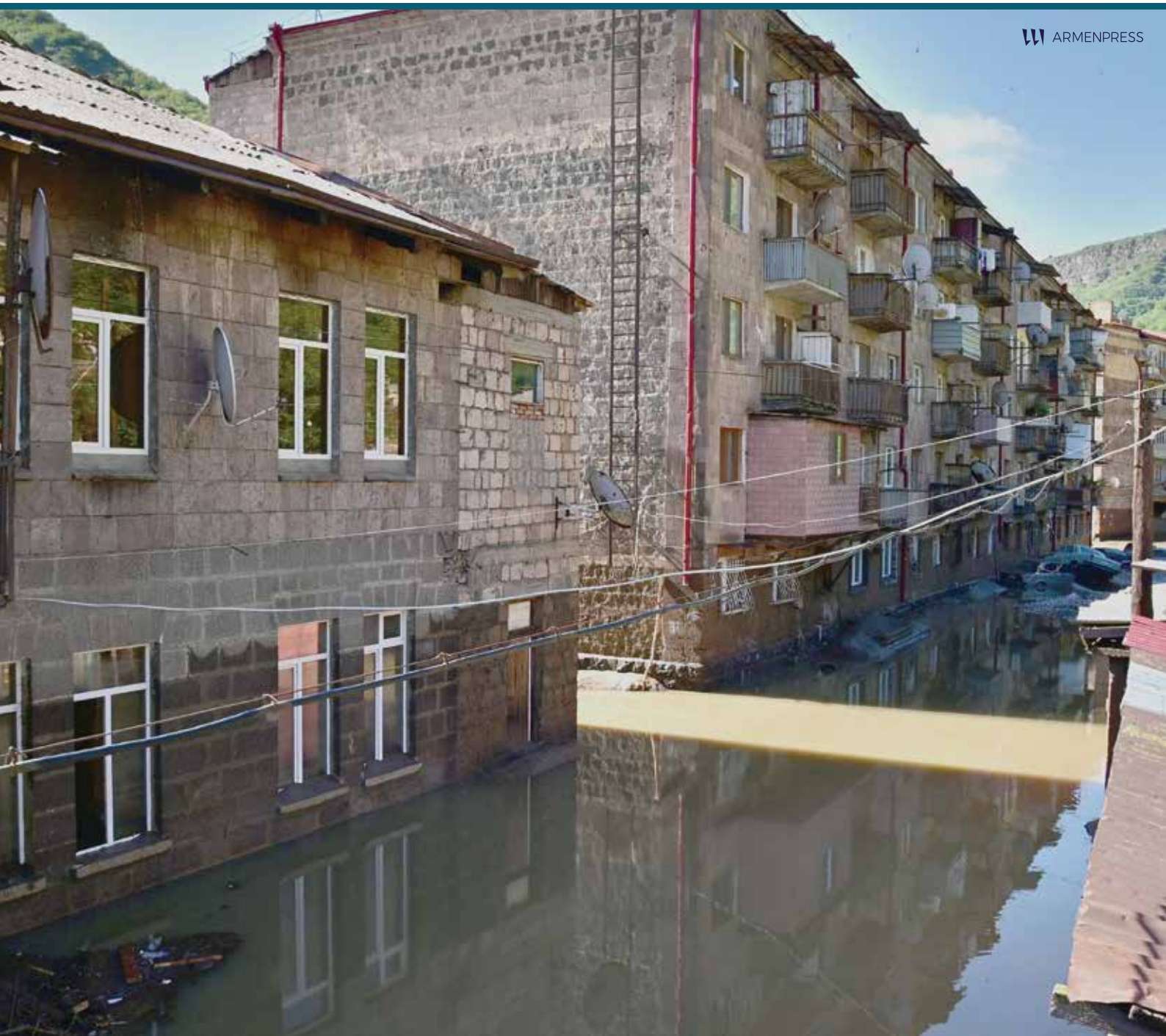
In **Gender insights**, field group discussions were organized to develop gender-specific recommendations for improving disaster response mechanisms with the specific focus to assess the gender component in post-disaster needs across all the nine affected consolidated communities. To achieve this, two on-line Focus Group Discussions (FGD) were conducted: one with Local Self Government (LSG) representatives and another with affected women from the same communities. The first FGD included 8 LSG representatives from Alaverdi, Tumanyan, Pambak, Gyulagarak, and Tashir communities in Lori region, and Ijevan, Dilijan, and Noyemberyan communities in Tavush region, comprising social workers, specialists, and a disaster response committee member. The second FGD involved 6 affected women, aged 34-75, from Dilijan, Gyulagarak, Pambak, Tashir, and Noyemberyan communities. LSG members engaged affected women for the FGDs, ensuring equal participation opportunities without discrimination.

In the sector of **Environment**, the extent of damage along the riverbanks was quantified through remote sensing analysis conducted

5 Swiss Rapid Response Team, May 2024 Floods in Armenia, Technical Assessment Report, June 2024
6 Waller et al. (2021), Waller et al. (2023) and Lalwani et al. (2024)

by the ICube-SERTIT emergency response service. SERTIT team provided a post-disaster analysis targeting: localization, qualification and quantification of debris along the Debed River; and estimation of the flood propagation using a flood simulation along the Debed river. According to the post-event satellite imagery availability, the required PDNA data were assessed over different areas of interest (AOI): identification of debris along the Debed River; and Flood simulation in Debed, Dzoraget and Aghstev valleys. As a result, remote sensing estimation of eroded river, trees, soil, wood, mud and metallic deposit in Debed river was developed.

Given that the **DRR sector** is a cross cutting sector which covered DRR needs for all the affected sectors such as Transport, Community Infrastructures, Housing, Agriculture, Health etc. the recovery cost was around 7 times higher than the respective DRR sector level damage and loss calculation. In return, the implementation of the suggested recovery solutions and strengthening of disaster and climate risk observation, modeling, EWS capacities, as well as enhancement of technical capabilities of Hydromet system will improve disaster risk informed decision making at all levels of administration, all affected regions and all PDNA sectors.



Disaster Response

National Response

In the immediate aftermath of the devastating floods of May 2024, the Armenian Government, through its key ministries, activated an extensive disaster response mechanism. The MIA spearheaded search and rescue efforts, while the MTAI coordinated emergency repairs. Additionally, the MoE directed clean-up operations, ensuring an organized approach to disaster recovery.

Key national response activities included:

- The formation of an operational emergency working group, established by a Deputy Prime Minister's decree, to oversee emergency response and early recovery actions. Crisis communication was maintained through regular press releases and media outreach.
- The deployment of 136 teams and 42 operative groups, mobilizing a total of 1,809 rescue personnel under the MIA. These teams constructed two temporary pedestrian bridges in Karkop and Sanahin to restore access to isolated communities.
- Temporary evacuation of 2,382 people, with 332 individuals housed with relatives or in six hotels, while others have safely returned home.
- Over 120 ecology patrols and forestry personnel participated in ongoing clean-up efforts.
- Temporary repairs and restoration of basic services such as electricity, gas, water, and roads were carried out by the relevant departments and companies, though full assessments and comprehensive reconstruction are still required.
- Damage assessment teams, under the direction of compensation commissions, were dispatched to collect data on damage.
- The Ministry of Labor and Social Affairs (MLSA), in collaboration with local governments, initiated the assessment of community needs, particularly in areas that were inaccessible during the initial 10 days after the floods.
- Non-food items (NFIs), such as clothing and hygiene supplies, were distributed to meet immediate needs.

As part of the business support program, a decision was made to extend the loan repayment period for the affected agro-producers by setting an additional grace period for repayment of principal amount or interest. The loan portfolio acquired by about 100 producers, primarily in the agricultural sector, is estimated at about 390 thousand USD.

Approximately 770,000 USD will be directed towards supporting around 150 entrepreneurs, including owners of damaged commercial properties. The amount of assistance will be determined based on the extent of the damage, the size of the affected property, and the taxes paid in the previous year. An additional 380,000 USD is allocated

to compensate farmers for lost livestock, destroyed crops, fruit trees, and berry bushes. The government will also provide compensation to car owners whose vehicles were damaged in the floods.

In July, the government decided that families affected by the flood would receive approximately 100-155 USD per square meter of flooded houses, and the same amount was set for each of the 854 affected residents in the two regions, as well as approximately 3,100 USD for the fully damaged property.

Despite the swift response, several challenges were identified:

- Many affected settlements were not covered by functional Early Warning Systems.
- The disaster exposed gaps in local Disaster Risk Management (DRM) capabilities, revealing shortcomings in planning, insufficient professional resources, and limited material capacity across prevention, preparedness, and response stages.
- There was a lack of public awareness about emergency response procedures, further complicating evacuation efforts.
- Risk modeling and contingency planning systems for effective emergency preparedness and response were found to be insufficiently developed, leaving decision-makers with limited access to essential risk mitigation tools.
- Despite the declared support packages, as of mid-August, almost half of the families affected by the disaster have not yet submitted applications to the municipality. Moreover, almost three months after the flood, the affected families have yet to receive any financial support from the state. During the phone call interviews not a single person indicated registration for any of the known business support packages, nor indicated that such support has been received. These make one think, that the recovery process, especially for the businesses and livelihoods, may progress slower than expected or planned, with growth potentially remaining below pre-flood levels for several months, if not years.

International Response

In coordination with the Government of Armenia, the international community promptly mobilized to provide critical support. This multi-level cooperation involved key partners such as the European Union, United Nations agencies, the Asian Development Bank, and the Swiss Agency for Development and Cooperation (SDC), among others.

On May 31, 2024, the Armenian Government activated the European Union Civil Protection Mechanism (UCPM), formally requesting international assistance in several key areas:

- Deployment of structural engineers and experts to assess damaged infrastructure, including roads, bridges, water supply systems, and waste management solutions.
- Provision of high-resolution satellite imagery, risk modeling, and analytical tools for accurate damage assessments.
- Supply of modular bridge solutions to restore access to cut-off communities.

The Ministry of Foreign Affairs (MFA) submitted a request to the United Nations for support in coordinating relief efforts. This included:

- Comprehensive damage and loss assessments to identify early recovery priorities.
- Financial and technical assistance programs aimed at rebuilding critical facilities and livelihoods through resilience-building initiatives, agricultural support, and vocational training.

- Psychosocial support programs to address the mental health needs of the affected population, including trauma counseling.
- Development and implementation of post-disaster recovery programs based on sectoral needs assessments.

Jointly coordinated international responses included:

- The acquisition of 35 satellite images to aid in analyzing the disaster zone (provided through the EU Aristotle project).
- The deployment of an SDC Rapid Response Team (RRT), composed of structural engineers, disaster risk reduction experts, and hydraulic engineers. This team conducted field assessments along the Debed River and in the Tavush and Tashir/ Stepanavan regions, focusing on bridges and riverbank protection. Initial findings were shared with the MTAI.
- The deployment of an EU Emergency Response Coordination Centre (ERCC) liaison officer to assist with further assessments.
- Collaboration between an Asian Development Bank team of engineers and MTAI's Roads Department to assess road damage.
- UNOSAT's analysis of two key affected areas (40 km^2 and 100 km^2) in Lori and Tavush regions, evaluating the impact on populations, buildings, bridges, roads, and railway segments.
- UNDP-led assessments utilizing drones and GIS technology in Karkop and Sanahin, visualizing the dynamic nature of flood-related damage.
- The UN system, in collaboration with the Government and regional administrations, conducted a comprehensive MIRA to determine immediate humanitarian needs and long-term recovery strategies.

Macroeconomy

Macroeconomic Situation in Armenia

Before COVID-19 pandemic and large-scale military escalation in Nagorno-Karabakh with Azerbaijan in 2020, the economy of Armenia had recorded robust growth with 6.77% annual average GDP growth rate during 2017-2019 (7.6% in 2019). After suffering a significant economic slowdown in 2020 at -7.2% GDP growth rate, the economy of Armenia started to recover, resulting in 12.6% and 8.3% GDP growth in 2022 and 2023[7].

In 2023, economic activity indicator showed a 9,8% growth, while agriculture sector experienced a slight decline of 0.3%. Significant increase was recorded both in exports (55.3%) and imports (40.2%), as well as in trade turnover (25,7%) and the services sector (10.3%)[8].

Figure 5. Real GDP growth in 2010-2023 (%)

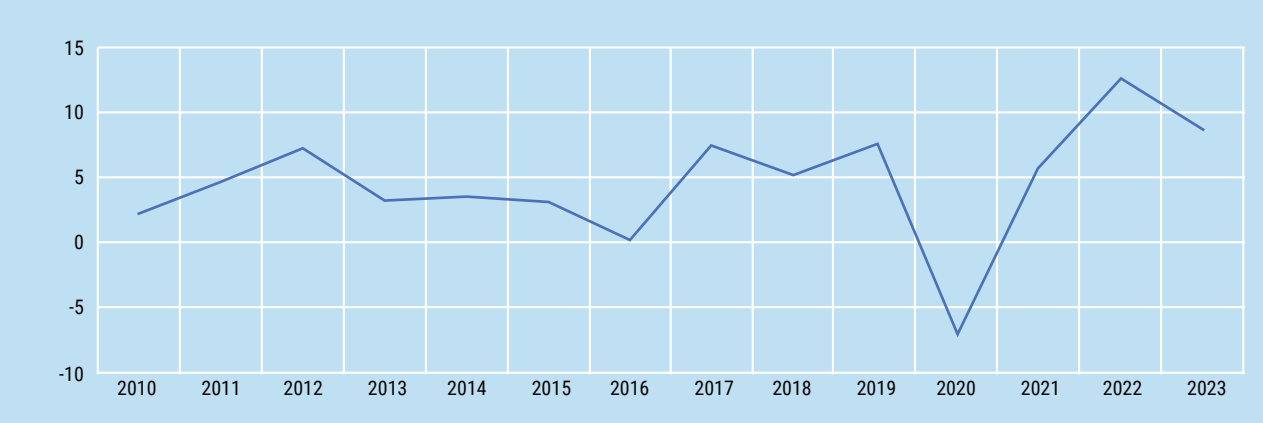


Table 4. Key macroeconomic indicators 2020-2023

	2020	2021	2022	2023
Consumption to GDP, %	90.3	84.9	78.6	79.5
Private consumption to GDP, %	75.3	71.2	66.9	65.4
Public consumption to GDP, %	15.0	13.6	11.7	14.1
Investment to GDP, %	19.7	23.0	22.4	21.3
Net export to GDP, %	-10.0	-7.9	-1.0	-0.8

7 Source: Ministry of Economy of RA, https://www.mineconomy.am/
8 Source: Ministry of Finance of RA, https://minfin.am/en/page/_en_chart_/

	2020	2021	2022	2023
Export of goods and services growth, %	-34.1	31.3	101.1	41.6
Import of goods and services growth, %	-33.2	20.4	74.3	41.6
Current Account Deficit to GDP, %	-4.0	-3.5	0.3	-2.3
External Public Debt to GDP, %	47.3	48.0	30.2	27.7

The flood had significant short-term and long term negative macroeconomic impact at both community and national levels in Armenia. The combined effects in various sectors have disrupted economic activities, necessitating substantial recovery efforts to restore normalcy and support long-term resilience.

Government Response

Following the severe flooding, the Armenian government, in coordination with international aid agencies, launched swift relief efforts. These included the provision of essential supplies such as food, clean water, medical aid, and temporary shelter for displaced families. Efforts also focused on restoring key infrastructure like roads and communication lines to facilitate recovery. Local authorities and humanitarian organizations collaborated to ensure that relief reached the most affected populations, helping to mitigate the disaster's immediate impacts.

The primary focus is placed on rehabilitating damaged infrastructure, including roads, bridges, and public buildings, to restore access to essential services such as healthcare, education, and transportation. Repair work on key transportation routes is ongoing, aiming to reconnect isolated communities and ensure the timely delivery of relief supplies. Additionally, sustainable and disaster-resistant designs are being incorporated into new infrastructure to reduce the risk of future flood damage. Efforts are also underway to support agricultural recovery by providing farmers with seeds, livestock, and equipment to resume production.

Recognizing the significant losses suffered by farmers and businesses, the government introduced financial assistance to aid recovery. This financial support aimed at helping agricultural operations and local enterprises resume activities, ensuring the stability of the local economy. As of August 2024, compensation has been provided to families affected by the floods in the affected regions.

Economic stimulus packages to support recovery and boost local economies has been launched by the Government. These initiatives include targeted tax relief for affected businesses and low-interest loans to help small and medium-sized enterprises rebuild facilities and restore operations. Grants are also being offered to encourage investment in key sectors like agriculture, tourism, and trade. These measures are designed to provide immediate financial relief while fostering sustainable economic growth and resilience in the affected regions.

Table 5. Government programs implemented for Lori and Tavush regions (In USD: millions)

Program / Measure	Allocated by RA Government Decisions	At the expense of reallocations	At the expense of the reserve fund of the RA government	On Account of Revenue/ Deficit
Total expenses	3.75	0.78	2.97	-
MLSA	0.01	0.01	-	-

Program / Measure	Allocated by RA Government Decisions	At the expense of reallocations	At the expense of the reserve fund of the RA government	On Account of Revenue/ Deficit
Social support given to individual social groups in order to combat crises and reduce and eliminate the consequences of emergency situations	0.01	0.01	-	-
MTAI	3.35	0.77	2.58	-
Implementation of projects requiring priority solutions in the regions, as a result of which solutions will be given to the socially important problems of the population and communities	0.77	0.77	-	-
Financial support to families affected by floods in Lori and Tavush regions	2.58	-	2.58	-
Ministry of Economy	0.39	-	0.39	-
Providing support to address agricultural damage in the areas of the declared disaster zones due to the floods caused by the heavy rains that fell on May 25-26, 2024 in Lori and Tavush regions	0.39	-	0.39	-

Macroeconomic Implications

The disaster have posed significant challenges for the Armenian economy. The immediate impacts include reduced agricultural output, infrastructure damage, and increased public spending. However, the long-term response and recovery efforts will be essential to rebuilding and ensuring sustainable growth. Overcoming these challenges will require coordinated efforts from the government, international partners, and local communities to enhance resilience and promote economic recovery.

Mining is one of the hardest-hit sectors. From January to July 2024, production volumes in the mining sector saw a sharp decline of 8.6% compared to the same period in 2023. This was largely due to damage to critical infrastructure, including electricity, which led to interruptions in power supply and forced mining companies to halt operations for several days, further exacerbating production losses. The metal ore mining sub-sector had the most significant decline, with production falling by 10.4%. This reduction in output has broader economic implications, affecting local revenues and potentially slowing the region's overall economic recovery.

The transport infrastructure also underwent substantial disruptions, which included key automobile roads, railways, and bridges of both inter-community and inter-state significance. From January to July 2024, cargo transportation volumes declined by 14.2% compared to the same period in 2023 due to damages to roads and bridges, not only delaying the movement of essential goods and services but also negatively affecting businesses that rely on efficient logistics.

The **energy sector** has also been severely affected, with two hydroelectric power plants in Lori heavily damaged, leading to a sharp decline in the electricity production. There have been significant damage also to the pylons of overhead power lines. As a result the production volume dropped significantly from approximately 0.21 million USD to 0.13 million USD. The restoration of these facilities is critical to resuming normal operations and preventing further economic fallout.

Early indicators suggest a decline in the **agricultural sector** as well. Circulation of agricultural retail products dropped in the first half of 2024. A decline of 4.4% was registered, compared to the same period in 2023.

Although it is too early to fully assess the long-term impact on the agricultural sector, these early signs indicate that both producers and retailers will continue to face challenges in the months ahead.

The disaster also had a profound effect on **local employment**, particularly for farmers and small businesses that are vital to the regional economy. The loss of crops and disruptions of planting cycles have led to immediate income losses for farmers, while small businesses, reliant on agricultural supply chains also suffered due to operational challenges caused by damaged infrastructure and reduced demand. As a result, many families are now experiencing increased unemployment and underemployment, exacerbating existing vulnerabilities in these communities. The ripple effects of this disaster underscore the urgent need for targeted support and recovery strategies to restore livelihoods and rebuild resilience in the affected regions. The government's recovery programs aim to mitigate this problem by creating jobs through reconstruction projects and support for small businesses.

The **Armenian government has responded to the challenges by significantly increasing public spending** to support affected families, farmers and businesses, allocating approximately 7.5 million USD for recovery and rehabilitation, contributing most of this allocation from the state reserve fund. While this immediate financial assistance is crucial, it also places additional pressure on the state budget. The reallocation of reserve funds may lead to an increase in the state budget deficit, especially given the potential reduction of revenues from key sectors like mining, transport, and energy due to the disaster. This could potentially limit the government's ability to invest in long-term development projects leading to higher public debt, with further pressure on the country's economic stability.

Lastly, the disaster is likely to contribute to rising **inflation rates**, further straining purchasing power and living standards. The disruptions in transportation lead to supply shortages and increased prices for essential goods. Damage to agricultural land also led to disruptions in food production, resulting in reduction of food supply and increase in prices of agricultural products. Energy costs may also rise, increasing the financial burden on households. These compounded challenges will erode disposable income, forcing families to allocate more of their resources to basic needs and potentially may lead to increased poverty levels. This will create long-term challenges for improving living standards in the affected areas

In a nutshell, the disaster has led to a reduction in economic output in the affected regions, which contribute to the national GDP. Several sectors have experienced a decline, impacting overall economic growth. On the positive side, reconstruction activities may provide a temporary boost to the construction sector and related industries, partially offsetting the negative impacts.

Human Impact and Livelihood

Pre-disaster Baseline Information

According to Armstat, as of January 2023 pre-disaster population in Lori region was 222,763 (including 104,477 male and 118,286 female), and in Tavush region 115,004 (including 55,963 male and 59,041 female)[9].

In the Tavush region, over 25.5% of the female population was over 60 years old, while approximately 22.9% were girls under 18. Among the male population, 27.8% were boys under 18, and 18.4% were elderly individuals over 60.

In the Lori region, 29.9% of the female population was over 60 years old, while around 22.0 % were girls under 18. In the male population, 26.9% were boys under 18, and 19.1% were elderly individuals over 60..

Further to the above figures, following September 2023 refugee influx from Nagorno Karabakh, Lori and Tavush hosted 4,401 and 3,083 refugees respectively. 7 percent of the total Nagorno Karabakh refugee population is being hosted in these two regions affected by floods (Tavush 3% and Lori 4%).

Assessment of Disaster Effects and Impacts

A total of 40,839 people across nine consolidated communities in the Lori and Tavush regions of Armenia were estimated to be affected by the flooding. There were four casualties, and 2,382 people were temporarily evacuated. With regard to children, as a result of the disaster, no child from the disaster area was placed in a 24-hour long-term care center or crisis support center for children.

In total, 464 dwellings including 327 family houses and 137 apartments were flooded, with 269 dwellings either partially damaged or completely destroyed. In the communities of Lori region, 350 families have lost auxiliary constructions, and in Tavush region that number reaches 124. The Alaverdi, Tashir, Gyulagarak, and Noyemberyan communities were the most affected.

Tashir and Alaverdi took the strain of displacement, with 1,100 individuals in Tashir and 723 in Alaverdi, comprising both refugees and the host community. The most impacted

9 Based on the RA 2022 population Census

settlements include Karkop (no refugees reside in this village), Tashir (1,242 refugees), Alaverdi (310 refugees) and Sanahin (14 refugees), with refugees faced severe challenges, from flooded basements and damaged food supplies to disrupted infrastructure and essential services. No direct impact of the flooding on refugees was observed in Gyulagarak community and Haghtanak village.

Prior to the floods, many of the affected areas already suffered from high unemployment rates, especially among households in rural areas.

As a part of the response the Government adopted the decision of 4 July 2024 No. 1033-L On approving social support measures for families affected by heavy floods on May 25-26, 2024 in Lori and Tavush regions of the Republic of Armenia and the procedure for the delivery of social support measures.

The following categories of affected population were provided with one-time cash assistance:

- Families with deceased victims: approximately 2,600 USD per family.
- For Alaverdi community in Lori region and Ayrum settlement in Noyemberyan community, Tavush region: approximately 155 USD per family member.
- For Tumanyan, Pambak, Tashir, Stepanavan, and Gyulagarak communities in Lori region, and Archis, Bagratashen, Debedavan, Haghtanak, and Ptghavan communities in Noyemberyan community, along with Dilijan and Ijevan communities in Tavush region: approximately 100 USD per family member.

As of September 30, 2024, the United Social Service (USS) received 621 applications (covering 1,510 individuals), of which 578 applications (1,425 individuals) were approved. This included 463 applications (1,036 individuals) from Lori region and 115 applications (389 individuals) from Tavush region.

A total of 0.33 million USD was allocated to affected families for damages to residential and non-residential spaces, distributed as follows:

Compensation for victims: approximately 10 thousand USD was allocated to the families of four deceased individuals.

Compensation for residential buildings: 0.1 million USD was disbursed, with Lori region receiving 0.09 million USD and Tavush region receiving 0.01 million USD.

Compensation for non-residential spaces: 0.21 million USD was allocated, with Lori region receiving 0.16 million USD and Tavush region receiving 0.05 million USD.

The disaster has further exacerbated pre-existing vulnerabilities in the affected regions, increasing the number of people in need of health, education, and social services, which were already scarce in these communities prior to the flooding.

While immediate response measures, including psychological support services (PSS) for the affected population, have been provided, the prolonged effects of the disaster will require a significant expansion and strengthening of these services.

The recovery process, including compensation for lost and damaged properties and income opportunities such as livestock and agricultural lands, is expected to take longer to achieve. This extended timeline could result in heightened anxiety and uncertainty among the affected population.

Recovery Needs

The floods are expected to have a profound impact on lives and livelihoods. As indicated above, the assessment shows that it had direct impact on the households' vulnerabilities and welfare arising from damage and loss, and disruption of basic services, in the aftermath of the floods. Thus, the response strategy to address those needs and challenges on the human impact needs to be also closely coordinated and led with/by other sectors, especially those focusing on agriculture, health, education, housing and business.

Vulnerable groups such as women, children, people with disabilities, and refugees are likely to be disproportionally affected by the floods given their dire circumstances and limited access to social services.

Protection and coping mechanisms. The impact of the floods is likely to exacerbate already existing gender inequalities, revealing serious differences in safety, education, decision-making, and employment.

The refugees are likely to be poorer than community members, have fewer assets (including land to cultivate and provide for a living). People with disabilities and elderlies are often marginalized, economically disempowered, and face discrimination in education, employment, housing and transport, and other social services. Particular attention should be paid to these vulnerable groups when planning and delivering long-term response and solutions.

Recovery interventions should address vulnerabilities that arouse and became more acute as a result of the disaster. The most vulnerable should be prioritized and not left behind. Cross cutting sectors to factor those vulnerabilities in planning the response.

Affected population suffered notable damage and loss to their livelihoods, particularly associated with agriculture and livestock, with attendant negative impacts on their economic empowerment and wellbeing that in turn made them vulnerable. The floods might have increased women's vulnerability to gender-based violence, that could have led to household tensions, related to lack or destruction of infrastructure.

In response to the floods, many individuals and households will experience a deterioration of their living standards and circumstances. Interventions have already provided for some immediate relief to those most in need, and the recovery must address the vulnerabilities of those most affected to strengthen the inclusive character of the recovery. The main point is that all the implementation arrangements across all the other sectors affected by floods need to factor in vulnerabilities and gender profile of the population to make sure that the most vulnerable are prioritized and not left behind.

Gender Insights

Assessment of Disaster Effects and Impacts

Focus group discussions conducted in the field revealed that there are several aspects under which women and particularly women-headed households have been additionally impacted by the May 2024 floods in Lori and Tavush regions.

Primary concerns are related to the problem of livelihoods since women-headed households are disproportionately affected by issues related to problematic property ownership. These families often own property that is not officially recognized or categorized, making it difficult for them to access support or compensation. Besides that, families who have constructed homes on their own land but cannot officially register them as residential properties due to land use regulations could not benefit from government compensation. This situation is particularly dire for women-headed households, who are at higher risk of losing their homes without the necessary documentation to prove ownership and damage.

Moreover, women-headed families who have lost their sources of income from businesses or agricultural activities located on land occupied without authorization face additional hardships. These families are ineligible for government compensation despite losing their primary means of support, exacerbating their economic vulnerability.

Similarly, such families will also face long-term economic hardship due to the inability to utilize remaining land or transition to different forms of farming or livestock management adds to their vulnerability and the need for targeted support to adapt to new agricultural conditions.

Additional problems are related to the women health issues given that many individuals continue to live in homes with uninhabitable conditions - damp, moldy, and infested with fungi. This situation is particularly detrimental to women and children, who are more susceptible to health issues such as joint pain and respiratory problems due to poor living conditions. On top of this, damage to water and sewage systems has led to contamination of rivers with sewage, posing significant health risks. Women, who are often responsible for managing household sanitation, face increased risks of infection and health complications due to these environmental hazards.

And finally, due to damage recorded with infrastructure **many women and girls are facing the issues related to accessibility**. The collapse of bridges leading to schools in Ayrum, Saratovka, Karkop, and the Sanahin station district of Alaverdi community has disrupted access to education. Women, who often bear the brunt of household responsibilities, face additional challenges in ensuring their children can attend school. The urgent need for bridge reconstruction highlights the broader impact on families, particularly women managing household and educational needs.

Similarly, the destruction of school facilities in Karkop and the Sanahin station area, including essential educational resources, severely impacts students and their families. The loss of educational infrastructure exacerbates the difficulties faced by women who are already managing multiple responsibilities.

It is also to be noted that following the disaster, the municipalities were collecting applications from residents and households affected by the floods. The information gathered included data on affected individuals and damaged property based on these applications. However, the Municipalities **still lack disaggregated data on affected residents** (by gender, age, socioeconomic status, etc.). As a result, identification of priority groups for support based on vulnerability was challenging. Consensus is that the affected individuals should receive assistance, however the focus should be on evaluating the damage and providing compensation according to need, rather than prioritizing specific vulnerable group.

Snapshots from the field

While the following examples focus on a few communities, it is important to note that similar challenges are faced by women in other flood-affected communities throughout the regions.

In **Alaverdi community** various vulnerable families reside in family-owned and rented accommodations with damaged ground floors and widespread foul smell of dampness, with women disproportionately represented among the most vulnerable. These include single-parent families, predominantly headed by women, single elderly individuals, families with four or more children, where mothers often bear a greater care-giving burden, families with members who have disabilities. Additionally, there is a likelihood that some families, not previously classified as socially vulnerable, may have fallen into this category due to the severe damage inflicted on their homes by the disaster.

> *"Residents have mostly left their homes and are now renting elsewhere. However, when we conduct home visits, it is impossible to proceed due to the smell of dampness; there is even fungus growing on the walls of the buildings. The residents of the 3rd and 4th floors have no alternatives and continue to live there. The residents of the first floor have moved out because it is completely uninhabitable; the ceilings are damp. The walls have not dried out to this day. People have scraped the walls, but they remain wet. Significant time will be needed for the walls to dry before any renovation work can be done." (Social worker, Alaverdi)*

In **Noyemberyan community**, the town of Ayrum and four settlements (Haghtanak, Bagratashen, Archis, and Debedavan) have been affected by the disaster with 14 damaged houses, but most of the damage – about 90% – is to gardens and crops, which were crucial for the residents' income. According to a representative from the Noyemberyan municipality, around 3% of affected people are people with disabilities. Many of the impacted families have three or more children. Women, who were primarily responsible for washing clothes, have been especially vulnerable and faced significant challenges. The burden of hand-washing large quantities of clothes for their families or carrying the dirty clothes to the nearest functioning washing machine, combined with the stress of recovering from the damage, has added to their already heavy workload. This issue also applied to other facilities that became non-functionable after the flood.

In the town of Ayrum, Yerkatughayinneri Street in one neighbourhood was significantly impacted by the disaster, with 11 residential houses damaged. In three of these two-story houses, residents continue to live on the upper floors, as the first floors have become

uninhabitable due to severe damage to furniture, walls, floors, and doors. All furniture has rotted, broken, and been removed, necessitating immediate renovation to make them liveable again. This situation has particularly affected women, who were primarily responsible for managing the household and its daily needs, further exacerbating their challenges in this already difficult time.

In the town of Ayrum, two bridges leading to the railway station – one for transportation and one for pedestrians – have collapsed. The pedestrian bridge was crucial for accessing the residential areas where many teachers live. Since most of the teachers are women, they are particularly affected by the collapse, as they face significant challenges in accessing their homes and workplaces. If the bridge is not reconstructed by September 1st, both teachers and students will be forced to use a detour, causing considerable inconvenience.

Following the floods, women have faced heightened vulnerability due to their care-giving roles, household, and economic responsibilities. For instance, in Haghartsin, a 75-year-old woman who cares for her bedridden husband and extended family was severely impacted by the sudden loss of her home and belongings. Her age and care-giving duties made it particularly challenging for her to cope with the aftermath, amplifying her emotional and physical strain.

> ***Case 1.*** *"The river swept away the house all at once, just like that. Now we are living at a relative's house. I lived with my husband, he's 86 years old and bedridden, my three sons, and my grandchild. We had been living there for 30 years, and all our belongings were there. Now the river has completely washed everything away, and we are out on the street. We went outside at night and couldn't do anything; we ended up on the street. It rained from above, and the river came in at night, flooding everything inside. We couldn't do anything; we only saved our lives." (75-year-old woman, Haghartsin)*

Similarly, in Tashir community, a 34-year-old woman managing a household with a disabled husband and young children faces compounded difficulties due to flooding that ruined their home and essential farming equipment. The disaster not only threatens her family's livelihood but also exacerbates her financial and care-giving burdens, as well as her son's health issues caused by damp conditions. The financial aid received is insufficient to address the extensive damage, highlighting the significant strain on women during such crises.

> ***Case 2.*** *"We are a family of 7: myself, my husband, my mother-in-law, and 4 young children. My husband is a first-category disabled person; he has no arms. Around 5-6 pm, the water slowly began to enter through the gate, then filled the barn area, and eventually flooded the house. The house was newly renovated, though still unfinished. The new furniture was ruined, the wallpaper is damaged, and there's significant moisture inside. A lot of furniture was spoiled, the bathroom tiles have swollen and deteriorated, the porch has collapsed, and two washing machines, a milk separator, and other small items like the vacuum cleaner, refrigerator, and freezer were damaged… Although my husband receives a pension and I get social benefits for the 4 children, it's not enough to support a large family... Parts of the barn have collapsed, creating 1.5-meter-deep holes. Cement and sand are needed to advance our construction. We haven't been able to do any construction work for the past two months due to lack of funds. Last week, my 15-year-old son had a fever of up to 40°C that wouldn't go down. Emergency services came and took him to the hospital. After an examination, they said the dampness and flooding might have caused him to catch a cold. They suspect he might have developed rheumatism from the damp conditions and recommended taking him to a rheumatologist in Yerevan for further examination…" (Speaking with an emotional tone)" (34-year-old woman, Tashir community).*

Women have also faced increased vulnerability due to their roles in managing household responsibilities and the aftermath of the disaster. In Vahagnadzor, a 40-year-old woman struggled with the impact on her family's resort, which was devastated by flooding. The extensive damage and financial strain have forced her to rely on loans and assistance to rebuild, while the reduced business and ongoing recovery efforts placed an immense burden on her and her family. The resort's decline in visitors and the need to restore both physical infrastructure and guest appeal further compound her challenges.

In Ayrum and Gyulagarak, the situation was similarly dire. In Ayrum, families without ownership certificates faced difficulties in securing compensation, leaving them to cope with significant property damage and loss of livelihood. In Gyulagarak, a 60-year-old woman and her family lived in a structurally compromised house severely affected by water damage. The house's ongoing dampness and damage to their livestock and crops added to their hardship, while their health and living conditions were deteriorating.

In Dilijan, a single mother with two young children had been left without a home and all her belongings after their rented house was completely swept away. This sudden loss intensified her vulnerability, as she had to navigate both immediate survival and long-term recovery without the safety net of a stable living situation.

In Tumanyan, two women who possessed community-owned land without authorization for their snack bars faced significant challenges. One woman lived on the land under poor conditions and had recently undergone surgery, while the other had a second-degree disability. Both women were ineligible for government support due to the unauthorized status of their land occupation, leaving them without their only source of income and struggling to recover from the disaster's impact.

In Tashir, affected individuals included refugees who had already experienced displacement. For one refugee, essential work equipment and residential property were damaged, compounding their difficulties. The added loss of property and vehicles further strained their already precarious situation, highlighting the heightened vulnerability of displaced individuals in the aftermath of such disasters.

Recovery Needs

The following were recognized as needs in regards of the women livelihoods, health, accessibility and data collection issues so the recommendations are as follows:

- **Expand support programs to include non-residential property owners:** international organizations and NGOs should extend their support and disaster compensation schemes to encompass owners of non-residential properties affected by the disaster, particularly when these properties were used as living spaces. Special attention should be given to female-headed households, who face additional barriers during the disaster and in the aftermath when addressing the damage and loss.
- **Support documentation of damage and loss for affected families:** establish programs to assist affected families, with a particular focus on women and marginalized groups, in documenting their damage and loss. This assistance should include legal aid, help in gathering evidence, and consideration of gender-specific needs and challenges throughout the documentation process.
- **Provide financial assistance for business recovery:** offer grants or low-interest loans specifically aimed at helping families, including single mothers and female-headed households, transition to new business locations or restart their operations. Financial support should include gender-sensitive criteria to address

the unique challenges faced by women in business.

- **Include privatized household areas in aid criteria:** expand aid criteria to include privatized areas used for household purposes (e.g., kitchens, barns, cellars), recognizing their critical role in daily life. Ensure that women, who are often the primary caretakers and users of such spaces, receive appropriate support.
- **Establish compensation framework for income loss:** develop a support framework that provides compensation for families who have lost their sources of income due to the disaster, including those on unauthorized land. This framework should address gender disparities in agricultural and income opportunities.
- **Conduct health assessments and provide targeted support:** carry out health assessments focusing on children and women, to address issues caused by damp and moldy conditions. Offer financial aid or repair services with a particular emphasis on the needs of female-headed households and children.
- **Develop a centralized database:** create a centralized database for collecting and managing information on affected residents and damaged properties. Ensure the data is disaggregated by gender, age, disability status, socioeconomic background and other relevant factors. Use this data to guide targeted support and resource allocation.
- **Train municipal staff on data collection:** provide training for municipal staff on gender-sensitive data collection methods to ensure accurate and comprehensive reporting. Include training on identifying and addressing the specific needs of women and other vulnerable groups.
- **Ensure transparency in fund allocation:** maintain transparency in the distribution of support funds to prevent disputes and ensure that all affected families, including women and marginalized groups, are treated equitably.

Housing Sector

Sector Summary

The floods caused extensive damage to the housing and settlements sector in 7 communities in two regions: Alaverdi, Gyulagarak, Pambak, Tashir and Tumanyan in Lori region, as well as Dilijan and Noyemberyan in Tavush region.

While the events and magnitude of the damage varied across communities, Alaverdi and Tashir experienced the most severe impact. A total of 25 apartments were identified as either destroyed or subject to demolition, with additional 244 suffering significant damage. Overall sector **damage** was estimated **at 4.54 million USD**. **Loss** was mainly incurred in the form of debris removal and temporary shelter, **totaling 0.28 million USD**.

An estimated **6.84 million USD** will be required for **reconstruction and recovery**, including repair and reconstruction of damaged and destroyed houses, introduction of the *Build Back Better* principle, demolition and debris removal, provision of essential household (HH) items, cost-benefit analyses for the potential relocation of highly vulnerable settlements, risk awareness raising as well as restoring or establishing additional governance processes.

Table 6. Damage, loss and needs by consolidated community (in USD millions)

	Damage	Loss	Needs
Alaverdi	2.86	0.20	3.41
Dilijan	0.10	0.01	0.13
Gyulagarak	0.005	0.0002	0.005
Noyemberyan	0.10	0.01	0.11
Pambak	0.03	0.002	0.04
Tashir	1.39	0.05	1.50
Tumanyan	0.06	0.01	0.09
Nationwide	-	-	1.55
Total	**4.54**	**0.28**	**6.84**

Out of the about 890,000 apartments in Armenia, 48% are single-family homes (SFH) and 45% are in multi-apartment buildings (MAB). In terms of total floor area (105 million m^2) more than 70% is associated to SFH and less than 30% to MAB. The 2.9 million Armenian population lives mainly in urban areas (64%) and the average floor area per person is about 36 m^2. The country is divided into 10 regions and capital city Yerevan, with 71 communities.

In the two affected regions, Lori has 84,386 apartments and Tavush has 42,050 (Table 7). In Lori, 74% of the total floor area consists of SFH and 39.6% is rural, consistent with the country average. In Tavush over 90% consists of SFH and 64.6% is rural. The average apartment size in MAB is 64 m^2 in Lori and 60 m^2 in Tavush, while in SFH, it's 159 m^2 in Lori and 206 m^2 in Tavush[10].

Table 7. Building stock and population in Lori and Tavush regions

	Total		Multi-apartment buildings		Single-family homes		Population[11]
	Number of apartments	Total floor area, m^2	Number of apartments	Total floor area m^2	Number of apartments	Total floor area m^2	
Lori	84,386	9,698,526	39,158	2,496,134	45,228	7,202,392	222,763
Tavush	42,050	7,040,290	11,160	667,149	30,890	6,373,141	115,004

Table 8 presents the building stock and the population in the urban area of the most affected communes: Alaverdi and Tashir in Lori region, and Noyemberyan in Tavush region. In Alaverdi 37.5% of total floor area is associated to SFH, compared to 89.4% in Tashir and 89.3% in Noyemberyan.

Table 8. Building stock and population in Alaverdi, Tashir and Noyemberyan urban areas

	Total		Multi-apartment buildings		Single-family homes		Population[12]
	Number of apartments	Total floor area, m^2	Number of apartments	Total floor area m^2	Number of apartments	Total floor area m^2	
Alaverdi	7,183	490,741	5,563	306,936	1,620	183,805	12,135
Tashir	3,312	521,625	1,114	55,205	2,198	466,420	7,425
Noyemberyan	1,715	307,369	578	33,034	1,137	274,335	4,273

SFHs are typically one or two stories, usually constructed from tufa stone. The ground floors often have wooden flooring, while intermediate floors are built with steel profiles or reinforced concrete (RC) prefabricated joists with concrete panels in between. Reinforced concrete ring beams are common. MABs can reach up to 6 stories or more, though most MABs in Alaverdi (80%) and in Noyemberyan (over 90%) can reach from three to five stories. MABs up to five stories are mainly built of volcanic tufa stone. Multi-story buildings are also constructed from prefabricated RC panels using Soviet-era technologies (51.4% in Tashir). Recent construction uses RC monolithic frame technology to meet seismic resistance requirements (8.1% in Alaverdi).

10 Housing stock and communal economy in RA for 2022, https://armstat.am/file/article/housing_stock__2022_1_en.pdf
11 The country is divided into 10 regions and capital city Yerevan, with 71 communities.
12 Ibid.

Table 9. Construction types for 3-5 stories MABs in Alaverdi, Tashir and Noyemberyan urban areas

	Multi-story MABs (quantity)	3-5 story MABs			
		Quantity	Stone	Panel	Monolithic
Alaverdi	189	149	91.9%	0.0%	8.1%
Tashir	99	11	48.6%	51.4%	0.0%
Noyemberyan	20	19	100%	0.0%	0.0%

The interior walls of the apartments are plastered, while the exteriors are mostly exposed masonry. Partitions in the oldest buildings are made of wood. Roofs, whether gable or pitched, are generally constructed of wood covered with metal or asbestos sheets. Visual assessments and field reports[13,14] also noted the presence of one or two-story buildings with RC frames and infill walls made of tufa stones.

In addition to SFHs and MABs, another typology known as cabins was identified in the affected areas. These informal constructions, typically one-story masonry or wooden buildings, are mainly used as warehouses and, in a few cases, as residences.

In Armenia, constructions projects are categorized into five categories according to their risk[15]. According to category, they may require a design and construction permit, a certificate of completion, and an expert review. Licensed organizations must carry out design, construction, and expert reviews[16]. Of those, *Category I* are low-risk projects and include minor repairs and small-scale construction, not requiring permits and review.

Spatial planning takes place at both regional and community levels, leading to the development of master and urban zoning plans at the local level[17]. The master plan, which outlines strategic development directions, should consider the protection of the area from floods and other hazards. Due to the lack of flood hazard maps, the only flood risk provision, dating back to the Soviet era, requires that new constructions be located at least 50 meters from riverbanks.

In the meantime, settlements in flood-prone areas face increased risks due to proximity to rivers and inadequate protection measures. Poor riverbed maintenance, illegal buildings near riverbanks, and a lack of resident awareness and preparedness, further complicate effective land-use management and exacerbate these risks. Additionally, Lori and Tavush are regions prone to landslides and earthquakes, as evidenced by the 1988 Spitak earthquake. Most buildings are not earthquake-resistant, particularly those built in the Soviet era.

Assessment of Disaster Effects

The housing and human settlements sector was severely impacted by the flood, affecting seven communities in Lori and Tavush regions: Alaverdi, Gyulagarak, Pambak, Tashir, Tumanyan, Dilijan, and Noyemberyan. Twelve settlements were affected, the most affected being Karkop, Alaverdi, and Tashir.

Approximately 2,500 volunteers assisted in cleanup efforts, coordinated by the Ministry of Labor and Social Affairs and the Ministry of Education, Science, Culture, and Sports. Currently, 269 dwellings are damaged, destroyed, or need demolition, and 47 families remain evacuated.

13 UCPT Armenia 2024, Technical Assessment Report, July 2024
14 Swiss Rapid Response Team, May 2024 Floods in Armenia, Technical Assessment Report, June 2024
15 Decision of the Government of the Republic of Armenia N. 596-N, 19 March 2015, "On Approving the Procedure for Granting Permits and Other Documents for Construction in the Republic of Armenia"
16 Law of the Republic of Armenia N. HO-193 "On licensing", 30 May 2001.
17 Ibid.

Infrastructure and Physical Assets

A total of 269 apartments, including 155 SFHs and 104 apartments in MABs, were affected by the flood (flooded, structurally damaged, washed away and some requiring demolition). The quantity of flooded apartments varies between communities, with Alaverdi and Tashir communities being the hardest hit, while Noyemberyan was affected to a lesser extent (Table 10). SFHs were mostly flooded in Alaverdi and Tashir, while the damage to Multi-Apartment Buildings (MAB) was higher in Alaverdi. A total of 10 cabins were also affected. The total affected floor area is 22,058 m^2, while the total flooded floor area is 20,959 m^2. The 1,099 m^2 difference is attributed to apartments in MABs that, while not directly flooded due to their location on higher floors, require demolition due to the overall condition of the building.

Table 10. Affected dwellings (number and flooded or damaged floor area) per building type

	SFHs		MABs		Cabins		Total	
	Number	Floor area, m^2	Number	Floor area, m^2	Number	Floor area, m^2	Number	Floor area, m^2
Alaverdi	29	2,097	102	6,796	6	196	137	9,089
Dilijan	4	380					4	380
Gyulagarak	1	60					1	60
Noyemberyan	14	1,001			1	120	15	1,121
Pambak	1	37					1	37
Tashir	106	11,096	2	123			108	11,220
Tumanyan					3	152	3	152
Total	**155**	**14,671**	**104**	**6,919**	**10**	**468**	**269**	**22,058**

Given that most SFHs and MABs are constructed with masonry using tufa stones or reinforced concrete, the structures generally withstood the water, with damage mainly observed in non-structural components. Typical damage includes the deterioration of wall and floor finishes, deformation of floors and doors, and the loss of furniture and household appliances. Electrical systems still require inspection by the utility company, as the walls have not yet fully dried. In some cases, structural wooden floors were so wet that complete replacement was necessary. Water remained for a several days in Alaverdi and about one day in Tashir, causing mold growth on the walls. Mud deposits, averaging 25 cm in Alaverdi and 10 cm in Tashir, compounded the damage. Sewage systems were blocked by mud, and basements were filled with water and mud. Soil damage and scouring effects were observed in a few cases, leading to soil cavities and settlements. In addition to flooded apartments, 2 SFHs (totaling 145 m^2) and 7 cabins (totaling 287 m^2) were washed away by the floods. Additionally, 1 MAB with 16 apartments (1,000 m^2) in Alaverdi needs demolishing. Two SFHs (totaling 248 m^2) suffered structural damage.

The damage to the housing sector could have been reduced through more effective settlement planning and raising awareness of dangers associated with construction close to rivers.

Access and Availability of Services

Due to the damage to housing, many families have been displaced from their residences. 2,382 people were temporarily evacuated[18], most of them were hosted with family or friends. A total of 289 people were accommodated in hotels or apartments immediately after the flood, mostly in Alaverdi (248). In Tashir most residents of the flooded apartments returned home the day after the flood. At the time of assessment, 185 people were still accommodated in apartments[19], most of them (155 people from 47 families) in Alaverdi. One dwelling in Alaverdi was used for economic activity (VTB Armenia Bank). The

18 Analysis of the Humanitarian Situation in the Lori and Tavush regions of Armenia, MIRA Report, June 2024
19 At the time of this assessment

economic loss encountered is reflected in the Business Sector section of the current report.

Governance

The event highlighted three key governance issues: post-event damage assessment, construction regulations, and finance. While the Government of Armenia has mandated local-level damage assessments, clear guidelines and documentation for post-event damage assessment need to be developed. Current construction regulations, such as the 50-meter construction limit near rivers, have proven insufficient, highlighting the need for development of flood hazard maps to improve land use management. Financially, the event has strained government budgets due to compensation for property damage and destruction. Volunteer involvement in disaster clean-up proved highly effective.

Risk and Vulnerabilities

The damage to homes and ongoing moisture issues have heightened the vulnerability of individuals who have few alternatives for accommodation. The floodwaters may have compromised or damaged building foundations, potentially causing long-term structural problems. The heavy rains increased the risk of landslides, with satellite images revealing 11 landslides potentially affecting buildings in Vahagni and Pambak[20]. Additionally, the emotional strain of losing a home and dealing with the aftermath can potentially lead to long-lasting psychological challenges. Reconstructing in these flood-prone areas without adequate flood defenses could exacerbate susceptibility to future flooding. Furthermore, property prices in these areas may decline, complicating financial recovery for residents.

Damage and Loss

The total negative impact is estimated at 4.82 million USD. This figures does not include household utility bills for water and electricity. Most of the residential damage was to private homes, with only two cases of damage recorded in public housing.

20 Recovery Observatory, PDNA Framework, May 2024 flood event in Armenia

Table 11. Cost of damage and loss to housing (in USD millions)

	Damage	Loss	Total
Alaverdi	2.86	0.20	3.06
Dilijan	0.10	0.01	0.11
Gyulagarak	0.005	0.0002	0.005
Noyemberyan	0.10	0.01	0.11
Pambak	0.03	0.002	0.03
Tashir	1.39	0.05	1.44
Tumanyan	0.06	0.01	0.07
Total	**4.54**	**0.28**	**4.82**

The damage assessment, which includes the cost of repair of flooded buildings, the replacement cost of the buildings washed away or subject to demolition, as well as the replacement cost of household goods, has been estimated at 4.54 million USD (Table 12). The "Totally Destroyed" column includes buildings that were washed away and those marked for demolition.

Table 12. Cost of damage to housing (in USD millions)

	Flooded	Structurally damaged	Totally destroyed	Household goods	Total damage
Alaverdi	1.49	0.03	0.90	0.44	2.86
Dilijan	0.02	-	0.08	-	0.10
Gyulagarak	-	-	-	-	-
Noyemberyan	0.07	-	-	0.03	0.10
Pambak	-	-	0.03	-	0.03
Tashir	1.05	0.02	-	0.32	1.39
Tumanyan	-	-	0.06	-	0.06
Total	**2.63**	**0.05**	**1.07**	**0.79**	**4.54**

The estimate is based on a building-by-building assessment conducted at local level, as mandated by the Government of Armenia[21].

The recorded loss comprises costs related to debris removal, including mud and furniture, and temporary shelter (costs of accommodation in hotels and rented apartments). The loss has been estimated at 0.28 million USD.

The total volume of mud to be removed from the apartments is estimated at 5,646 tons, while the total weight of furniture and appliances is 624 tons. The debris of the washed away buildings and buildings to be demolished is estimated at 2,342 tons.

Assessment of Disaster Impact

Although the flooded floor area is only about 1.7% of the total floor area of buildings in both Alaverdi and Tashir communities, several settlements, including Alaverdi, Karkop, and

21 Decision of the Government of the Republic of Armenia N. 1043, 04 July 24, On Approving the Procedure for Compensation of Damage to Individuals Caused by the Emergency Situation Resulting from Floods Due to Heavy Rains in the Lori and Tavush regions of the Republic of Armenia on May 25-26, 2024.

Tashir, were highly impacted. In the short term, the housing sector will need temporary shelters, while in the short to medium term, there will be a need to rebuild or reconstruct flooded buildings and potentially resettle those exposed to high flood risk. In addition to the flood risk, constructions will also face added risks from seismic and landslide hazards.

Without comprehensive policy and programming measures, recovery will be hindered by a lack of resources and support. The lack of resources for repairing and rebuilding will prolong the reconstruction process, keeping people in temporary shelters for an extended period. Homes rebuilt without proper planning and regulation will remain vulnerable to future floods. The absence of strict land use control could lead to reconstruction in the same high-risk areas, and the presence of illegal buildings in flood zones will further complicate future mitigation efforts. Additionally, rebuilding without energy-efficient designs will lead to increased energy consumption and higher costs for residents.

The Sector Recovery Strategy

Sector Recovery Vision

The vision for housing sector recovery focuses on swift reconstruction to minimize time in temporary accommodation and foster resilient settlements. Key guiding principles include:

- **Financial and Technical Support:** providing financial assistance and technical training on flood-resistant construction techniques.
- **Community Involvement:** engaging communities in planning, decision-making, and education on flood risks and land use regulations.
- **Resilient Reconstruction:** implementing *Build Back Better* principles, creating flood hazard maps, regulating land use, relocating vulnerable populations.
- **Inclusivity and Equity:** addressing the needs of vulnerable populations and ensuring equitable distribution of resources.
- **Continuous Monitoring:** establishing mechanisms to evaluate the effectiveness of recovery and reconstruction efforts.

The vision of the sector recovery is fully aligned with the National Strategy for Disaster Risk Reduction 2017-2030 and its action plan[22].

Reconstruction and Recovery Needs

Reconstruction needs in the housing sector should prioritize repairing and rebuilding damaged and destroyed homes. The new housing units should be built with flood and seismic resilience features, along with energy efficiency improvements. These needs may also include relocation of a limited number of housing units from high flood-risk areas.

Key recovery needs include:

- Temporary accommodations, debris removal, and replacement of essential household goods.
- Securing funds for reconstruction, developing a post-event damage assessment methodology, implementing an Early Warning system, improving land use planning, managing illegal buildings, and raising community awareness on flood risk.
- Preparing flood hazard maps integrated with landslide and seismic risk assessments.

These needs to be aligned with Armenia's Disaster Risk Reduction strategy.

22 Decision of Government of Armenia N. 40, dated 13 October 2017

The Housing sector recovery plan is composed of the following components:

- **Repairs and new construction:** an owner-driven process supported by government financial assistance to eligible homeowners. A total of 269 apartments needs repair or replacement.
- **Flood and seismic resilience and EE rehabilitation:** incorporation of energy efficiency measures where feasible, including the replacement of damaged windows with energy-efficient ones. Construction of new units with flood mitigation measures (through use of solid foundation, raising the floor levels, introducing valves in the plumbing system), along with seismic and energy efficiency measures.
- **Cost-benefit analyses on potential relocation of buildings exposed to high flood risk,** facilitating informed decisions on potential relocation of buildings exposed to high flood risks.
- **Sheltering population:** accommodation of permanently displaced 185 residents, mostly in the Alaverdi community, in apartments and hotels.
- **Demolition** of 11 apartments in 1 MAB.
- **Debris removal**, including natural (mud) and artificial (household goods and demolished buildings) debris, while there is no debris recycling facility in the disaster zone.
- **Replacement of damaged household goods**
- **Development of compensation mechanism:** including ensuring budget funds at the entity and state levels designated for the reconstruction and relocation of houses, proportionate to the extent of damage experienced by households, as well as introducing criteria for identifying and selecting potential beneficiaries, along with the definition and implementation of administrative procedures and monitoring systems.
- **Development of multi-hazard post-event building damage assessment methodology**, integrating standardized procedures for inspections, data collection, and damage categorization. Advanced technologies, like drone surveys and GIS, should be widely used to improve damage evaluation and data visualization. Relevant training, exercises and guidelines for assessors should be introduced as well.
- **Implementation of Early Warning and Early Actions system**, including enhancing equipment and training personnel for effective hazard detection and forecasting, with a special focus to public engagement through mobile phones and apps, placing additional focus on the needs of vulnerable populations. Local-level early actions should be identified based on the severity of early warnings.
- **Improvement of land use planning and illegal building regulations**, as an essential factor to regulate construction activities in flood-prone areas. This should include incorporating flood hazard risk in land use management, ensuring that future land allocations for housing are carefully mapped vis-à-vis the natural disaster risks. No new houses should be constructed without first obtaining a construction permit to prevent development in flood-prone areas.
- **Community engagement and awareness raising**, ensuring involvement of the population from affected communities in the recovery and reconstruction process. Communities in high-flood risk areas need to be informed about risks and encouraged to rebuild in safer locations.
- **Capacity building in the housing sector**, focusing on disaster resilient housing construction, spatial and urban planning, flood resistant buildings, recovery

preparedness, loss and needs assessment, debris recycling.

- **Developing insurance schemes**, tailored to flood risks.
- **Monitoring reconstruction and recovery**, ensuring community feedback and subsequent priorities adjustments.
- **Preparation of flood hazard maps and flood risk maps**, with the identification of areas prone to flooding through hydrological and topographical analyses, mapping historical flood events, and modeling potential flood scenarios.
- **Integrated hazard and risk assessment (including flood, landslide, and seismic risk)**, ensuring holistic understanding of the potential impacts on communities and facilitating coordinated mitigation strategies, resilient urban planning, and informed decision-making. This should include multi-hazard evaluation (floods, landslides, and seismic risks) within a single framework.

The Sector Recovery Needs Costing

The recovery and reconstruction needs are estimated to reach 6.84 million USD over the short (5.19 million USD) and medium term (1.65 million USD). The costs include the repair of 244 apartments and the new construction of another 25, as well as demolition, debris clearance and temporary accommodation. Additionally, the costs include activities for restoring governance and social processes and addressing pre-existing and new risks, as outlined in Table 13.

Table 13. Reconstruction and recovery needs assessment for Housing sector (in USD millions)

Component	Short-term Needs	Medium-term Needs	Total
Reconstruction Needs	**3.46**	**1.06**	**4.52**
Repairs and new construction	2.81	0.94	3.75
Flood and seismic resilience, EE rehabilitation	0.35	0.12	0.47
Cost-benefit analyses on potential relocation of buildings	0.30	-	0.30
Recovery Needs	**1.73**	**0.59**	**2.32**
Sheltering population	0.06	0.02	0.08
Demolition and debris removal	0.20	-	0.20
Replacement of household goods	0.71	0.08	0.79
Development of MH post-event building damage assessment methodology	0.14	0.06	0.20
Improvement of land use planning and illegal building regulations	0.21	0.09	0.30
Community engagement and awareness raising	0.14	0.06	0.20
Capacity building in the housing sector	0.14	0.06	0.20
Developing insurance schemes	0.09	0.21	0.30
Monitoring reconstruction and recovery	0.04	0.01	0.05
Total	**5.19**	**1.65**	**6.84**

The costs for the preparation of flood hazard maps and flood risk maps, the integrated hazard and risk assessment, and the implementation of the Early Warning and Early Actions system are accounted for in DRR Sector. The costs for capacity building on natural and artificial debris recycling are accounted for in Environment Sector. The value of recovery needs may potentially increase, if studies indicate that additional households need to be relocated as a result of high flood risk.

The amount of government compensation is estimated at 2.14 million USD for apartments damage and up to 0.64 million USD for the replacement of goods.

Implementation Arrangements

In the two affected regions of Lori and Tavush, Government of Armenia[23] established a compensation framework based on results of the damage assessment conducted at local level. Compensation is provided to owners of legally registered apartments, designated as primary residences and not insured against natural disasters, based on the actual flooded area with the limit of 80 m^2 per dwelling. Additionally, compensation is established for the lost furniture and electric appliances, with priority given to households most severely affected by the disaster.

The Government of Armenia[24] also provided social support, in the form of a one-time cash assistance, to the families of those who lost their lives, as well as to the families whose residential properties were damaged.

Particularly, a total of 578 applications were approved covering 1,425 individuals and a total of 0.33 million USD was allocated to affected families as a compensation for damages to residential and non-residential spaces.

Supported by government compensation, the repair of flooded apartments is already ongoing. These works fall under Category I by law[25] and hence do not require design and construction permit.

23 Decision of the Government of the Republic of Armenia N. 1043, 04 July 24, On Approving the Procedure for Compensation of Damage to Individuals Caused by the Emergency Situation Resulting from Floods Due to Heavy Rains in the Lori and Tavush regions of the Republic of Armenia on May 25-26, 2024.

24 Decision of the Government of the Republic of Armenia N. 1033, 04 July 24, On Establishing the Procedure for Compensation of Damage to Individuals in the Disaster Zone as a Result of the Emergency Situation Due to Heavy Rains and Floods of May 25-26, 2024, in Lori and Tavush Regions of the Republic of Armenia.

25 Decision of the Government of the Republic of Armenia N. 596-N, 19 March 2015, “On Approving the Procedure for Granting Permits and Other Documents for Construction in the Republic of Armenia”


LASER

Business Sector

Sector Summary

The devastating flood caused significant damage, disrupting economic activities and inflicting considerable financial loss on the local economy. Many commercial buildings, industrial factories, warehouses and retail stores were affected, with significant **damage** in building property, inventory and equipment, **estimated at 6.27 million USD**.

The disaster has inflicted substantial damage on commercial and industrial infrastructure, as well as on micro and small businesses, resulting in significant financial loss and disruptions. If recovery measures are not promptly and effectively implemented, the local economy may experience a protracted downturn, with diminished investment and reduced economic activity.

Table 14. Damage, loss and needs by community (in USD millions)

Consolidated Community	Damage	Loss	Needs
Alaverdi	3.27	2.49	4.54
Dilijan	0.98	0.17	1.41
Ijevan	0.19	0.07	0.29
Noyemberyan	1.85	0.23	2.54
Pambak	0.30	0.15	0.43
Tashir	0.07	0.02	0.10
Tumanyan	0.02	0.25	0.02
Nationwide (no specific region)	-	-	2.69
Total	**6.27**	**3.39**	**11.21**

The flood led to prolonged business interruptions, as many manufacturing units were forced to halt production due to floodwaters and supply chain disruptions especially in Alaverdi and Noyemberyan cities. The loss of approximately 2,100 jobs, coupled with a significant drop in business revenues resulted in **loss estimated at 3.39 million USD**. This may lead to further increase in unemployment and a decrease in household incomes, potentially exacerbating poverty levels and creating long-term economic hardship for affected communities.

Armenia needs to ensure immediate employment and economic opportunities for the people and businesses that had suffered the most from the disaster in all subs-sectors. This will allow to mitigate immediate disaster effects, while also sustaining and possibly increasing post-disaster employment in the business sector, based on different multiplier recovery effects, and developing basic

livelihood means. It's post-disaster recovery strategy will need to enable risk-informed sustainable economic growth including through relevant stimulation packages and legal amendments, which will stimulate future resilient investments and also ensure sustainable competitiveness for the future.

Pre-disaster Baseline Information

Sector Overview

Armenia's economy has made significant progress in recent years. The GDP per capita reached 8,126 USD, while foreign trade increased by 46%, amounting to 20.7 billion USD. The business sector, spread across services, industry, and agriculture, plays a pivotal role in this growth, with Lori and Tavush regions contributing to national development through key industries.

The services sector is the largest contributor to Armenia's national GDP, accounting for 59%, and encompassing trade, finance, real estate, tourism, and information technology. In 2023, the IT sector alone generated revenues of 1.2 billion USD, and the tourism sector saw a 39% increase in visitors, bringing in 1.5 billion USD.

Retail trade is another important component of the national economy, growing by 17.5% in 2022, with a turnover of 11 billion USD. However, only 25% of retail sales occur outside of the capital, with rural and regional markets, including Lori and Tavush, being less developed.

In Lori industry accounts for 3.3% of Armenia's overall industrial output, with a strong focus on mining. The region produces approximately 150,000 tons of copper ore annually. Agriculture, particularly livestock and dairy farming, also plays a vital role. Next comes the region's manufacturing sector, which includes textiles and machinery. Tourism in Lori is emerging as a significant sector, with eco-tourism and cultural heritage sites such as Haghpat and Sanahin monasteries attracting 120,000 visitors annually.

Tavush region's economy is heavily reliant on agriculture and forestry. Fruit and vegetable production is particularly prominent, with an annual production of 20,000 tons. Tavush's industrial sector, including the production of construction materials and food processing, adds about 30% to the regional GDP, while the region's tourism sector, driven by nature and cultural sites such as Dilijan National Park and Goshavank monastery, attracts 90,000 visitors annually.

Alaverdi in Lori, once an industrial town with a focus on copper manufacturing, now has a growing tourism sector with a 33.3% increase in hotels and B&Bs since 2012. Stepanavan, located on the Yerevan-Georgia interstate road, is also developing its tourism and manufacturing industries, with several small factories in food processing and electrical equipment. In Tavush, wine production and the growing light industry are significant contributors to the local economy, with small hydro-power plants playing an important role in energy production.

The recent floods have heavily impacted key sectors, particularly agriculture, tourism, and small and medium enterprises (SMEs), which are critical to sustaining livelihoods and regional economic stability.

The devastating flood caused significant damage, disrupting economic activities and inflicting considerable financial loss on the local economy. Commercial buildings, industrial factories, warehouses and retail stores were affected, with significant damage in building property, inventory and equipment, estimated at 6.27 million USD. The flood led to prolonged business interruptions, as many manufacturing units were forced to halt production due to floodwaters and supply chain disruptions. Retail businesses and service providers suffered significant damage and loss due to stock damage and a drop in consumer traffic.

While not the hardest hit, the tourism sector also experienced a considerable decline in visitors, according to interviews with sector representatives. Micro and small enterprises operating in the 9 impacted communities were particularly vulnerable, with many facing the risk of permanent closure due to financial stress and considerable damage.

The temporary closure of businesses led to the loss of approximately 2,100 jobs for periods ranging from 2 weeks to 3 and more months and loss of estimated 3.38 million USD (including 1.1 million USD in jobs and almost 2 million USD in lost revenue). Although the long-term impact on the local labor market is yet to be assessed, the disaster can potentially lead to increased unemployment and a decline in household incomes.

The long-term economic slowdown can and probably will lead to reduced investments, lower tax revenues, and increased poverty both in Lori and Tavush regions. Therefore, immediate short-term post-disaster business support programmes are needed for boosting local economic activity.

Damage

Due to the limited data on 149 businesses in the affected communities of Alaverdi, Tashir, Tumanyan, Pambak, Noyemberyan, Ijevan, and Dilijan, UNDP took the initiative to conduct its own survey. Through this effort, UNDP contacted 35% of the listed businesses via email and follow-up phone calls to gather comprehensive and reliable data on the types of enterprises and the extent of the damage.

Based on the available data and necessary assumptions made, the damage caused by the May 25-26 flood in 9 communities of Lori and Tavush regions of Armenia to business property, equipment and merchandise were estimated at 6.3 million USD. The loss was estimated at 3.4 million USD, and the recovery needs were estimated at 11.2 million USD.

From the identified 149 affected businesses[26] 27 were engaged in production, 42 in the service sector (predominantly hospitality services) and 80 in trade (predominantly retail stores). Micro and small businesses represented the largest share of the businesses, as 65% of all businesses were small individual entrepreneurs, with the remaining 35% being registered as limited liability, open or closed joint stock companies.

108 businesses or 72% of all entities that reported any damage to the MTAI were operating in Alaverdi community, 9% in Noyemberyan, 7% in Dilijan, 4% in Ijevan, etc. However, it is important to mention that this does not necessarily present the actual composition of the impact in all communities.

46 percent of all damage identified were to commercial buildings, offices, factories, warehouses and retail stores. 35 percent of identified damage affected production lines, office equipment, different business tools, etc., and 18% of identified damage was related to the goods in stock, such as the stores goods, raw materials and finished products in warehouses or stores.

26 The previously conducted Multi-sectoral initial rapid assessment revealed ninety-seven affected SMEs and five industrial facilities.

Table 15. Damage sustained by buildings, equipment and merchandise (in USD millions)

	Damage		Total
Buildings	Minor	0.50	
	Partial	1.29	**3.14**
	Total	1.35	
Equipment	Minor	0.38	
	Partial	0.98	**2.38**
	Total	1.02	
Merchandise	Minor	0.19	
	Partial	0.48	**0.76**
	Total	0.50	

Companies in production sector primarily reported damage to facilities and warehouses, which, while typically having lower construction costs, cover larger areas and house expensive machinery and equipment. In contrast, the trade sector, comprising retail shops, service areas, offices, etc., suffered greater damage, despite less costly furniture and equipment, due to higher number of impacted facilities (Table 15).

Alaverdi was the hardest-hit community, both in terms of overall costs and the number of affected businesses. At the same time, although not many businesses were affected in Tumanyan, Pambak and Dilijan communities, several big producers registered significant damage.

Loss

The total cost for loss in manufacturing, services and trade sub-sectors was estimated at 3.39 million USD, mainly divided into 3 main groups, as presented in Table 16. Due to limited information available, it was not possible to calculate loss for each of Manufacturing, Services and Trade sub-sectors.

Table 16. Estimation of loss (in USD millions)

Region	Communities	Value			Ownership		
		From Lost Jobs	From Lost Revenue	From Debris Removal	Total	Public	Private
Lori	Tashir	0.002	0.01	0.01	0.02		100%
	Pambak	0.04	0.10	0.02	0.15		100%
	Tumanyan	0.02	0.23	0.0002	0.25		100%
	Alaverdi	0.94	1.42	0.13	2.49		100%
Tavush	Dilijan	0.03	0.05	0.09	0.17		100%
	Ijevan	0.02	0.02	0.04	0.07		100%
	Noyemberyan	0.07	0.12	0.04	0.23		100%
Total loss		**1.11**	**1.96**	**0.32**	**3.39**		

The greatest job loss was registered in the Alaverdi community, amounting to 2.49 million USD. It is important to note that many respondents were reluctant to disclose the actual salary figures, which likely reduced the loss estimates considerably. It was assumed, that the actual loss from lost jobs is double the reported figure.

According to the Survey results and assumptions, approximately 2,100 employees from 149 business entities temporarily lost their job as a result of the disaster. The duration of unemployment varied based on the severity of the damage to the entities, with the average recovery time for most jobs estimated at 1.6 months. The majority of employment loss occurred in Alaverdi and Noyemberyan,

followed by the businesses based in Pambak, Dilijan, Ijevan and Tumanyan communities. No information was received on the affected business entities operating in Gyulagarak and Stepanavan communities.

Debris removal: the total costs for debris removal were estimated based on data from Housing Sector assessment, as well as the data received through telephone interviews. The calculation was done based on the price per square meter of damaged or destroyed physical infrastructure, with manufacturing facilities being relatively more expensive than trade facilities.

Considering the scarcity of available data on business property loss, it was agreed to use a unified calculation for all types of debris, assuming that 3 m^2 area would contain approximately 1 m^3 of debris, with a cost of 18 USD for removal (13 USD for transportation and 5 USD for labor). Hence the total cost of the debris removal was estimated at 0.32 million USD. As shown in the table below the most of these costs come from manufacturing sub-sector in Alaverdi, Noyemberyan, Dilijan, Ijevan.

Assessment of Disaster Impact

The devastating flood that struck the Lori and Tavush regions has precipitated severe immediate effects, but its medium and long-term impact on the local economy and key sectors demands further scrutiny.

Economic Decline: the disaster has inflicted substantial damage on commercial and industrial infrastructure, resulting in significant financial loss and disruptions. If recovery measures are not promptly and effectively implemented, the local economy may experience a protracted downturn, with diminished investment and reduced economic activity. Small and micro enterprises, which constitute a major portion of the local business landscape, face the highest risk of long-term closure due to financial strain and infrastructural damage.

Unemployment and Income Reduction: the loss of approximately 2,100 jobs, coupled with a significant drop in business revenues, is likely to lead to a sustained increase in unemployment and a decrease in household incomes. This could exacerbate poverty levels and create long-term economic hardship for affected communities.

Sector-Specific Challenges: the tourism sector, though not the most heavily impacted, has also seen a notable decline in visitor numbers.

Should policy and programming measures not be adopted, the worst-case scenario could include:

- **Prolonged Economic Recession:** the continued decline in economic activity may lead to a deeper and more prolonged recession. Small businesses might not recover, leading to permanent job loss and further erosion of the economic base.
- **Increased Poverty and Inequality:** prolonged unemployment and reduced income could result in widespread poverty and increased social inequality. Vulnerable populations may face severe difficulties in accessing basic needs and services.
- **Sector Collapse:** key sectors, especially those already struggling, could face collapse. For instance, if tourism and retail sectors do not receive adequate support, they might not rebound, leading to lasting damage to these vital areas of the local economy.

The Sector Recovery Strategy

The devastating flood in 9 consolidated communities of Armenia has inflicted severe economic damage on the affected Lori and Tavush regions, with estimated **recovery needs exceeding 11.2 million USD**. The recovery process will require coordinated efforts from the Armenian government and community administrations, private sector and international partners. Building community based resilience and improving preparedness will be essential in mitigating the impact of future floods and ensuring sustainable economic growth.

Sector Recovery Vision

The principles and guidelines for developing a recovery strategy shall be thoroughly discussed within the competent ministries, such as the MoE, MTAI, Urban Development Committee, community administrations, etc. These strategies must also align with Armenia's long-term development priorities and applicable national and sectoral strategies, while incorporating lessons learned and adapting to emerging challenges related to climate change adaptation, refugee/ displacement contexts, local business environment dynamics, and political developments.

The business sector recovery strategy needs to thoroughly address both production, trade and services sub sectors, aiming to reconstruct more resilient physical infrastructure and also to reduce future disaster vulnerabilities as part of soft capacity building, training and enabling environment measures which are to follow the *Build Back Better* strategy.

The post-disaster recovery process shall also introduce, where relevant, applicable business innovations and digital solutions to increase competitiveness and strengthen resilience against potential disasters and crises.

The economic recovery will require joint efforts both from the Government of Armenia, the nine affected consolidated communities, the private sector, including the business and financial service providers; employers' organizations, CSOs, other grass-root entities, as well as the international organizations and agencies in order to address the immediate, short-term and medium to long-term recovery priorities.

Importantly, the recovery needs and subsequent recovery strategy shall firstly ensure immediate employment and economic opportunities for the people and businesses that had suffered the most from the disaster in all subs-sectors. This will allow

to mitigate immediate disaster effects, while also sustaining and possibly increasing post-disaster employment in the business sector, based on different multiplier recovery effects, and developing basic livelihood means.

The post-disaster recovery strategy will need to enable risk-informed sustainable economic growth for the targeted 9 consolidated communities in Lori and Tavush regions of Armenia, including through relevant stimulation packages and legal amendments, which will stimulate future resilient investments and also ensure sustainable competitiveness for the future. Such stimulation packages and normative amendments will be crucial for supporting the affected 9 consolidated communities and the local businesses, while also ensuring simplified procedures and less administrative regulations for accessing targeted financial subsidies and infrastructure subventions, as they predominantly lack the financial, technological and human capacities for meaningful post-disaster recovery.

Reconstruction and Recovery Needs

The recovery strategy for the business sector must comprehensively address the production, trade, and services sub-sectors. The goal is to rebuild a more resilient physical infrastructure while simultaneously reducing future disaster vulnerabilities through capacity building, training, and the creation of an enabling environment. These efforts should align with the *Build Back Better* strategy, ensuring long-term sustainability. Additionally, the post-disaster recovery process should incorporate relevant business innovations and digital solutions to enhance competitiveness and fortify resilience against future disasters and crises.

The businesses surveyed in production, service and trade sub sectors have reported damage in 3 categories of severity (minor, partial and full damage) to buildings, equipment and merchandise.

The businesses also registered loss from income generation, which was subsequently mirrored in the employment loss as well.

Table 17. Reconstruction and recovery needs assessment for Business sector (in USD millions)

Component	Short-term Needs	Medium-term Needs	Total
Reconstruction Needs	**4.68**	**3.53**	**8.20**
BBB Reconstruction in business sector	2.41	1.82	4.23
Furniture, equipment and machinery for manufacture	1.83	1.38	3.21
Merchandise	0.43	0.33	0.76
Recovery Needs	**2.21**	**0.80**	**3.01**
Debris Removal	0.32	-	0.32
Revision of resilience/safety standards, including for inspection and insurance requirements, for effective emergency prevention, preparedness, response and recovery.	-	0.70	0.70
Development of business recovery and employment promotion strategy at community levels	0.20	-	0.20
Immediate short-term post-disaster business support programmes for boosting local economic activity	1.49	-	1.49
Development of contingency business planning models, with supporting administrative capacities and regulatory framework.	0.20	0.10	0.30
Total	**6.89**	**4.33**	**11.22**

For a short-term recovery there is a need for immediate financial assistance to affected businesses and households. In this regard the PDNA recovery needs were estimated at 2.21 million USD for the short term interventions, mainly aimed at:

1. Development of business recovery and employment promotion strategies at community levels.

2. Immediate short-term post-disaster business support programmes for boosting local economic activity.[27]
3. Debris removal,

For **Mid-Term recovery**, needs were estimated at 0.8 million USD, with recommendations to:

1. Invest in revision of resilience and safety standards, including for inspection and insurance requirements for effective prevention, preparedness and response planning and implementation.
2. Invest in development of contingency business planning models, with supporting administrative capacities and regulatory frameworks.
3. Invest in resilient business infrastructure, including innovation and digitalization to reduce vulnerability to future floods.

The Sector Recovery Plan

GOAL	• Ensuring disaster and climate risk informed economic growth, • Creation of local competitive employment opportunities; • Legal regulations for formulation, promotion and application of more risk resilient investments • Capacity building for increasing application of innovation and digitalization for sustainable competitiveness, while also ensuring inclusivity and gender balance.
SHORT TERM	• Development of business recovery and employment promotion strategies • Immediate short-term post-disaster business support programmes for boosting local economy • Debris Removal
MEDIUM TERM	• Invest in revision of resilience and safety standards, including for inspection and insurance requirements for effective prevention, preparedness and response planning and implementation. • Invest in development of contingency business planning models, with supporting administrative capacities and regulatory frameworks. • Invest in resilient business infrastructure, including on innovation and digitalization to reduce vulnerability to future floods.

27 Considering the average support package provided by different UN and non UN agencies is around 10k USD, the cost of such support package was set at 1.49 million USD.

Agriculture Sector

Sector Summary

Disaster effects in the agriculture sector are **estimated at 19.15 million USD**, out of which **12.12 million USD in damage** and **7.03 million USD in loss**. **Recovery and reconstruction needs are estimated at 23.86 million USD**, as detailed in table below. The floods significantly damaged agricultural assets, particularly irrigation systems related to crop production. Besides that, 162 hectares of land was reported as washed away, eroded or submerged. Damage and loss were relatively evenly distributed across annual (mostly vegetables, herbs and fruits) and perennial crops. The most affected consolidated community was Noyemberyan accounting for almost half of all the disaster effects recorded. Important to note is that the agriculture damage and loss significantly affected livelihoods given that the primary source of income for most affected households is in fact the production and sale of agricultural products. That said, restoration of livelihoods for flood-affected agriculture households through the provision of access to agricultural inputs, additional agricultural financing, and the restoration and improvement of irrigation methods must be prioritized within the agriculture sector recovery.

Table 18. Damage, loss and needs by community (in USD millions)

Consolidated Community	Damage	Loss	Needs
Alaverdi	2.26	1.74	4.98
Dilijan	0.05	0.05	0.12
Gyulagarak	-	0.76	0.95
Ijevan	1.27	0.72	2.49
Noyemberyan	5.62	3.25	11.05
Pambak	1.86	0.08	2.40
Stepanavan	0.79	-	0.99
Tashir	0.27	0.43	0.87
Total	**12.12**	**7.03**	**23.86**

Pre-disaster Baseline Information

Agriculture is the third largest sector of the Armenian economy contributing about 8.5% to Armenia's GDP in 2023 and employing about 19.1% of the country's population, according to official statistics.[28] Agriculture plays an important role for the Armenian economy, contributing to macroeconomic stability, food security, rural employment, income generation for the rural population, and poverty reduction. While about 70% of Armenia's territory is classified as agricultural land, arable land represents only 21.7% of the total agricultural land.

In 2023 gross agricultural output was around 242 million USD decreasing by 0.3% compared to the same period of previous year. Plant production contributes 47.2% and animal husbandry 52.8% to the total agricultural output.[29]

Country Context Situation:

People living in rural areas: ***1,063.6 thousand***[30]

Agricultural land: ***68.7%*** *of Armenia's territory*

Arable land: ***14.9%*** *of the total territory*

Food Security: the FAO Food Price Index (FFPI) was estimated at ***118.3*** *points in March 2024, showing a growth by 1.3 points (1.1%) from its February level*[31].

The Food Price Index in Armenia was estimated at ***100.4%*** *in 2023.*

Total population in the affected areas is comprised of 22,510 households, with 44% involved in crop production. Of the total population 2.6% or 576 households experienced flooding of agricultural land, representing 5.9% of the farming households. Additionally, 463 households, or 4.7% of the farming households and 2.1% of all households, had other assets impacted by the flood.

Lori Region

As of April 1, 2024 the total population of Lori region was 228,100, with 128,600 (56.4%) urban and 99,500 (43.6%) rural population. Almost 66% (2,508 km^2) of the total area of 3,799 km^2 of the region are agricultural lands, of which 16.7% (419.77 km^2) are arable.

The key economic sectors in Lori region are agriculture and industry, with tourism also playing important role. Agricultural sector is primarily focused on the production of grains, potatoes, vegetables, and animal husbandry products. The main crops of the province are grains, followed by potato and vegetables.

Gross agricultural output of Lori region in 2022 was 228 million USD.

Lori region has a great potential for fodder production. Animal husbandry and the milk-processing industry are identified as key

28 Source: https://armstat.am/am/?nid=82&id=2646
29 Source: https://armstat.am/en/?nid=12&id=03001
30 As of 01.01.2023, based on the RA 2022 population Census.
31 This rise was driven by higher prices for vegetable oils, dairy products, and meat, which more than offset declines in the indices for sugar and cereals

areas with good potential for development. The region also has a great potential for the cultivation of cereals and legumes – beans, peas, green peas.

Lori is one of the most humid regions in Armenia, receiving 600-700 mm of precipitation annually. The region's subtropical foothills experience moderately hot, dry summers and mild winters, making them ideal for cultivating subtropical crops like persimmon, fig, pomegranate, and olive. These crops often grown on small plots, are profitable for local markets. With fragmented land, the focus is on developing high-value agriculture, including non-traditional vegetable and berry cultivation. Gathering wild greens, mushrooms, wild fruits, berries, rose-hips, walnuts have great development potential in the region.

The beekeeping industry is well developed in the region, with local honey products easily sold in the market. Several companies specialize in organic beekeeping and herbal tea production, adhering to EU organic standards. Additionally, over a dozen small tea factories produce fruit and herbal teas, further diversifying the agricultural economy.

Ecotourism has a great potential for development in the region, with the presence of health resorts playing a key role in health resort tourism development. In recent years, large flows of domestic tourists have been recorded in Stepanavan and nearby settlements. Such inflow stimulates the development of lodges, small guest houses, and small service units like eateries.[32]

In 2022, the Lori region contributed to Armenia's economy with the following shares in key sectors:[33]

- Industry 3.3%,
- Agriculture 8.7%,
- Construction 4.2%,
- Retail trade 2.4%,
- Services 1.2%.

Tavush Region

Tavush region is a predominantly agricultural region in Armenia, known for its diverse production of fruits, such as peaches, apples, pears, plums, persimmons, grapes, figs and mulberries. Due to the fragmented nature of the land, high-value agriculture could be a rather effective development direction for the region. The most developed branches of agriculture are cereal production and viticulture. The collection of wild berries and wild fruits is also widespread, with groups of individuals engaged in wild harvesting. In recent years beekeeping developed as well.

In the area of animal husbandry, the primary sectors include cattle and pig breeding and forage cultivation,[34] accounting for 75% of total production.

Like Lori region, Tavush also receives 600-700 mm of precipitation annually, with a subtropical climate, characterized by a moderately hot and dry summers and mild winters. Such climatic conditions are ideal for cultivation of subtropical crops, such as kaki, persimmon, olives, pomegranate, and figs, which are particularly profitable on small land plots. The expansion of walnut orchards is also seen as promising.

51 percent of the total area of the Tavush territory is occupied by mixed forests, rich in diverse flora and fauna, and home to unique monuments of natural heritage sites. Forests are predominantly located around the towns of Dilijan, Ijevan and Berd.

Gross agricultural output of Tavush region in 2022 was approximately 118.77 million USD.

As of April 2024 the total population of Tavush region was 117,300, with 42.2% urban and 57.8% rural population. Almost 41% of the total area of 2,704 km^2 are agricultural lands, out of which 23% (254.8 km^2) are arable.

In animal husbandry cow and pig breeding are primary activities, while in plant growing the most developed branches are grain and grape growing. Horticulture experiences a significant growth recently. Additionally, fruit

32 Agriculture in Tashir+ LAG
33 Source: https://www.armstat.am/file/doc/99542163.pdf
34 Agriculture in Aghstevi Hovit LAG

gardens are being established, mainly with figs and persimmon as main crops.

The leading sector of the economy is the processing industry, with most prominent activities being the food industry and woodworking.

In 2022, Tavush region contributed to Armenia's economy with the following shares in key sectors:[35]

- Industry 1.4%,
- Agriculture 4.5%,
- Construction 3.0%,
- Retail trade 2.4%,
- Services 0.9%.

Assessment of Disaster Effect

The estimated total financial effects by agricultural sub-sector are presented in the table below, with total damage at 12.12 million USD and total loss at 7.03 million USD. Damage account for 63% of the total with the highest impact in the Assets sub-sector, particularly related to irrigation for crop production. Loss makes up 37% with the most significant portion (61%) occurring in the assets sub-sector related to crops.

Table 19. Agricultural damage and loss by sub-sectors (in USD)

Sub-sector	Damage	Loss	Total
Assets	11.86	-	11.86
Annual Crops	-	3.6	3.60
Perennial crops	-	3.0	3.0
Livestock	0.18	0.13	0.31
Aquaculture	0.087	0.3	0.38
Total	**12.12**	**7.03**	**19.15**

The territorial distribution of damage and loss is shown in the table below. The disaster effects are most prominent in the Noyemberyan consolidated community, accounting for 46% of all damage and 45% of all loss. Alaverdi consolidated community follows, with notable impacts, accounting for 18% of the total damage and 24% of all loss.

Table 20. Territorial distribution of damage and loss (in USD millions)

Community	Damage	Loss	Total
Alaverdi	2.26	1.74	4.00
Dilijan	0.05	0.05	0.10
Gyulagarak	-	0.76	0.76
Ijevan	1.27	0.72	1.99
Noyemberyan	5.62	3.25	8.87
Pambak	1.86	0.08	1.94
Stepanavan	0.79	-	0.79
Tashir	0.27	0.43	0.70
Total	**12.12**	**7.03**	**19.15**

35 Source: https://armstat.am/file/article/marzer_2023_30.pdf

Table 21. Damage and loss per sub sector and location (in USD millions).

Area	Assets	Annual Crops	Perennial crops	Livestock		Aquaculture	
Type	Damage	Loss	Loss	Damage	Loss	Damage	Loss
Tashir	0.20	0.38	-	0.04	0.04	0.03	-
Gyulagarak	-	0.76	-	-	-	-	-
Dilijan	0.04	0.02	0.03	0.01	-	-	-
Ijevan	1.26	0.37	0.14	-	-	0.01	0.21
Noyemberyan	5.60	0.93	2.22	-	-	0.01	0.09
Pambak	1.82	0.04	0.01	0.01	0.01	0.02	0.01
Alaverdi	2.14	1.09	0.58	0.11	0.07	-	-
Stepanavan	0.79	-	-	-	-	-	-
All	**11.86**	**3.60**	**2.98**	**0.18**	**0.13**	**0.08**	**0.31**

The effects of the flood on the crops sector can be classified largely into two categories:

- **Direct flooding** affecting households and cropland along the rivers and canals causing damage to crop and irrigation assets and land;
- **Shortage of water** for agricultural irrigation systems, causing decrease of yields and abandonment of arable land.

The table below presents damage and loss per household. The calculation excludes costs related to lost land, and the communal infrastructure.

Table 22. Damage and loss per households (in USD)

Sector	Per household		
	Damage	Loss	Total
Assets	2,211.68	-	2,211.68
Annual crops	-	4,433	4,433.27
Perennial crops	-	3,918	3,918.20
Livestock	306	230	535.51
Aquaculture	131	534	664.59
Total	**2,648**	**9,115**	**11,763**

Assets

The affected irrigation infrastructure was reported to supply water for a total of 2,279 hectares of irrigable land, which accounts for 17% of the total arable land. Prior to the flood, approximately 1,631 hectares (12% of total arable land) was being actually irrigated.

As a result of the disaster the total irrigable area was reduced to 1,743 hectares, with actually irrigated area reduced to 1,135 hectares. This makes a reduction of 24% and 30% respectively.

A total of 24 irrigation and water control assets were affected by the flood, including 3,587 m of pipelines of various size, irrigation channels and water intake structures, 43 pumps and 2,571 m of retailing walls for riverbed regulation as well as various water intake structures, covered in details in Disaster Risk Reduction section.

At the time of the assessment, 6% of the affected irrigation and water control assets had been fully repaired, while 72% were undergoing repair, and for the remaining 22% no recovery activities have yet begun. Field visits revealed that most repairs were temporary measures to restore basic operations of the irrigation infrastructure, with preparations being made for more permanent solutions.

Additionally, Tavush and Lori regions reported damage on a total of 19 pieces of self-propelled agricultural machinery. Damage to agricultural infrastructure, equipment, stored yields and inputs has been summarized in the table below.

162 hectares of land was reported as washed away, eroded or submerged due to expansion of the riverbeds and destruction of retaining walls, calculated at replacement cost for damage and annual production costs for loss.

Table 23. Damage to agricultural infrastructure (in USD millions)

Item	Units	Damage
Pumps/Pumping stations	43 units	0.93
Land	162.7 ha	3.78
Pipelines / Channels	3,590 meters	6.04
Mechanization/ Equipment		0.23
Agricultural Facilities		0.80
Inputs/Products		0.08
Total		**11.86**

Crops

In the affected areas 44% of the population is involved in crop production, covering approximately 13,741 hectares, with an average 1.4 hectare per producer household.

9,558 hectares, or 70% of the arable land of the producers are used for production of high value annual crop, 8% for perennial crops, and the remaining for low value combinable crops.

A total of 304 hectares (3.2%) of land under high value annual crops and 310 hectares (2.3%) of land under low value annual crops were flooded.

Table 24. The financial effects of the flood per type of production (in USD millions)

Annual Crops	Low value % (Combinable, industrial crops)	High value % (Vegetables, herbs, annual fruits)	Total
	0.40	3.19	3.59

The flood affected 84 hectares (7.8%) of perennial crops.

Although only a small portion of the crops was yielding at the time of the assessment, farmers expect an average reduction of yields of 49.4% for the affected annual and perennial crops, as much of the affected area experienced up to one month of interruption of irrigation at a crucial development period of the plants.

The crop producers reported additional production costs averaging to approximately 320 USD per hectare, with 170 USD per hectare for treatment of crops in the aftermath of the disaster, to restrict yields reduction.

Conditioned by the loss of irrigation for the remaining part of the production season, the production on 43 hectares (2.6%) of crops has been discontinued, causing a total loss of the annual production. Production continued on 58 hectares (5.1%) without any irrigation.

Farmers reported a total cost of approximately 12,780 USD in short-term cleanup operations, while the local authorities, as reported, undertook sediments and debris removal on 58 hectares of land, representing 18.8% of the flooded land, at a cost of approximately 3,000 USD per hectare and approximately 300 USD per flooded household.

Livestock

A total of 4,378 households or 17% of the population in the affected areas, are involved in livestock production. The disaster affected a total of 636 households or 15% of the livestock producers (2% of all households).

Damage to the livestock sector were estimated based on data provided by local authorities

regarding animal deaths among the affected households. Loss was estimated from reduced production and additional treatment costs for injured animals.

As a result of the flooding the livestock populations of the affected areas have significantly reduced (Table 25).

Table 25. Reduction of livestock population

Species	Livestock Population #	Lost #	Share % of reduction
Beehives	1,900	456	24%
Cattle	3,795	22	1%
Pigs	3,087	447	14%
Poultry	19,760	1,693	9%
Rabbits	1,499	473	32%
Sheep	117	16	14%

The beehives and the rabbits, as the most stationary production, suffered the most damage, accounting for one-quarter and one-third of the total livestock population respectively.

Table 26. The documented financial effects on the livestock sector per species affected (in USD)

Livestock	Pigs	Beehives	Poultry	Cattle	Rabbit	Small ruminants	Total
	75,213	117,617	57,129	45,989	6,201	3,921	306,069

A total of 3,975 m^2 of livestock pens were reported as affected, with the repair and short run costs reported under the Assets chapter.

Aquaculture

A total of eight aquaculture facilities were affected by the disaster, including six facilities producing mostly Salmonid species and two producing Cyprinid species of fish. Prior to the disaster, these facilities occupied over a total area of 6.7 hectares.

The disaster accounted caused a total loss of 3,358 pieces of brood-stock (reproductive fish) usually kept for several years, to reach sexual maturity, along with 30,325 pieces of food fish of various species and sizes.

The assessment did not include the loss from the lost brood-stock during the replacement and repair period of the damaged facilities.

Livelihoods and incomes

The primary source of income for most affected households is the production and sale of agricultural products (94%), with most of the households having minimum one complementary income source such as welfare, pension, remittances (66%), salary from employment (48%) or self-employment and daily wages (16%).

The agricultural income represents an average 61% of the income of the affected population. Households primarily dependent on production and sales of agricultural products were most affected, followed by recipients of welfare, pension, and remittances, with 30.2% experiencing income reduction.

The data highlights both the vulnerability of households reliant on production and sales of agricultural products, and the substantial impact of the disaster on agricultural livelihoods.

43 percent of the affected households have access to formal finance sources and 64% currently have debts. Since the flood, overall debt increased for 41% of the households by 3-8%. Most of the debt incurred has been used for purchasing food (25%) followed by agricultural inputs (23%) and repairs of assets (22%).

A significant 71% of households spent 41 to 60% of their income on food, highlighting the high financial burden related to food expenses. Moreover, 16% of households experienced food insecurity.

The long-term impacts of the disaster on the agricultural sector are expected to be profound, affecting both productivity and livelihoods. The immediate destruction of crops, livestock, and infrastructure will likely lead to reduced agricultural outputs over the coming years. Interrupted irrigation, land degradation, and the loss of livestock will diminish the sector's ability to meet local food demands, revealing food security issues.

The disruption of irrigation systems, particularly in flood-prone areas, has the potential to cause sustained reductions in crop yields. With a significant portion of high-value crops affected, farmers will face challenges in recovering their production levels. The prolonged recovery of damaged irrigation infrastructure will likely result in decreased agricultural productivity for future planting seasons, affecting the overall economic stability of farming communities.

The financial strain placed on affected households, many of which are already highly dependent on agriculture for income, may further limit their ability to invest in recovery. Increased debt levels and ongoing expenses for basic needs, agricultural inputs, and asset repairs will likely weaken farmers' capacity to rehabilitate their farms. This could lead to the abandonment of arable land, reducing the region's overall agricultural potential and compounding rural poverty.

Livestock loss, including the decimation of beehives and small animals, will have long-lasting effects on households that rely on these resources for supplementary income. The reduction in livestock, coupled with a lack of financial resources to replace lost animals, will slow the recovery of animal husbandry and diminish the income diversification necessary for resilience.

The long-term consequences of the disaster will likely amplify pre-existing vulnerabilities in the agricultural sector, reducing its ability to withstand future shocks. Without substantial investment in rehabilitation, modernization of irrigation systems, and improved disaster preparedness, the region's agricultural productivity may remain below pre-disaster levels for years to come.

The Sector Recovery Plan

The recovery framework should be guided by international best practices in post-disaster recovery and reconstruction efforts. These include leadership and coordination by the government and partners, balancing urgent needs and medium- to long-term goals, differentiated approaches that prioritize impact and needs and that promote, resilience and *Build Back Better* principles for a more sustainable future, durable solutions, access to services, social protection, and livelihoods, and continuous data collection.

The Government of Armenia has announced plans to rebuild infrastructure, incorporating improvement opportunities, a process that will take time. In this endeavor, certain systematic elements will need to be addressed timely to prevent further degradation of the affected agricultural assets. This emphasizes the need to remain vigilant in the coming years, focusing on reducing erosion and optimizing irrigation.

Sector Recovery Vision

Two phases in the recovery and reconstruction could be outlined, each with different time-frames, different complexities and different durations.

Immediate / Short-term

The initial phase of the intervention should be focused on preserving and reestablishing agricultural production as a mean of

safeguarding food security and protecting current level of agricultural livelihoods. This will prevent further decline in agricultural production and facilitate the restoration of essential services and infrastructure critical to the basic functioning of the agricultural sector. Investments should prioritize financial, technical, and critical infrastructural support to revive the sector. Focusing on economic activities that support the medium-term recovery and have the greatest multiplier effect will accelerate the overall recovery.

Medium-term

The first phase sets the stage for the second and most crucial part of the recovery process. Most of the infrastructure reconstruction and recovery investments are expected to occur in the medium term, with only a few sectors anticipating long-term recovery activities. This phase will integrate the *Build Back Better* approach. Reconstruction and recovery activities should primarily target the strategic infrastructure and services that provide reliable, efficient and sustainable water supply for irrigation for the affected areas; rebuild local service infrastructure and restore and enhance services to meet highest standards of resilience and reliability.

Reconstruction and Recovery Needs

To support the recovery of the agricultural sector and restore livelihoods in the affected areas the following needs must to be addressed in the coming years.

Access to Finance: access to finance for maintaining, expanding, and normalizing production is relevant for all sectors of agricultural development and for commercial agricultural producers. In the short-term the focus should be on de-risking investment options and finding innovative tools to attract investment.

As access to financial liquidity impacts the vast majority of agricultural crop, livestock, fish producers and fisherfolk, a systematic and sustainable approach to facilitating access to it for the affected producers is a significant element to be addressed on the way to recovery.

This could possibly involve in the short-term on-line investment platforms, matching grants, or stronger connection between financial institutions and producers. In the medium to long term the emphasis should be switched to securing access to finances, preferential credits, credited agricultural inputs and maintaining markets. Such approach should be backed by governmental policies, shifting those policies from an emergency aid to a more sustainable, normalized framework, enabling institutions to suggest crediting and marketing support.

Planting, cultivating, and sowing of crops: immediate support for producers, particularly households and small farmers, is required in the short term to enable them to utilize the land with reduced or unavailable irrigation. The most effective tools here will be provision of access to agricultural inputs or finance / voucher distributions to farmers with flooded land to re-establish their lost crop and livestock production and to assist fishers whose livelihoods have been affected.

Irrigation and water supply: efficient water management is essential for recovery. Establishing new water sources, introducing drip irrigation for high value / perennial crops, solar irrigation, small- and large-scale rainwater harvesting will allow reducing dependence from furrow irrigation.

Simple and affordable improvements, such as retrofitting for smart irrigation, should be used as *Build Back Better* principles, to reduce irrigation water consumption and to ensure short payback periods.

Some of the described tools and actions have already been suggested by the private sector and are supported by the government.

Livestock: initial efforts should focus on helping livestock to recover and restart their production through in-kind support or matching grants and credits.

The recovery and rebuilding process in the aftermath of the disaster presents an opportunity to incorporate the latest technologies alongside climate-friendly, nature-based solutions to support the *Build Back Better* approach. This approach not only

aims to restore the agricultural sector to its pre-crisis situation, but to also address the pre-disaster challenges, as well as the new ones that emerge in a post-crisis phase.

As recovery progresses, it is essential to reflect on how agriculture can establish a more sustainable relationship with available water resources. Even before the disaster Armenia's irrigation system and the water usage in agriculture required improvements. Rising temperatures and more frequent droughts driven by climate change further increase the urgency of adapting to reduced water usage for irrigation.

To address these challenges, the recovery of the agricultural sector should be guided by three key elements:

1. Improved efficiency of water management for irrigation;
2. Adoption of conservation agriculture methods and landscape approaches to reduce water needs ;
3. Increased focus on water efficient crop selection and patterns.

Improving efficiency of irrigation systems is a vital step towards sustainable water management. Recovery efforts should focus on reducing water damage and loss in the canal infrastructure, lowering power consumption (including introduction of sustainable energy sources) and increasing the efficiency of pumping stations. Legislative reforms and financial support should promote the use of precision and water saving irrigation techniques that can be combined with accurate fertilizer application.

Conservation agriculture and the landscape approaches adoption, as components of Climate Smart Agriculture (CSA), includes practices such as minimum mechanical soil disturbance, no-tillage seeding, organic mulch application, and crop diversification to preserve soil moisture. Such approaches will offer multiple benefits, including higher productivity and income; better climate change adaptation, reduced vulnerability to erratic rainfall distribution, and reduced greenhouse gas emissions.

The Sector Recovery Needs Costing

The principal recovery and reconstruction efforts for the identified needs are presented in the table below. The recovery costs per household are calculated based on the average damage and loss incurred, amounting to 23,86 million USD.

Table 27. Recovery needs assessment[36] for Agricultural sector (in USD millions)[37]

Component	Short-term Needs	Medium-term Needs	Total
Restoration of livelihoods for flood-affected smallholders, including households, through provision of access to agricultural inputs and equipment	3.10	3.10	6.20
Introduction of irrigation alternatives for crop farmers	2.06	2.06	4.12
Irrigation channels, pumping stations, affected by flood	4.38	3.61	7.99
Recovery of aquaculture production	0.39	-	0.39
Agricultural financing for crop farmers, livestock, and fish farm producers	2.58	2.58	5.16
Total	**12.51**	**11.35**	**23.86**

Considering the level of devastation, it is unlikely that the resources needed for full implementation of this recovery framework will be easily available. To address potential resource constraints, four key indicators have been selected to prioritize recovery actions:

36 Due to methodological limitations, reconstruction and recovery activities in the agriculture sector are interlinked and, therefore, are not separated within the table.
37 Source: Assessment team

- **Indicator 1:** estimated value of damage and loss per agricultural sector or sub-sector;
- **Indicator 2:** proportion of households affected within the agricultural sector or sub-sector;
- **Indicator 3:** proportion of overall agriculturally active population benefiting;
- **Indicator 4:** feasibility of the intervention.

Taken together these indicators offer a comprehensive view of the severity of damage and loss, alongside an understanding of household vulnerability and recovery potential. It is important to note that the overall value of Damage and Loss is likely underestimated due to limited information and the figures may increase as the delayed effects on perennial crops become evident.

Transport Sector

Sector Summary

The 2024 floods in Northern Armenia hit the Achilles' heel of Armenia's transport network the narrow Debed river gorge, which accommodates both Armenia's only international railway link and the interstate highway M6, the main trade road link to the Black Sea ports and markets in the European Union (EU) and Eurasian Economic Union (EAEU).

Disaster effects in the transport sector are **estimated at 33.02 million USD**, thereof, **22.67 million USD in damage** and **10.35 million USD in loss**, and the **recovery and reconstruction needs are estimated at 44.25 million USD**, as detailed in Table 28. The floods caused significant damage to the railway, two interstate highways, local roads and bridges, and 161 vehicles. International trade along the M6 and local access was disrupted for nearly a week and the railway for nearly 3 weeks. Apart from the disruption of lives and livelihoods, the significant detours and delays on the road networks and the temporary suspension of railway operations caused significantly higher operating costs and revenue loss in the transport sector.

Table 28. Damage, loss and needs by community (in USD millions)

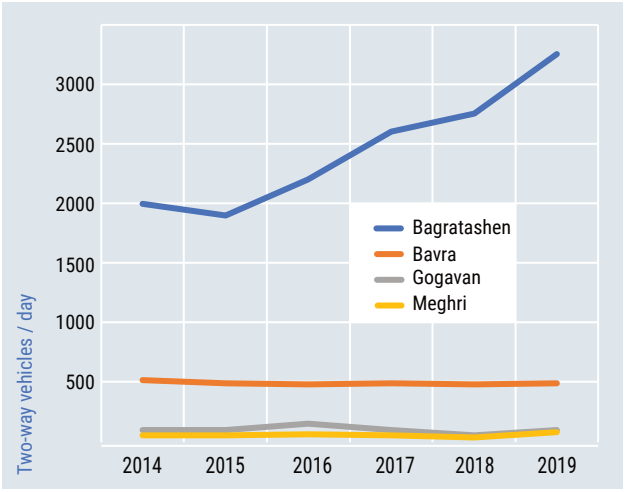
Consolidated Community	Damage	Loss	Needs
Alaverdi	10.76	0.57	12.88
Dilijan	0.77	-	1.00
Gyulagarak	1.23	0.12	1.59
Ijevan	0.39	-	0.50
Noyemberyan	1.77	0.12	2.27
Pambak	0.22	-	0.28
Stepanavan	0.01	-	0.02
Tashir	1.46	0.23	1.90
Tumanyan	5.08	0.06	5.33
Nationwide (no specific region)	0.99	9.25	18.48
Total	**22.67**	**10.35**	**44.25**

Armenia's geopolitical location and topography present a particular transport challenge. Armenia is a landlocked country and out of its four bordering neighbors, it only shares an open border with Georgia to the North and Iran to the far South.

Figure 6. Main transport routes in affected regions of Lori and Tavush[38]

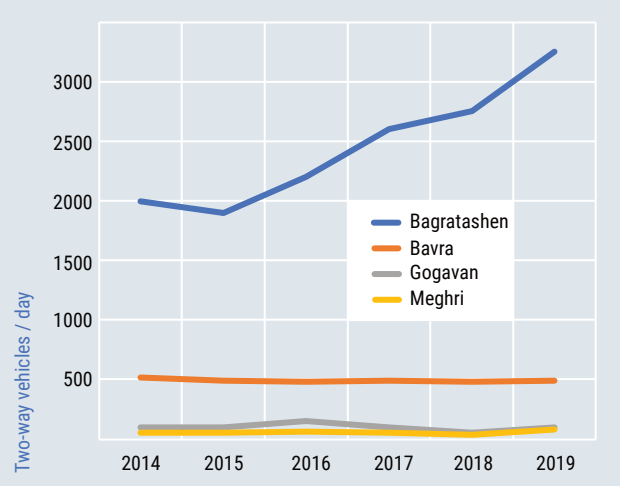
Roads serve as the main transport network in Armenia. With an underdeveloped railway network, principally due to its difficult terrain, the road system is of vital importance for the development of the country and accounts for about 77% of total cargo tonnage and virtually all passenger transport[39]. From a trade perspective the road links between Armenia and Georgia are the most important in the highway network: in 2019 they handled 70% (just under 2Mt) of Armenia's imported road tonnage. Of the three northern road Border Control Posts (BCP) connecting Armenia to the Black Sea ports and markets in the European Union and Eurasian Economic Union, Bagratashen handled by far the biggest share (1.4Mt), followed by Bavra (0.3Mt) and Gogavan (0.26Mt), as shown in Figure 6[40]. The M6 is the main route connecting Bagratashen to the national network and even prior to the 2024 floods, reliance on a single, two-lane road for 70% of imports by road was perceived as risky.[41] Similarly, the only railway connection to Georgia and the outside world runs, like the M6, along the narrow Debed river gorge. The recent flood event further accentuates the need for increased resilience and redundance in the transport sector in general and in particular along the bottleneck of the Debed river gorge.

Figure 7. Goods traffic at BCPs



38 Source for Figures 5, 6 and 7: ADB, PDNA assessment team
39 Asian Development Bank. 2021. Armenia Transport and Trade Facilitation Strategy 2020-2040 (Draft).
40 Ibid
41 Ibid

Figure 8. Passanger traffic at BCPs



Governance

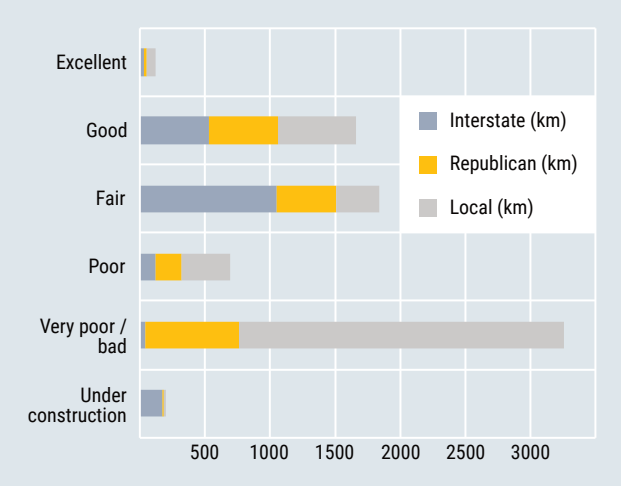
The Road Department Fund (RDF) of the Ministry of Territorial Administration and Infrastructure is the responsible body for road infrastructure in Armenia, whereas local roads and bridges are under the jurisdiction of the regions. The Armenian railway system is operated by the South Caucasus Railway (SCR) a Russian Railways' subsidiary under a 30-year concession agreement with oversight of the Railway Department of MTAI.

Road

Armenia's road network largely dates back to Soviet times and is relatively dense totaling 7,498 kilometers (km), and is divided into interstate (1,724 km), republican (1,968 km), and local roads (3,806 km)[42] There are quite a few connecting routes, despite the mountainous nature of the country. Armenia connects to European road networks via the International E-road network through e.g. E001, E60, E117, and E691 and also connects to the Asia Highway Network through routes AH81, AH82 and AH83. The North-South corridor (Meghri – Yerevan – Bavra) and the M6 (Yerevan – Vanadzor - Bagratashen) are also part of the extended Trans-European Transport Network (TEN-T). The extended TEN-T focuses on removing bottlenecks hampering connectivity and trade in the region and with the EU.

About 89% of interstate and 78% of republican roads are paved, whereas only 42% of local roads are paved (Figure 9). 19 percent of the interstate roads, 28% of the republican roads and 18% of the local roads are considered to be in excellent to good condition. Despite Armenia's strides to improve its road network, about 55% of primary roads and 74% of local roads are still in poor condition. The overall poor condition of the Armenian road network is also reflected in the Road Quality Index established by the World Economic Forum, where Armenia is only ranked No.92 of 141 countries studied[43].

Figure 9. Road Network Conditions (kilometres)[44]



Traffic intensity on interstate roads is counted yearly, whereas traffic counting on republican roads is irregular and on the local network almost non-existent. Existing traffic levels on the Armenia road network are moderate. Annual average daily traffic (AADT) on Interstate roads is 3,600 vehicles per day, ranging from 23,710 to less than 100 vehicles/day[45]. In 2023, AADT for the M4 near Dilijan is 6,790 vehicles/day, thereof 6,500 cars, 260 trucks and 178 heavy trucks, and for the M6 at Vanadzor is 3945 vehicles/day, thereof 3,596 cars, 149 trucks and 200 heavy trucks[46].

Railway

Armenia's railway system is 100% electrified and extends to about 850 km of railway tracks. Rail is a cheaper mode for long-haul

42 Ibid
43 Source: https://www.theglobaleconomy.com/rankings/roads_quality/
44 Based on comprehensive road survey in 2018/19 with World Bank support
45 Asian Development Bank. 2021. Armenia Transport and Trade Facilitation Strategy 2020-2040 (Draft)
46 Source: Automatic (M6) and manual (M4) traffic counts by RDF

freight transport. However, there is no railway connection to the Southern regions and since the conflict with Azerbaijan no direct connection to Iran and Russia. There is only one international connection to Georgia along the disaster affected Debed river valley. In addition, the Armenian Railway system experienced declining traffic and revenues between 1991 and 2015 and is operating far below its potential capacity due to several reasons, including strong competition from road hauliers, who generally offer faster delivery times and greater reliability. Import volumes are around 0.8 MT and exports just under 0.6 MT[47]. Average daily freight prior to the floods was just under 5,000 tons, with an average daily revenue of 93.6 thousand USD[48]. In the passenger market SCR suffers heavy damage and loss every year, approximately equal to the profits made in the freight market. But carrying passengers is a public service obligation imposed under the concession agreement and the Government pays SCR a subsidy to cover a proportion of those damage and loss. Passenger trains face strong competition from private operators of buses, "marshrutkas" and shared taxis, all of which offer more frequent services with fares very close to SCR's.

Risk and Vulnerabilities

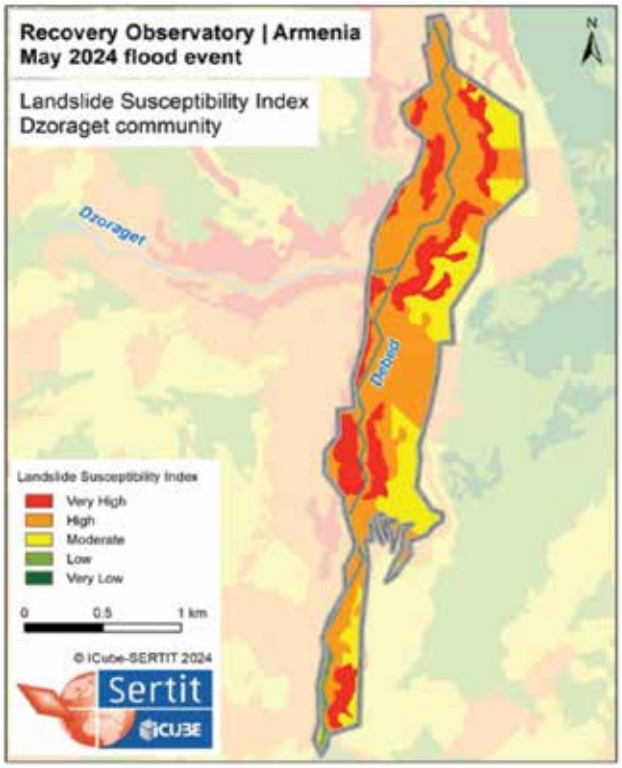
As mentioned earlier, the mountainous terrain with associated flood, landslide and rockfall risks provides a particular challenge to land transport in Armenia.

In North Armenia the landslide and rockfall risks in the transport sector are significant, and a landslide analysis by the EU recovery observatory highlights the high to very-high susceptibility to landslides along the M6 and M4 road and railway corridors (see for example Figure 10)[49], as do previous studies[50].

In addition, the seismic hazard is substantial and can lead to direct disruption and damage of transport assets as well as trigger landslides and rockfalls along the steep canyon slopes[51],[52].

In the border regions transport corridors are often confined to steep and narrow mountain valleys highly exposed to flood and landslide hazards with limited alternative routes.

Figure 10. Landslide Susceptibility Index



47 Asian Development Bank. 2021. Armenia Transport and Trade Facilitation Strategy 2020-2040 (Draft)
48 Estimates based on SCR data for May to July 2023.
49 Source: https://seafile.unistra.fr/d/bd2d1d90d8b944b7b088/
50 E.g. World Bank and Global Facility for Disaster Reduction and Recovery. 2018. Hazard and Risk Assessment of Rock Failures in the Republic of Armenia
51 Bingming SHEN-TU, Elliot KLEIN, Mehrdad MAHDYIAR, Arkadi KARAKHANYAN, Marco PAGANI, Graeme WEATHERILL, and Robin GEE. 2018 Seismic hazard analysis for Armenia and its surrounding areas.
52 Georisk. 2016. Assessment of potential damage and loss and impact to key infrastructure induced by a scenario earthquake in the Dilijan community.

Disaster effects in the transport sector are estimated at 33.02 million USD, thereof 22.67 million USD in damage and 10.35 million USD in loss. Damage and loss in the transport sector were estimated based on assessments and data provided by RFD, the regions and SCR. In addition, the rapid engineering damage assessment by the EU Civil Protection Team from Spain, as well as technical assessment by Swiss Rapid Response Mission, provided detailed information to estimate damage of car bridges and crossings.

Damage

The floods caused significant damage to transport sector assets, namely roads, bridges and railway, completely disrupting the main international trade route with Georgia and the only international railway connection, as well as basic access to several settlements for about a week.

Table 29. Damage by transport asset (in USD millions)

Asset Type	Damage	Public	Private
Interstate highways (M4&M6)	8.81	100%	
Local Roads	1.50	100%	
Local bridges (car)	8.90	100%	
Local bridges (pedestrian)	0.14	100%	
Railway	2.34		100%
Vehicles	0.99		100%
Total	**22.67**		

The main affected transport assets are:

- National highway M6 damaged at 30 sections over a 50 km stretch between Tumanyan and Ayrum, with damaged sections ranging from 15 m to 1 km (totaling 7.1 km); at 5 sections both lanes destroyed; highway closed for 6 days for emergency repairs
- National highway M4 partly damaged at 10 sections over a 11 km stretch between Dilijan and Ijevan
- 2 km of railway track were completely disrupted at several locations over a 50 km stretch between Tumanyan and Ayrum; the railway closed for emergency repairs on the Armenian side for 19 days; resuming operations on the Georgian side after 6 days with goods being transported to/from Ayrum by truck.
- 4 bridges collapsed connecting settlements across the Debed river with the M6
- 7 smaller car bridges and 8 drainage structures destroyed or partly damaged (Table 29)
- 20 pedestrian bridges destroyed or partly damaged (Table 29)
- Several km of local roads
- 161 vehicles

Table 30. Characteristics of damaged bridges

Structure	Destroyed	Partly damaged	Minor damage	Total	Average length (m)	Average width (m)	Range (L/W)
Bridges	7	4		11	29.5	8.5	48.0-6.0 m/15.0-4.0 m
Drainage structure	3	3	2	8	5.7	2.8	8.0-3.0 m/4.0-2.0 m
Pedestrian bridge	5	8	7	20	21.2	1.1	45.0-17.0 m/4.0-1.0 m
TOTAL	**15**	**15**	**9**	**39**			


34 SV 023

Damage to roads and railways was caused by riverbank erosion typically on the outer edge of the river bend leading to failure of the flood retention walls by scour and overturning, and subsequent undercutting and erosion of embankments, roads and railway tracks. Damage is localized to sections of tens to hundreds of meters and only at five sections damaged both lanes of the highway leading to its temporary closure. Damage to bridges typically occurred as a result of the combined blockage of the river openings of the bridges by debris and trees accumulated around the piers and scour of the riverbed around the piers leading to significant settlement of the piers and subsequent heavy damage and frequent collapse of the bridge superstructure and deck. Many of these (partly) collapsed bridges are beyond repair[53].

Loss

The floods caused significant disruption to transport services and basic access, in particular along the Debed river. Several settlements were completely cut off from the main highway for about a week and the M6 was closed for emergency repairs for 6 days and remained (officially) closed for heavy traffic. However, post flood traffic counts from 5 June -12 July 2024 by RDF indicate that the average daily number of heavy trucks nearly resumed pre-flood conditions, whilst the number of medium and small trucks was even 75% larger. Increased traffic of construction vehicles assisting with the emergency repairs and debris clearing might explain the higher number of trucks, as well as potential seasonal differences in traffic.

As outlined in Table 31, the main loss, which occurred in the transport sector are *(i)* cost of demolition (bridges), debris removal and temporary emergency repairs of embankments, highways and bridges[54], *(ii)* higher vehicle operating costs and increased journey times due to alternative traffic routes (roads only), and *(iii)* loss of revenue on freight due to temporary suspension of trains[55].

Table 31. Loss in the Transport Sector (in USD millions)

Component	Loss	Public	Private
Demolition & debris removal	1.10	100%	
Temporary emergency repairs	1.93	100%	
Higher Vehicle Operation Costs:			
- emergency phase	0.62		100%
- reconstruction phase	4.14		100%
Revenue loss (railway):	2.55		100%
Total	**10.35**		

To better understand how traffic responded and rerouted during the closure of the M6, a rapid planning modeling process using machine learning/applied artificial intelligence techniques in conjunction with traditional traffic planning methodologies was applied to rapidly modify a regional and national road traffic network planning model capable of hypothetical scenario evaluation. The technical details of the methodology are documented in *Waller et al. (2021), Waller et al. (2023) and Lalwani et al. (2024)*. The modeled system-wide re-routing of traffic patterns estimates an increase in Vehicle Kilometers Traveled across the network of 1.8% amounting to 276,179 km. This indicates that vehicles are traveling longer distances to reach their destinations, likely due to detours around the closed and restricted routes.

53 Swiss Rapid Response Mission. 2024. Technical Assessment Report: May 2024 Floods in Armenia.

54 Demolition of bridges are estimated assuming a cost of 340 USD per square meter. Debris removal costs are estimated at 20 USD per ton for the transportation to the landfill and assumes a density of 1.53 t/m^3 and that at least two thirds of concrete and bituminous road materials were eroded and transported away by the flood and/or used for temporary emergency repairs. The cost of temporary emergency repairs of transport sector assets was estimated at 10% of damage to these assets.

55 Revenues from passenger and freight transport dropped by 28.0% and 26.5%, respectively, over a three-month period from May to July 2024 compared to the same period the previous year.

In the aftermath of the floods, it is anticipated that the transport sector will face increased operational costs and reduced reliability due to the vulnerabilities exposed in Armenia's aging road and railway networks. The reliance on the M6 as the primary road link for 70% of the country's imports already posed significant risks prior to the disaster. The flood further highlighted the need for redundancies in transport routes and more resilient infrastructure to mitigate the impacts of future natural hazards. Without urgent intervention, the sector will likely experience prolonged disruptions, affecting not only trade but also the movement of people and goods within the country.

Emerging Risks: the following risks emerging in the transport sector from the 2024 floods were identified by the Swiss rapid response team[56]:

- Temporary crossings are not durable and, in some cases, structurally problematic, and are even more vulnerable to floods than before the event. Many of the temporary measures and bridge structures will collapse in a next flood, even in an event with smaller return periods.
- Retaining walls and embankments, which were damaged but survived this event will see far more damage and risk collapse in future events if not repaired and/or strengthened.
- Emergency repairs and temporary stabilization of damaged road/railway sections may not be sufficient to withstand future floods, and there is no proper foundation below the riverbed.
- Changes to the riverbed due to accretion of debris/sediments from upstream river sections, landslides and local bank erosion might decrease the capacity in some river stretches and potentially increase local flood risks.

In addition, the event highlighted the significant exposure and vulnerability of the M6 and the need to strengthen the embankments and climate/disaster-proof the M6 road corridor[57], as well as in general, the need for increasing road network resilience and understanding the climate and disaster risks to mitigate impacts in the future. In the medium term, the transport sector's ability to recover from the flood damage depends heavily on investments in infrastructure resilience. Reconstruction efforts will need to prioritize not only repairing damaged assets but also strengthening key infrastructure against future disasters, especially in high-risk areas such as the Debed river gorge. Over the long term, failure to invest in sustainable recovery and disaster risk reduction measures could leave the country's transport sector vulnerable to increasingly frequent and severe climate events, leading to cyclical disruptions and mounting economic loss.

Addressing these risks is essential for ensuring that Armenia's transport network can support the country's economic development goals, maintain trade flows, and safeguard livelihoods dependent on reliable transportation.

The Sector Recovery Plan

Safe, fast and reliable access to homes, farms, markets and all commercial and social activities is the main vision driving developments in Armenia's transport sector. In addition, transforming Armenia from a landlocked to a land-linked country with seamless integration

56 Swiss Rapid Response Mission. 2024. Technical Assessment Report: May 2024 Floods in Armenia.
57 No climate-proofing measures were considered for the recent rehabilitation of the M6 financed by the Asian Development Bank (ADB) and the European Investment Bank (EIB).

of an efficient and competitive railway system with shipping lines at the Georgian Ports is a key priority within the sector. Climate and disaster resilience is intrinsic to all pillars, but above all important for the reliability of the networks, specifically of main trade routes and international connectivity, as the recent disaster demonstrates.

Reconstruction and Recovery Needs

Taking this and the lessons from the 2024 floods into account, the following main recovery priority areas emerge:

1. **Rehabilitation/reconstruction of affected transport infrastructure**

- Climate-proofing of the entire M6 road corridor, including rehabilitation of damaged sections, strengthening of embankments, drainage and alignment (as required), within 24-48+ months[58].
- Rehabilitation of M4 and railway[59], including strengthening of embankments, within 12-18 months.
- Reconstruction of collapsed bridges connecting settlements across the main rivers to more resilient standards[60], within 15-30 months (longer if international finance required).
- Reconstruction/rehabilitation of local roads, smaller car and pedestrian bridges connecting communities with each other and areas of agricultural productivity, 18-36 months (longer if international finance required).

2. **Risk and design studies for BBB**

- Detailed event analysis, including *(i)* documenting the event and flood levels, *(ii)* analyzing contributing factors and processes that led to bridge and embankment failures, *(iii)* informing bridge, embankment and highway designs, within 6 months.
- Design study for climate-proofing of M6, including multi-hazard risk assessment and design measures for strengthening the resilience of the M6 corridor, within 6 to 18 months.
- Resilient transport study looking at disaster risks across the networks and opportunities for creating more robustness and redundancy in the network, within 18-24 months.

In addition, the following two cross-sectoral activities will increase the resilience of the M6 and railway following the flood disaster:

- River management and debris clearance to restore pre-disaster river capacity (refer to recovery needs in Environment sector).
- Risk informed spatial planning and compliance with planning regulations, to avoid negative impacts on key transport assets from developments along the narrow gorge (refer to recovery needs in Disaster Risk Reduction sector).

The Sector Recovery Needs Costing

Table 32 outlines the estimated costs of reconstruction and recovery needs in the transport sector. The costs are only indicative, as detailed costings will only be available once detailed designs for the rehabilitation and reconstruction activities are completed. The climate-proofing of the M6 corridor is estimated to costs about 10-20% of the previous rehabilitation works[61] as part of the *Build Back Better* principle added to the rehabilitation costs of the flood damaged sections. For all other reconstruction needs an additional 30% was added to the estimated replacement costs to allow for additional costs of improved designs and risk protection measures.

58 The indicative timing of activities considers apart from the priority, the scale of rehabilitation/reconstruction works, the different stages of construction from design to bidding and implementation of works and how these differ depending on who is financing and implementing the activities.

59 The rehabilitation of the railway was completed by SCR within the first three weeks following the floods, and the required strengthening of the embankments will be undertaken once financing is secured.

60 The location of the bridges in regard to the M6 will need to be carefully evaluated given the space restrictions in the narrow Debed river gorge, in particular if the new designs recommend increase in elevation. Rationalisation of bridges should be considered, where feasible.

61 The cost of the previous rehabilitation of the M6 amounted to about 100 million USD, financed by EIB (51 million Euro) and ADB (42.5 million USD). Thus, climate-proofing is expected to cost about 10-20 million USD.

Table 32. Recovery and reconstruction needs assessment for Transport sector (in USD millions)

Component	Short-term Needs	Medium-term Needs	Long-term Needs	Total
Reconstruction Needs	**3.82**	**15.38**	**23.05**	**42.25**
Climate-proofing of M6	-	-	23.05	23.05
Rehabilitation of railway	2.34	0.70	-	3.04
Rehabilitation of M4	-	0.98	-	0.98
Reconstruction of local roads	-	1.95	-	1.95
Reconstruction of local bridges (car)	-	11.57	-	11.57
Reconstruction of local bridges (pedestrian)	-	0.18	-	0.18
Replacement/repair of vehicles	1.28	-	-	1.28
Event analysis	0.20	-	-	0.20
Recovery Needs	**-**	**2.00**	**-**	**2.00**
Design climate-proofing M6	-	1.80	-	1.80
Resilient transport study	-	0.20	-	0.20
Total	**3.82**	**17.38**	**23.05**	**44.25**

It is expected that the rehabilitation of *(i)* railway works was financed and implemented by SCR with potential support by the state government for improving embankments and retention walls, *(ii)* the rehabilitation of the M4 will be implemented by the RDF with government resources, *(iii)* whereas the climate-proofing of the M6 will likely require additional external finance by international development banks, and *(iv)* local roads and bridges will be implemented by the regions with support from the RDF and financial support of the state government and potentially international development banks. The Swiss Development Cooperation offered technical assistance for a detailed event analysis and ADB offered to finance the climate-proofing design and other required technical studies from unutilized loan proceeds of the M6 rehabilitation.

Community Infrastructure

Sector Summary

Community infrastructure refers to the systems and facilities that operate at the community level. In this report, community infrastructure encompasses telecommunications, gas, electricity, water, and sanitation systems, as well as health and education sub-sectors. Since each sub-sector has its own distinct infrastructure operating independently, this chapter addresses them separately.

The community infrastructure has been severely damaged in the consolidated communities of Alaverdi and Noyemberyan, and to some extent in Tashir, Stepanavan, and Dilijan. The damage has primarily affected pipes, cables, networks, and supporting facilities, while losses in the sector relate to temporary reconstruction costs and lost revenues due to the inability to provide services. Damage in the education and health sectors was registered only in one school and one medical center in Alaverdi consolidated community.

In the community infrastructure sector, the **damage is estimated at 2.06 million USD**, **losses amount to 0.87 million USD**, and **recovery needs total 4.54 million USD** (Table 33).

Table 33. Damage, loss and need calculation in Infrastructure sector (in USD millions)

Consolidated Community	Damage	Loss	Needs
Alaverdi	1.56	0.46	2.86
Dilijan	0.37	0.05	0.79
Gyulagarak	-	-	-
Ijevan	0.01	0.002	-
Noyemberyan	0.08	0.04	0.29
Pambak	0.01	0.06	0.06
Stepanavan	0.02	0.02	-
Tashir	0.01	0.01	0.04
Tumanyan	0.0002	-	-
Nationwide	-	0.22	0.49
Total	**2.06**	**0.87**	**4.54**

The most affected sector is **energy**, with damage estimated at **0.93 million USD**. The second most affected sector is **water and sanitation**, also with damage estimated at **0.56 million USD**. Damage in other sectors is relatively similar: in **education**, the damage is estimated at **0.19 million USD**; in **communication**, at **0.19 million USD**; and in **health**, at **0.19 million USD** (Table 34).

Approximately 78% of the total damage across all infrastructure sectors is registered in the Lori region, estimated at 1.6 million USD, while Tavush accounts for around 22%, with an estimate of 0.45 million USD.

The main loss in the infrastructure sector, estimated to around 0.87 million USD, is related to emergency recovery and renovation activities, which include: *(i)* materials and goods, *(ii)* extra work, *(iii)* revenue loss, and *(iv)* leakage loss specifically in the gas and water infrastructures. Losses in the energy, health, and communication sectors are quite similar, with estimates of **0.25 million USD for energy**, approximately **0.25 million USD for health**, and **0.23 million USD for communication**. Loss in the **water and sanitation** sector are estimated at **0.13 million USD**, while losses in **education** are minimal, estimated at **0.002 million USD**.

Approximately 64% of the total loss across all infrastructure sectors are registered in the Lori region, estimated at around 0.56 million USD, while Tavush accounts for about 11%, with an estimate of 0.09 million USD. The loss amounting to 0.22 million USD (25%) related to the health sector, specifically for the provision of medicines and medical supplies and water quality sanitary assessment, is estimated for the entire affected area (nationwide).

The total need for recovery and reconstruction of the infrastructure sector is estimated at 4.54 million USD. The primary needs are in the energy and water sectors, estimated at 1.71 million USD for energy and 1.17 million USD for water and sanitation. Needs for other sectors are approximately similar: 0.43 million USD for communication, 0.42 million USD for health, 0.31 million USD for education, as well as 0.49 million USD nationwide.

Approximately 65% of the total needs across all infrastructure sectors are registered in the Lori region, estimated at around 2.96 million USD, while Tavush accounts for about 24%, with an estimate of 1.08 million USD. Nationwide needs are estimated at 11%, primarily related to the health sector, including the development of a unified data management geoportal for each sector and the assessment and mapping of the drainage system in 71 consolidated communities, totaling around 0.49 million USD.

Table 34. Damage, loss and need calculation per each Infrastructure sector (in USD millions)

Sectors	Damage	Loss	Needs	Private	Public
Communication	0.19	0.23	0.58	100%	
Energy	0.93	0.25	1.93	100%	
Water and Sanitation	0.56	0.13	1.30		100%
Health	0.19	0.25	0.42	100%	
Education	0.19	0.002	0.31		100%
Nationwide	-	-	0.49		
Total	**2.06**	**0.87**	**4.54**		

Pre-disaster Baseline Information

The Republic of Armenia (RA) currently has 71 communities, a reduction from 915 prior to consolidation. Of these, 64 are consolidated, and 7 remain separate, including Yerevan, Gyumri, Vanadzor, and four communities that are densely populated by ethnic minorities.

The RA Law "On Local Self-Government" assigns specific and delegated rights to local self-government bodies to address community issues. However, infrastructure management and maintenance are primarily carried out by regional and central government bodies, as well as private companies. Public schools fall under the authority of regional administrations, while high schools are managed by the Ministry of Education, Science, Culture, and Sports. Pre-primary education institutions are primarily overseen by local self-government bodies. Healthcare institutions are managed by both regional administrations and the Ministry of Health.

The operation and maintenance of energy infrastructures (electricity and gas) are managed by private companies, with the relationship between these companies and the government regulated by the "Law on Energy." Water supply and drainage in communities are handled by a private operator as per Government Decision N 1662-A. For communities not listed in the annex of this decision, operation and maintenance are managed by the respective community.

The heads of communities are responsible for maintaining and operating roads, road traffic facilities, other technical means, bridges, and other engineering structures ("Law on Local Self-Government," Article 44). Interstate, state, and regional highways passing through the administrative borders of the communities are managed by the state administration body authorized by the RA government, in accordance with the RA "Law on Highways."

In the Lori region, consolidation resulted in 9 consolidated communities and 2 separate communities (Lermontovo and Fioletovo) with ethnic minority populations. In the Tavush region, 4 consolidated communities were formed. Following flooding in the Lori and Tavush regions, the Government of Armenia declared 9 consolidated communities as disaster zones, which includes Gyulagarak, Stepanavan, Tashir, Gugark, Tumanyan, and Alaverdi, representing about 60% of the communities in Lori region, and Dilijan, Ijevan, and Noyemberyan, which account for 75% of the consolidated communities in Tavush region.

Assessment of Disaster Effects

The assessment of the infrastructure sector was conducted in close collaboration with line ministries, namely the Ministry of High-Tech Industry, Ministry of Territorial Administration and Infrastructures, Ministry of Health, Ministry of Education, and Ministry of Internal Affairs, as well as in consultation with the 9 community administrations affected by the flood. Data and information were provided by the Ministry of High-Tech Industry, the Ministry of Territorial Administration and Infrastructures, Gazprom Armenia CJSC, Veolia Jur CJSC, and Electric Networks of Armenia CJSC. This was followed by desk research for baseline information, quantitative data analysis, and semi-structured interviews with stakeholders.

It was identified that there is a significant gap in skills and technical capacity to identify and analyze the interrelatedness between different community and national-level infrastructure projects and challenges. This issue affects both public and private institutions responsible infrastructure management and regulation. Enhancing collaboration between private entities and community administrations was highlighted as a priority to improve data-driven and evidence-based developments at the local level.

Additionally, the need for digitalization of risk identification and subsequent collaboration processes was emphasized as crucial. Digital tools would enable all sectors and actors to access information on available capacities, interrelated risks, and the impacts of activities. Such tools would facilitate better coordination and collaboration among stakeholders, streamline processes, and enable more comprehensive, context-specific,

people-centered, and prevention-oriented actions for risk-informed and resilient development. The integration of these digital solutions into each sector was recommended, tailored to the peculiarities and network coverage of the relevant infrastructure.

Communication Sector

Pre-disaster Baseline Information

The Armenian communication sector consists of over 210 private operators, with four major providers dominating the market: Viva, Team Telecom Armenia, Ucom, and Ovio. These providers cover nearly the entire communication sector in Armenia, offering fixed-line, mobile, and Internet services through wired, wireless, and fiber-optic networks.

Mobile coverage in Armenia is widely accessible, with penetration rates exceeding 100%, indicating multiple subscriptions per person. Internet access is available to over 80% of the population, covering most of the country's territory. The sector is regulated by the Public Services Regulatory Commission and the "Law on Electronic Communications."

In the Lori and Tavush regions, fifty operators provide electronic communication services. However, the four major providers also dominate these regional markets, while the other, smaller operators function primarily as resellers, relying on the infrastructure of the major players.

Assessment of Disaster Effects

Following the flooding, the Ministry of High-Tech Industry and operators formed emergency recovery teams. These teams promptly replaced and repaired damaged channels in collaboration with other entities, including communication utilities. Although electronic communication has been fully restored, operators have implemented temporary solutions at some points, particularly for simple and fiber-optic cables, to ensure continuity of service while planning for a comprehensive and permanent restoration of connections in the longer term.

The assessment of the communication sector in the affected communities was conducted based on information provided by the four major operators. According to this assessment, the flooding primarily damaged underground infrastructure and cables, including simple cables, ground cables, and fiber-optic cables, in the Alaverdi, Tumanyan, and Stepanavan consolidated communities of the Lori region, as well as the Noyemberyan consolidated community in the Tavush region.

Table 35. Damage, loss and needs in communication infrastructures (in USD millions).

Consolidated Community	Damage	Loss	Needs
Alaverdi	0.19	0.23	0.44
Dilijan	-	-	-
Gyulagarak	-	-	-
Ijevan	-	-	-
Noyemberyan	0.002	-	-
Pambak	-	-	-
Stepanavan	0.01	-	-
Tashir	-	-	-
Tumanyan	0.0002	-	-
Nationwide	-	-	0.14
Total	**0.19**	**0.23**	**0.58**

Overall, 45% of the communities in the disaster area experienced full communication outages, which were restored within 2-3 days. Notably, the flooding damaged cables across the Debed River and M6 highway, resulting in nearly 10 km of damaged infrastructure and cables (both ground and underground).

In the communication infrastructure sector, the **damage is estimated at 0.19 million USD**, **loss amounts to 0.23 million USD**, and recovery **needs total 0.58 million USD** (Table 35). Approximately 96% of the total damage in communication was registered in the Alaverdi consolidated community, estimated at 0.19 million USD, while the remaining 4% was registered in Stepanavan, Tumanyan, and Noyemberyan.

The flood significantly affected the communication network, with extensive damage reported to underground infrastructure. The damage by asset type is detailed in Table 36. The primary damage was to ground cables, estimated at 0.15 million USD, which accounts for 75% of the total damage. The remaining 25% of the damage, estimated at 0.05 million USD, was to underground infrastructure and other types of cables affected by the flood. All of the damage is associated with the private sector.

Table 36. Damage as per asset type in communication infrastructures (in USD millions).

Asset Type	Damage Estimates	Public	Private
Underground Infrastructure	0.02	-	0.02
Ground Cables	0.15	-	0.15
Fiber Optic Cable	0.01	-	0.01
Cable	0.01	-	0.01
Manhole	0.01	-	0.01
Total	**0.19**		**0.19**

The loss in the communication sector is reported only in Alaverdi (Table 35) and is estimated at 0.23 million USD. This total includes a revenue loss of 0.03 million USD and temporary recovery costs 0.21 million USD (Table 37).

Table 37. Loss in communication infrastructure (in USD millions).

Component	Loss Estimates	Public	Private
Temporary Recovery of Cable	0.02	-	0.02
Temporary Recovery of Fiber Optic Cable	0.04	-	0.04
Temporary Recovery of Ground Cables	0.15	-	0.15
Revenue Loss	0.03	-	0.03
Total	**0.23**		**0.23**

Recovery Needs and Estimates

The sector recovery cost is estimated at 0.58 million USD (Table 35), with 0.44 million USD allocated for reconstruction needs and 0.14 million USD for recovery needs (Table 38).

Reconstruction efforts include restoring infrastructure and cables in the Alaverdi consolidated community, with a primary focus on the cable lines across the M6 highway, which are currently under restoration. Given that much of the damaged infrastructure was located near the river, the recovery plan incorporates a *Build Back Better* approach, with an additional 30% allocated to mitigate risks and reduce vulnerabilities to future disasters.

Recovery needs were identified based on stakeholder interviews, which highlighted several long-term requirements: *(i)* developing relevant standards for collaboration between telecommunication entities and community specialists, *(ii)* designing and developing a unified data management geoportal for communication systems, and *(iii)* reviewing

the scope of information collected by the Statistics Committee, as their data on telecommunications systems is currently outdated.

Table 38. Recovery and reconstruction need assessment for Communication sector (in USD millions).

Component	Short-term Needs	Medium-term Needs	Total
Reconstruction Needs	**0.16**	**0.28**	**0.44**
Underground Infrastructure Reconstruction including cables and BBB	0.08	-	0.08
Fiber Optic Cable network Reconstruction including BBB	0.08	-	0.08
Ground cable network Reconstruction including BBB	-	0.28	0.28
Recovery Needs	**-**	**0.14**	**0.14**
Enhancing collaboration with telecommunication and community.	-	0.01	0.01
Developing unified geoportal on telecommunication.	-	0.13	0.13
Review the information collected standards on telecommunication.	-	0.004	0.004
Total	**0.15**	**0.42**	**0.58**

Energy Sector

Pre-disaster Baseline Information

The energy sector in Armenia encompasses both electricity and natural gas infrastructures. According to the RA "Law on Energy", the primary policies governing the energy sector are developed and implemented by the Ministry of Territorial Administration and Infrastructures. Meanwhile, the tariff-setting and licensing policies are overseen by the Public Services Regulatory Commission.

Gas Infrastructure

Armenia imports gas from Russia and Iran. In 2022, 2,599 million m^3 of natural gas were imported from Russia and 371.8 million m^3 from Iran.

Gazprom Armenia CJSC, a wholly owned subsidiary of PJSC Gazprom, is the sole supplier and distributor of natural gas in the Republic of Armenia. The company operates through 15 gasification and gas supply branches. Additionally, it owns the Hrazdan-5 station, which is the fifth block of the Hrazdan Thermal Power Plant.

The gasification rate in the Republic of Armenia exceeded 96%, with 650 settlements connected to the gas network as of 2022, including the regions of Lori and Tavush. Gas distribution is facilitated by approximately 1,669 km of highway gas transportation pipelines and about 23,100 km of gas distribution networks. The company serves around 769,000 residential customers and approximately 21,000 other consumers.

Natural gas consumption in Armenia is primarily distributed across three key sectors: households (50%), transport (31%), and industry (19%). Approximately 80% of Armenia's vehicle fleet operates on compressed natural gas (CNG), placing the country among the global leaders in using natural gas as a motor fuel. The use of CNG is more cost-effective than petroleum products and significantly reduces emissions of harmful substances and greenhouse gases.

In 2022, the transport sector consumed 504.8 million m^3 of natural gas. This amount is approximately 1.6 times lower than the 812.1 million m^3 consumed by households but 1.7

times higher than the 296.7 million m^3 used for energy purposes in 13 industrial sectors. Additionally, 87.6 million m^3 of natural gas were consumed for technical heating in agriculture, specifically in greenhouses. The service sector's gas consumption totals 254.9 million m^3.

Electricity

Armenia uses a mix of traditional and alternative sources for electricity production, including Nuclear Power Plants (NPP), Thermal Power Plants (TPP), and Hydro-power Plants (HPP). In 2022, the Armenian NPP produced 2,846.2 million kWh of electricity, contributing approximately 32% of the total electricity production in the country. The production from other sources was as follows:

- **Yerevan TPP:** the steam-gas cycle unit produced 1,761.7 million kWh (19.8% of total production).
- **Hrazdan TPP:** the condensing power units generated 890 million kWh (10% of total production).
- **Hrazdan 5:** produced 3 million kWh (0.03% of total production).
- **Arm Power:** generated 1,220.5 million kWh (13.7% of total production).

Hydro-power in Armenia is primarily generated by two large HPP cascades managed by International Energy Corporation CJSC and Contour Global Hydro Cascade CJSC, alongside many small HPPs. In 2022:

- **International Energy Corporation** CJSC's Sevan-Hrazdan Cascade produced 390.6 million kWh, representing 4.4% of the total production.
- **Contour Global Hydro Cascade** CJSC's Vorotan Cascade generated 740.1 million kWh, representing 8.3% of the total production.
- **The 189 small HPPs** had a total installed capacity of 409 MW and produced 809.2 million kWh, accounting for 9.1% of total electricity production.

Wind power contributed to Armenia's electricity production with 4.2 MW of wind power plants generating 1.8 million kWh in 2022, which was just 0.02% of the total output. Photovoltaic (PV) power stations also played an increasing role. In 2022, licensed PV stations had a total installed capacity of 204.8 MW and produced 241.3 million kWh. Autonomous PV producers, with a total capacity of 196.9 MW, generated 282.2 million kWh, marking a significant increase of approximately 1.4 times compared to 2018.

Electricity is distributed through High Voltage Electric Networks (HVEN) CJSC and Electric Networks of Armenia CJSC, the latter being responsible for distribution and sale across Armenia. Since 2017, ownership of Electric Networks of Armenia CJSC has been split between Tashir Capital CJSC (70%) and Liormand Holding Limited (30%).

The distribution network spans approximately 36,000 km and includes 102 substations of 110 kV with a total capacity of 4,478 MW and 224 substations of 35 kV with a combined capacity of 1,736 MW. The system features 26,000 km of overhead lines and 5,700 km of underground cables. Power distribution is managed at tariffs approved by the Public Services Regulatory Commission. The company serves over 1 million customers nationwide, with nine branches, including the Debed and Aghstev branches serving the Lori and Tavush regions, respectively.

Assessment of Disaster Effects

In the affected area, only the consolidated communities of Alaverdi and Tashir experienced a complete loss of gas supply, which was restored within 20-30 days. The main damage in this sub-sector was to gas pipes in Alaverdi and Noyemberyan. Overall, 6,074 meters of pipes suffered minor or partial damage in the disaster zone. Other consolidated communities, including Stepanavan in the Lori region and Ijevan, Dilijan, and Noyemberyan in Tavush, experienced partial disruptions in gas supply. Most of these communities regained access within a few days, except for Noyemberyan, where full restoration took 15 days.

The damage to pipes resulted in significant gas loss for the supplier company. In the Lori region, gas leakage was reported at 96,913 m^3

per hour, while in Tavush region, it reached 12,750 m^3 per hour. Additionally, the flooding prevented the delivery of 65,456 m^3 per hour of gas to affected communities in Lori and 1,043 m^3 per hour in Tavush.

The electricity sub-sector also suffered damage as the flooding destroyed infrastructure, including 0.4 kV, 0.6 kV, and 10 kV power transmission lines, supplementary equipment, transformers, and electric stations. Significant damage was recorded in Alaverdi and Dilijan, with minor damage in Pambak and Noyemberyan. Sector loss includes costs for reconstruction and lost revenues due to the inability to supply electricity.

Damage calculations for the energy sector totals to **0.93 million USD**. Major damage is concentrated in Alaverdi, estimated at 0.8 million USD, which represents 85% of the total damage across the 9 consolidated communities. Other communities with substantial damage include Noyemberyan, estimated at 0.07 million USD, and Dilijan, Stepanavan and Tashir estimated at 0.02 million USD each. The remaining communities have minor damage totaling 0.01 million USD, approximately 5% of the total damage (Table 39).

Table 39. Damage, loss and needs in energy infrastructures (in USD millions).

Consolidated Community	Damage	Loss	Needs
Alaverdi	0.80	0.11	1.33
Dilijan	0.02	0.03	0.06
Gyulagarak	-	-	-
Ijevan	0.01	0.002	-
Noyemberyan	0.07	0.02	0.22
Pambak	0.01	0.06	0.06
Stepanavan	0.02	0.02	-
Tashir	0.02	0.01	0.05
Tumanyan	-	-	-
Nationwide	-	-	0.22
Total	**0.93**	**0.25**	**1.93**

The total **loss** for the energy sector is estimated at **0.25 million USD**. The major loss is recorded in Alaverdi, estimated at 0.11 million USD, which represents 44% of the total loss across the 9 consolidated communities. Other significant loss is reported in Pambak, estimated at 0.06 million USD; Dilijan, estimated at 0.03 million USD; and Noyemberyan, estimated at 0.02 million USD.

The remaining communities have minor loss totaling 0.03 million USD, approximately 3% of the total loss (Table 39).

Table 40. Loss in energy infrastructures (in USD millions)

Component	Loss	Public	Private
Temporary repairs	0.15	-	0.15
Extra Work	0.03	-	0.03
Revenue Loss	0.07	-	0.07
Total	**0.25**	**-**	**0.25**

The calculation of loss in the energy sector includes temporary repairs, estimated at 0.15 million USD, which accounts for approximately 61% of overall loss. Additional costs include extra work estimated at 0.03 million USD and revenue loss (including also gas leakage) estimated at 0.07 million USD, representing approximately 28% of the total loss (Table 40).

Recovery Needs and Estimates

The sector **recovery** cost is estimated at **1.93 million USD** (Table 39), with the **reconstruction** need amounting to **1.71 million USD** and the **recovery needs at 0.22 million USD** (Table 41).

Stakeholder consultations highlighted the urgent need for modernization of substations in the Lori and Tavush regions, which are crucial for receiving and distributing high-voltage electricity to communities. Reconstruction of the gas pipeline is also identified as a high-priority action, given that the current renovations are only temporary solutions.

Additionally, stakeholders proposed the development of a unified data management geoportal for electricity and gas. This geoportal would enhance communication across sectors by providing comprehensive information on existing capacities, inter-related risks, impacts, and necessary coordinated actions, thus fostering greater synergy and effectiveness.

The reconstruction need includes energy network rehabilitation, which an additional 30% allocated for *Build Back Better* component. This component, agreed upon with relevant stakeholders, accounts for potential risks from floods, landslides, and other hazards, and involves full or partial reconstruction of both electricity and gas pipelines. Reconstruction needs represent approximately 89% of the total sector rehabilitation needs.

Recovery efforts will focus on two main areas: *(i)* enhancing collaboration between energy sector stakeholders and community administrations, and *(ii)* developing a unified geoportal for energy. These activities are planned as medium-term objectives and account for around 11% of the total rehabilitation cost (Table 41).

Table 41. Recovery and reconstruction need assessment for Energy sector (in USD millions).

Component	Short-term Needs	Medium-term Needs	Total
Reconstruction Needs	**0.42**	**1.29**	**1.71**
Energy Network Reconstruction including BBB	0.42	1.29	1.71
Recovery Needs	**-**	**0.22**	**0.22**
Enhancing collaboration with Energy sector and community.	-	0.02	0.02
Developing unified data management geoportal on Energy sector.	-	0.20	0.20
Total	**0.42**	**1.51**	**1.93**

Water and Sanitation Sector

Pre-disaster Baseline Information

The water system in Armenia is owned by the government. Approximately 80% of services and management is delegated to Veolia Jur CJSC, which acts as the United Operator in Armenia, while the remaining 20% (580 settlements) is served by local governments, and the systems are community owned. Veolia Jur is responsible for the production and distribution of drinking water, the management of wastewater treatment systems, and the provision of related services. It serves 527,000 active customers across Yerevan, 41 towns, and 321 rural communities, providing both water supply and wastewater services. The current water supply system includes:

- 184 water production facilities,
- 563 water supply pumps (excluding boosters),
- 791 water transmission lines totaling 4,061 km in length,
- 7,800 km of water distribution network.

The drainage and wastewater treatment system comprises:

- A drainage network with a total length of 3,700 km,
- 8 wastewater treatment stations,
- A surface water and rainwater removal system extending 350 km.

The water sector is regulated by the Water Code of the Republic of Armenia, the Water Committee of the Ministry of Territorial Administration and Infrastructures, and the Public Services Regulatory Commission.

Assessment of Disaster Effects

The flooding caused significant damage to the water and sanitation sub-sector, primarily affecting water distribution lines and sewer lines. In total, 680 meters of sewage pipeline were affected, with major damage occurring in the Alaverdi consolidated community. Additionally, 4,090 meters of drinking water pipeline were partially or totally damaged. Among the affected communities, Dilijan experienced the most extensive damage, with 3,150 meters of water pipes (including approximately 3,000 meters that need full reconstruction) and 280 meters of sewage pipes damaged (Table 42). Alaverdi also sustained considerable damage, with 830 meters of water pipes and 600 meters of sewage pipes affected. In Noyemberyan, 110 meters of drinking water pipes were damaged. The restoration of the water system and cleaning of the sewage system took about 5 days in Dilijan and Noyemberyan, while in Alaverdi it took approximately 15 days for the water system and 25 days for the sewage system.

The total **damage** in the water and sanitation sector is estimated at **0.56 million USD**. The major damage was recorded in Dilijan, estimated at 0.35 million USD, and in Alaverdi, estimated at 0.2 million USD. Damage in Noyemberyan is estimated at 0.01 million USD (Table 42).

Table 42. Damage, loss and needs in Water and Sanitation sector (in USD millions).

Consolidated Community	Damage	Loss	Needs
Alaverdi	0.20	0.09	0.42
Dilijan	0.35	0.03	0.74
Noyemberyan	0.01	0.01	0.01
Nationwide	-	-	0.13
Total	**0.56**	**0.13**	**1.30**

The total **loss** for the water and sanitation sector is estimated at **0.13 million USD**. The majority of this loss was registered in Alaverdi, amounting to 0.09 million USD, representing approximately 71% of the total loss across the three affected communities. The loss in Dilijan is estimated at 0.03 million USD, and in Noyemberyan it is estimated at 0.01 million USD (Table 42).

Table 43. Loss in Water and Sanitation sector (in USD millions).

Component	Loss Estimates Total	Public	Private
Temporary repairs	0.06	0.06	-
Extra Work	0.04	0.04	-
Water Leakage	0.02	0.02	-
Revenue Loss	0.02	0.02	-
Total	**0.13**	**0.13**	**-**

The loss calculation for the water and sanitation sector includes several components: temporary repairs are estimated at 0.06 million USD, accounting for approximately 67% of the total loss; extra work is estimated at 0.04 million USD; water leakage loss is estimated at 0.02 million USD; and revenue loss is estimated at 0.02 million USD (Table 43).

Recovery Needs and Estimates

The total **recovery cost** for the water and sanitation sector is estimated at **1.30 million USD** (Table 42). This includes a **reconstruction need of 1.16 million USD** and a **recovery need of 0.26 million USD** (Table 44).

Reconstruction needs are distributed as follows:

1. **Dilijan:** the recovery need is estimated at 0.74 million USD, accounting for approximately 62% of the total recovery need, including;
   - Reconstruction of 3,150 meters of drinking water pipelines;
   - Reconstruction of 280 meters of the sewerage system;
   - Installation of 300 water measurement systems;
   - Development of 2 water intake systems;
   - Establishment of 18 drinking water observation points.
2. **Alaverdi:** the recovery need is estimated at 0.42 million USD, representing about 36% of the total recovery need, including;
   - Reconstruction of 830 meters of drinking water pipelines;
   - Reconstruction of 600 meters of the sewage system;
   - Installation of 482 water measurement systems.
3. **Noyemberyan:** the recovery need is estimated at 0.01 million USD, or around 2% of the total recovery need, including:
   - Reconstruction of 110 meters of drinking water pipelines;
   - Installation of 182 water measurement systems.

Recovery efforts should be focused on:

- Enhancing collaboration with water and sanitation sector stakeholders and community administration;
- Developing a unified geoportal for water and sanitation;
- Assessing and mapping out the drainage system;
- Debris removal, specifically for 880 meters of the sewage system, which includes transportation and demolition costs (Table 41).

Table 44. Recovery and reconstruction need assessment for Water and Sanitation sector (in USD millions).

Component	Short-term Needs	Medium-term Needs	Long-term Needs	Total
Reconstruction Needs	**1.16**	**-**	**-**	**1.16**
Water system reconstruction including BBB	0.90	-	-	0.90
Sewerage system reconstruction including BBB	0.26	-	-	0.26
Recovery Needs	**0.005**	**0.12**	**0.01**	**0.14**
Enhancing collaboration with water & sanitation and community.	-	0.01	-	0.01
Developing unified data management geoportal on Water and sanitation.	-	0.10	0.006	0.11
Assessment and mapping the drainage system in 71 consolidated communities	-	0.006	0.006	0.01
Debris removal	0.005	-	-	0.01
Total	**1.22**	**0.116**	**0.01**	**1.30**

Health Sector

Pre-disaster Baseline Information

Armenia's health system is decentralized, with the Ministry of Health serving as the primary payer for publicly funded health services. Although the country provides a relatively comprehensive Basic Benefits Package, the system faces challenges such as underfunding and high out-of-pocket payments. These issues particularly affect vulnerable groups, impacting financial protection and accessibility. Noncommunicable diseases account for approximately 93% of all deaths in Armenia. The country faces several public health hazards, including COVID-19, seasonal influenza, antimicrobial resistance, earthquakes, air pollution, fires, transportation accidents, and international armed conflicts. Historically, floods have not been considered a major public health risk in Armenia.

The National Center for Disease Control and Prevention (NCDC) under the Ministry of Health is the key public health body in Armenia. It operates with regional branches and a Reference Laboratory Center. The NCDC's responsibilities include maintaining population health, disease prevention, health promotion, risk assessment, management, communication, preventive and anti-epidemic measures, laboratory investigations, and outbreak response.

The Ministry of Health oversees the development and implementation of national health policies and regulations, including the licensing of healthcare providers. Armenia's healthcare system is structured into three levels:

- **National Level:** provides tertiary care through specialized hospitals;
- **Regional Level:** offers secondary care via regional hospitals;
- **Municipal and Community Level:** delivers primary healthcare through various facilities.

In the Lori region, the healthcare infrastructure includes 5 medical centers (hospitals) and 24 primary healthcare facilities, such as polyclinics, ambulatories, and health posts. In the Tavush region, there are 3 medical centers and 22 primary healthcare facilities.

Assessment of Disaster Effects

The emergency had a limited impact on public health due to several factors: the initial effects on healthcare infrastructure were isolated, the national health and emergency

sectors responded promptly, alternative healthcare facilities remained accessible, and medical evacuations were carried out efficiently. The swift establishment of epidemiological monitoring, including water quality surveillance and vector and rodent control, helped prevent potential outbreaks of infectious diseases.

The Ministry of Health supported medical organizations in the affected regions by supplying medicines and medical products and coordinating with relevant specialists. Notably, six pregnant women were successfully transferred to medical centers. Most medical facilities and workers in the affected regions remained operational and continued to provide essential services to the population.

To address increased health needs, medicines and medical supplies were transported from Akhtala and Chochkan village, utilizing mountain transit roads. The National Center for the Provision of Medicines and Medical Supplies provided approximately 120 types of medicines and 100 types of medical supplies, including protective clothing and disinfectants, as humanitarian aid.

The NCDC, through its branches in Lori and Tavush, strengthened epidemic-control measures. This included:

- Monitoring drinking water quality with 582 additional water samples and microbiological and chemical tests, totaling 4,635 laboratory investigations;
- Conducting door-to-door visits with primary health care doctors for early detection of infectious diseases and raising public awareness;
- Performing rodent and vector surveillance, with 8 field visits conducted by the NCDC's Environmental and Epidemiological Evaluation (EEE) laboratory specialists.

The flooding caused damage to one medical facility and two pharmacies. The most significantly affected was the Hellenic Medical Center, a private ambulatory clinic providing free medical services to vulnerable populations. The center experienced physical damage to its buildings, furniture, equipment, and a loss of medical supplies and income due to its temporary closure.

The two affected pharmacies, Aralia LLC and Hegoda Farm LLC, also suffered physical damage, loss of supplies, and income. Their damage and loss and recovery needs are categorized under the business sector.

The total **damage** in the health sector is estimated at **0.19 million USD**, with the entire amount attributed to the Hellenic Medical Center in the Alaverdi consolidated community. The total **loss is estimated at 0.25 million USD**. The total **needs** are estimated at **0.42 million USD** (Table 45).

Table 45. Damage, loss and needs in Health sector (in USD millions).

Consolidated Community	Damage	Loss	Needs
Alaverdi	0.19	0.01	0.30
Alaverdi (Observation)	-	0.01	0.06
Noyemberyan (Observation)	-	0.01	0.06
Nationwide	-	0.22	-
Total	**0.19**	**0.25**	**0.42**

Recovery Needs and Estimates

The flooding primarily affected private healthcare facilities, with no reported impact on state-run healthcare infrastructure. Consequently, there are no reconstruction needs for the public health sector as managed by the Ministry of Health.

However, the Hellenic Medical Center, a private facility, requires renovation. The estimated reconstruction costs are as follows:

- **Building Reconstruction:** 0.09 million USD,
- **Medical Equipment and Supplies:** 0.21 million USD.

These estimates cover the necessary repairs to the facility's structure and the replacement of damaged medical equipment and supplies.

The **recovery needs** cover national requirements and are estimated at **0.12 million USD**. Of this, 0.01 million USD is allocated for a Strategic Public Health Risk Assessment for the Lori and Tavush regions, using the Strategic Toolkit for Assessing Risk (STAR).

This assessment aims to identify region-specific hazards, assess the likelihood of these risks occurring, estimate their impact on the region, determine the level of risk, draft key recommendations and priority actions based on risk ranking, and integrate these recommendations into national and subnational action planning processes.

Capacity building needs are estimated at 0.11 million USD. This includes training tailored to needs and audiences for Mental Health and Psychosocial Support (MHPSS) services, as well as pre-hospital life support training for local healthcare personnel.

Debris removal needs are estimated at 0.003 million USD, which covers the removal of mud and the demolition of damaged equipment and furniture (Table 46).

Table 46. Recovery and reconstruction need assessment for Health sector (in USD millions).

Component	Short-term Needs
Reconstruction Needs	**0.30**
Reconstruction including BBB	0.09
Equipment, furniture, and supply	0.21
Recovery Needs	**0.12**
Strategic public health risk assessment per region	0.01
Capacity building for needs and audience tailored MHPSS services	0.03
Pre-hospital life support trainings for the local healthcare personnel (8 trainings)	0.08
Debris removal	0.003
Total	**0.42**

Education Sector

Pre-disaster Baseline Information

The Armenian education sector has experienced significant transformations in recent decades, evolving from a Soviet-style system to one that increasingly aligns with international standards, particularly through participation in the Bologna Process in higher education.

Education is compulsory for children between the ages of 6 and 16. The structure is divided into three main levels: primary education (grades 1 to 4), lower secondary education (grades 5 to 9), and upper secondary education (grades 10 to 12).

Public schools operate under the authority of regional administrations, high schools are managed by the Ministry of Education, Science, Culture, and Sports, and pre-primary education institutions are mainly overseen by local self-government bodies.

Both public and private institutions offer higher education, and since Armenia's adoption of the Bologna Process in 2005, academic qualifications have become more comparable across Europe.

Despite this progress, the sector faces several challenges. One of the key issues is ensuring both the quality of education and equal access, particularly in rural areas where schools often struggle with inadequate infrastructure

and a lack of qualified teachers. Additionally, Armenia's demographic decline, driven by lower birth rates and ongoing emigration, has resulted in shrinking student populations, which in turn threatens the sustainability of schools, especially in remote regions.

Higher education in Armenia has also seen significant changes, with universities increasingly adopting the European Credit Transfer and Accumulation System (ECTS) to enhance the global recognition of Armenian degrees. International collaboration has grown, particularly through partnerships and exchange programs supported by initiatives like the Erasmus+ program.

The private sector's involvement in education is expanding, with private institutions offering specialized curricula in fields like technology and business. These developments, coupled with ongoing reforms, suggest a sector that is both adapting to new realities and facing important challenges that will shape its future trajectory.

Assessment of Disaster Effects

Educational facilities sustained limited damage in the aftermath of flash floods in Lori and Tavush regions of Armenia. Overall, the impact of floods on educational continuity in schools was mitigated due to the timing of the disaster during summer holidays. UNICEF identified only the consolidated community of Alaverdi, Lori region as affected in terms of educational facilities, based on field visits, consultations with community administration and liaison with the Ministry of Education, Science, Culture, and Sports (MoESCS) of the Republic of Armenia. The school in Karkop village of Alaverdi consolidated community sustained 60% damage and the pre-school facility in the same village that was established jointly with UNICEF has sustained 20% damage. To date the pre-school education for 16 children remains disrupted, since the rehabilitation has not started yet.

The table below depicts the educational facilities of the declared disaster zones by RA Government N-722 decree[62] on May 27. Out of

62 RA Government Decree N-722, May 27 on declaration of disaster zones due to flash floods in Lori and Tavush regions of Armenia. Available at: https://www.irtek.am/views/act.aspx?aid=125775

64 schools and 49 pre-schools only one school and pre-school were damaged.

Prior to the floods the government had planned construction of new secondary schools by 2026[63] in several settlements. These include Gandzakar and Lusadzor in the Ijevan consolidated community,and Bagratashen and Ptghavan in the Noyemberyan consolidated communities of Tavush region. In Lori region, new schools were planned for Tashir, Metsavan settlements of Tashir consolidated community; Alaverdi, Akhtala, Chochkan of Alaverdi consolidated community, Stepanavan and Tashir towns of Lori region.

Table 47. Educational facilities in disaster-affected areas.

Region	Affected Consolidated Community	Number of schools	Number of affected schools	Number of pre-schools	Number of affected pre-schools
Lori	Alaverdi	20	1	15	1
	Tashir	8	0	5	0
	Stepanavan	6	0	4	0
	Gyulagarak	2	0	2	0
	Pambak	2	0	1	0
	Tumanyan	1	0	1	0
Tavush	Noyemberyan	7	0	5	0
	Ijevan	12	0	9	0
	Dilijan	6	0	7	0

While the MESCS ensured uninterrupted schedule of exams for the school that were temporarily isolated due to collapsed bridges in Alaverdi town's Sanahin Kayaran district, the disaster has disrupted the pre-school education of 16 children in Karkop village, where the whole village was inundated. The secondary school in Karkop serving 58 students was damaged by 60%.

The children and their caregivers had to evacuate in the middle of the night through rising flood water and collapsing bridges, with no early warning activated, exposing them to stress and trauma. The need for mental health and psychosocial support (MHPSS) emerged and confirmed through multiple interviews during the needs assessment.

The total **damage** in the education sector is estimated at **0.19 million USD**, as registered in Karkop settlement of Alaverdi consolidated community. The loss is estimated at **0.002 million USD**, which is the cost of debris removal from school and pre-school. The **needs for recovery and reconstruction** are estimated at **0.32 million USD** (Table 48).

Table 48. Damage, loss and needs in Education sector (in USD millions).

Consolidated Community	Damage	Loss	Needs
Alaverdi	0.19	0.002	0.32
Total	**0.19**	**0.002**	**0.32**

Recovery Needs and Estimates

The most urgent recovery needs in the sector are to ensure the continuity of education for the school and pre-school in Karkop village of Alaverdi consolidated community in a sustainable way.

The total cost of reconstruction needs for the sector is estimated at 0.32 million USD, covering the rehabilitation of facilities,

63 RA Government Decree N-2093 30 November 2023 on establishing construction norms for 300 schools to be constructed, reconstructed or repaired before 2026. Available at: https://www.arlis.am/DocumentView.aspx?docid=188807

refurbishment, and the procurement of two green buses for transportation of students from Karkop to Chochkan after 2026 (Table 49).

The recovery need was calculated solely for debris removal and is estimates at 0.002 million USD.

Table 49. Recovery and reconstruction need assessment for Education sector (in USD millions).

Component	Short-term Needs	Medium-term Needs	Total
Reconstruction Needs	**0.11**	**0.21**	**0.32**
Reconstruction including BBB	0.05	-	0.05
Equipment, furniture, supply, and green buses	0.06	0.21	0.27
Recovery needs	**0.002**	**-**	**0.002**
Debris removal	0.002	-	0.002
Total	**0.11**	**0.21**	**0.32**

While the Government of RA responded promptly by initiating the rehabilitation of the secondary school in Karkop, no interventions have yet started in the pre-school, disrupting education for 16 children. Using sustainable and energy efficient solutions during the rehabilitation is crucial to ensure *Build Back Better* principles are applied. Additionally, disaster risk management plans of schools and pre-schools in high-risk areas should be reviewed and updated accordingly, incorporating the lessons learned from this disaster. Strengthening the capacities of schools to offer alternative/digital solutions for continuity of education during crises times must be prioritized.

As the floodwaters have damaged personal belongings in number of communities, UNICEF, in cooperation with Ministry of Labor and Social Affairs has started to distribute clothing vouchers to up to 500 affected children to ensure that the impact of the floods is minimized for getting back to school in September 2024.

Environment Sector

Sector Summary

Climate change-induced environmental and other harmful effects are growing in severity and frequency in Armenia. The recent 2024 floods in Northern Armenia have had a particularly negative impact on the environment, disrupting the integrity of lands, water, forests, rich biodiversity in the Lori and Tavush region, increasing the risks for the existing stability of mining activities, as well as contributing to the land erosion and landslide development.

Disaster effects in the environment sector are estimated at **10.12 million USD**, including **0.02 million USD in damage** and **10.10 million USD in loss**. Recovery and reconstruction **needs** are estimated at **10.51 million USD.** Most of the damage is associated with the need to replant trees along the riverbeds, while loss is mostly linked to debris removal from the riverbeds and erosion control efforts. Recovery needs include further studies on the flood's impact on biodiversity, the development of solid soil conservation measures to mitigate erosion risks, and ecosystem-based adaptation for integrated flood risk management. Additionally, there is a need to strengthen environmental governance mechanisms, legal frameworks and policies to include policies for fast-track debris removal and debris recycling strategy. Strengthening MoE through capacity building in disaster response mechanisms, alongside efforts to mitigate environmental risks and vulnerabilities, is essential for bolstering climate resilience.

The summary of the total damage, loss and needs is presented in the table Table 50 below:

Table 50. Total damage, loss and recovery (in USD millions)[64]

Consolidated Community	Damage	Loss	Needs
Alaverdi	0.01	4.34	4.35
Dilijan			
Gyulagarak	0.002	0.47	0.47
Ijevan			
Noyemberyan	0.0008	3.52	3.52
Pambak	0.0008	0.33	0.33
Stepanavan			
Tumanyan	0.0007	0.06	0.06
Tashir		1.39	1.39
Nationwide (no specific region)			0.40
Total	**0.02**	**10.10**	**10.51**

64 Some cells in this table are left empty due to insufficient satellite imagery covering the specific areas at the time of assessment. As a result, a full evaluation of disaster effects could not be completed for these regions.

Armenia's geography includes a vast range of altitudinal variation (from 375 m to the 4,095m peak of Mt. Aragats) and a diverse climatic zone, including deserts, semi-deserts, steppes, forests, sub-alpine, and alpine regions. The diversity results in a rich variety of landscapes, flora and fauna, including many regionally endemic, relict, and rare species[65].

The areas affected by the flood do not include any protected areas.

Lori and Tavush regions include Specially Protected Areas of Nature: Arjatkhelni Hazel Sanctuary, Ijevan Sanctuary, Gyulagarak Sanctuary, Rhododendron Caucasicum Sanctuary, Gandzakar Sanctuary, Zikatar Sanctuary, Dilijan National Park, as well as Berd "Soranner" dendropark, Stepanavan Dendropark, Ijevan, Vanadzor Subtropical Arboretum. Eight natural monuments are located in the Lori region, while 15 natural monuments are in Tavush region.

The two regions contain 65% of Armenia's forest resources, which provide essential ecosystem services such as water provision for urban and agricultural use, landslide control, and carbon storage and sequestration. The main cause of land and forest degradation in these regions is the deforestation and overexploitation of forest resources[66].

The environment sector in Armenia covers a broad range of issues, from biodiversity conservation to pollution control and sustainable resource management

- **Biodiversity:** Armenia's diverse climate and topography make it rich in biodiversity, including many endemic species. Efforts are ongoing to preserve biodiversity through protected areas and national parks. In Lori and Tavush region, specific sites have been identified, rich in endemic, relict, or rare species, that support ecosystems of global or regional significance. These species include:
  - *Mammals:* 31 of Armenia's 94 mammal species are found in Lori and Tavush.
  - *Birds*: 54 species inhabit the regions, five of which are included in the Red Book of Animals of Armenia, and ten are protected by the Bern Convention.
  - *Reptiles and Amphibia:* this area is critical for the distribution of endemic and endangered rock lizards, including *Darevskia praticola*, *D. dahli*, and *D. rostombekowi,* along with snakes like *Zamenis hohenackeri* and the newly described *Elaphe urartica*.
  - *Fish:* native fish species in the Debed River include *Alburnoides eichwaldii, Barbus cyri, Capoeta capoeta, Gobio cf. artvinicus, Luciobarbus mursa,* and *Oxinoemacheilus brandtii*.
- **Water Resources:** water management is essential in Armenia, due to its reliance on river systems for irrigation in agriculture. Challenges include improving surface and groundwater management and infrastructure, water quality, irrigation, water supply and sanitation. Water quality in Debed and Aghstev rivers are monitored in, respectively 3 and 4 sampling points, as per the Ministry of Environment 2021 decision No.: 212-N.
- **Forestry and Land Use:** deforestation and land degradation are ongoing concerns. Reforestation projects and sustainable land management practices are being implemented to combat soil erosion and desertification.
- **Waste Management:** waste management infrastructure is underdeveloped in many areas. There is a growing emphasis on improving waste collection, recycling, and disposal systems to reduce environmental pollution. However, no post-disaster debris removal system exist in Armenia.

65 Biodiversity Assessment for Armenia, Task Order under the Biodiversity & Sustainable Forestry IQC (BIOFOR), USAID, 2000

66 UNDP Armenia project, Mainstreaming Sustainable Land and Forest Management in Mountain Landscapes of North-Eastern Armenia

Debris removal activities currently involve lengthy process of assessments, tender preparations, and resource mobilization not accounted for in the national disaster response budget.

- **Mineral resources:** Armenia has approximately 900 mines and sites with reserves of precious, non-ferrous, black and rare metals, salt, building materials, ground minerals and freshwater. More than 50% of these sites are actively exploited[67]. Four tailings dams are located in the affected area: the Nazik tailings dam (in need of re-cultivation), the Explosives Gorge tailings dam (not re-cultivated), the Nahatak tailings dam (operational, re-cultivation works started) and Teghut's functional tailings dam.
- **Chemical pollution from mining:** Akhtala area suffers from mining waste accumulation and non-reclaimed tailings dams.
- **Landslide risk:** The Dilijan National Park and Ijevan State Reserve in Tavush are prone to landslides.

Governance and Decision-Making Processes

Armenia has a very diverse climate, ranging from dry subtropical to cold highland climate. The country is vulnerable to the impacts of climate change, including increasingly frequent extreme weather events. As a result, the country is investing on climate adaptation strategies and reducing greenhouse gas emissions as part of its commitments under the UN Framework Convention on Climate Change and its Paris Agreement.

Armenia has also ratified the Kigali Amendment to the Montreal Protocol on "Substances that Deplete the Ozone Layer" in 2019 and has committed to phase-out the use of Hydrofluorocarbons (HFC) from 2024 onwards, seeking a total reduction by 80%–85% by 2045. Armenia's Nationally Determined Contribution (NDC) establishes the country's strong commitment to climate change adaptation measures and identifies its efforts and targets for national greenhouse gas mitigation efforts.

Key sectors identified for adaptation action include natural ecosystems, human health, water resources management, agriculture, forestry, and fisheries, energy, human settlements, infrastructure, and tourism. Armenia's Second National Environmental Action Plan (NEAP) was approved in August 2008 and provides a strategic framework for policy and investment.[68]

The 2021 – 2026 Plan Programme of the Government of the Republic of Armenia approved 18.08.2021[69] includes a Nature Protection chapter stating: *The policy of the sector will be fundamentally aimed at increasing the level of the country's resistance to climate change, contributing to the implementation of the best adaptation practices, active participation in global efforts towards low-carbon development, international commitment to climate change mitigation through proper performance of duties*.

The second Environmental Performance Review (EPR)[70] of Armenia released in September 2022 as well as the EU Environment Compliance Assurance system in Armenia[71] provide a series of recommendations for environment developments regarding air quality, water management, biodiversity and protected areas, soil conservation, waste and chemicals management and greening the economy as well as improvement of laws and regulations.

Armenia has a specific state body, the Environmental Protection and Mining Inspection that ensures compliance with the requirements of the legislation in the fields of environment and safety in the environmental

67 4th NAC report, Armenia, MoE, 2020
68 Source: https://www.gov.am/en/gov-program/
69 Ibid.
70 Armenia Environment Performance Review: https://unece.org/sites/default/files/2022-09/CEP-SS_InfoPaper-No.15_e.pdf
71 EU environment compliance system for Armenia: https://www.eu4environment.org/app/uploads/2022/03/Environmental-compliance-assurance-system-in-Armenia.pdf

and mining sector. Its main function is to ensure:

- The management of risks in the fields of nature protection, subsoil, the implementation of control over the observance of the requirements of the legislation of the Republic of Armenia, as well as the organization of preventive measures within the framework of the implemented control;
- The implementation of measures that prevent or reduce negative impacts on the environment and/or irrational use of natural resources.

Assessment of Disaster Effects

Environment sector damage and loss are by their nature difficult to assess, especially in a short period of time. As such, physical and monetized impacts are expected to be underestimated.

Infrastructure and Physical Assets

No damage was recorded on natural monuments. However, flood-related environment sector damage includes:

- Changes in stream morphology, primarily the destruction of vegetation (trees) along riverbanks,
- Damage to embankments and agriculture lands (covered in the DRR and Agriculture sectors).

The extent of damage along the riverbanks was quantified through remote sensing analysis (SERTIT report[72]) along the Debed river.

The estimated effects of the floods on the affected communities are as follows:

- Volume of eroded river banks: 422,242 m^3;
- Volume of removed trees: 594 m^3 (2,969 trees);
- Surface area of soil, mud, wood and metallic deposits: 133 hectares;
- Number of destroyed buildings: 661;
- Number of washed away households appliance: 624;
- Volume of damaged roads and bridges: 146,998 m^3.

Loss include:

- Removal of debris (wood, mud, soil deposit, rocks),
- Negative effect on biodiversity,
- Potential increases in water pollution,
- Changes in stream morphology in the form of riverbank erosion, bank cutting, debris accumulation.

Table 51. Remote sensing estimation of eroded river, trees, soil, wood, mud and metallic deposit in Debed river[73].

Consolidated Community	Settlements	Volume of eroded river banks (m)	Number of removed trees	Volume of wood (m^3)	Surface of soil deposit (ha)	Surface of wood deposits (ha)	Surface of mud deposits (ha)	Surface of metallic deposits (ha)
Noyemberyan	Ayrum	25,040.7	142	28.4	0.67		62.92	
Alaverdi	Akhtala	93,411.2	519	103.8	2.78	0.57	25.05	0.01
	Shnogh	5,351.1	276	55.2	0.94		12.5	0.02
	Alaverdi	145,186.5	986	197.2	3.23	0.88	5.39	0.02
	Odzun	53,233.7	394	78.8	0.82	0.31	5.58	
Tumanyan	Tumanyan	45,976.4	133	26.6	0.12	0.23		

72 SERTIT report: https://seafile.unistra.fr/d/7c946b71cd0047568c1d/
73 Source: SERTIT remote sensing analysis

Consolidated Community	Settlements	Volume of eroded river banks (m)	Number of removed trees	Volume of wood (m^3)	Surface of soil deposit (ha)	Surface of wood deposits (ha)	Surface of mud deposits (ha)	Surface of metallic deposits (ha)
Pambak	Pambak	188.3						
	Vahagnadzor	11,010.2	33	6.6	0.32	0.03	1.52	
	Dzoraget	14,921.9	108	21.6	0.67	0.34		
Gyulagarak	Gyulagarak	27,921.9	378	75.6	0.18	0.03	7.93	
Total		**422,241.9**	**2,969**	**593.8**	**9.73**	**2.39**	**120.89**	**0.05**

Increased landslide risk was assessed in June 2024, using remote sensing data, in two Areas of Interest, namely AOI01 DSEGH (912 km^2) and AOI02 ALAVERDI (307 km^2). The analysis provides the distribution of the surface area per landslide risk class with the major part of the area characterized by a moderate landslide risk, of 38% for both Dsegh and Alaverdi areas, as detailed in the table below:

Table 52. Landslide risks in affected areas[74]

Landslide risk class	Dsegh		Alaverdi	
	Area (ha)	%	Areas (ha)	%
Very low	8,692.9	8	2,319.3	10
Low	22,025.3	23	6,937.7	24
Moderate	35,012.8	38	11,758.5	38
High	22,495.8	26	8,016.2	25
Very high	2,930.3	6	1,707.6	3

Increased Risk and Vulnerabilities

Debris accumulation: the flood resulted in significant amount of debris, including material from destroyed roads and buildings, uprooted trees. It deposited a large amount of soil and mud. The amount of debris generated by the floods along the Debed river was calculated using remote sensing data, with estimated surface of flood deposits amounting to 142.7 hectares, of which:

- Soil: 10.9 ha,
- Wood: 2.5 ha,
- Mud: 129.3 ha,
- Metal: 0.05 ha.

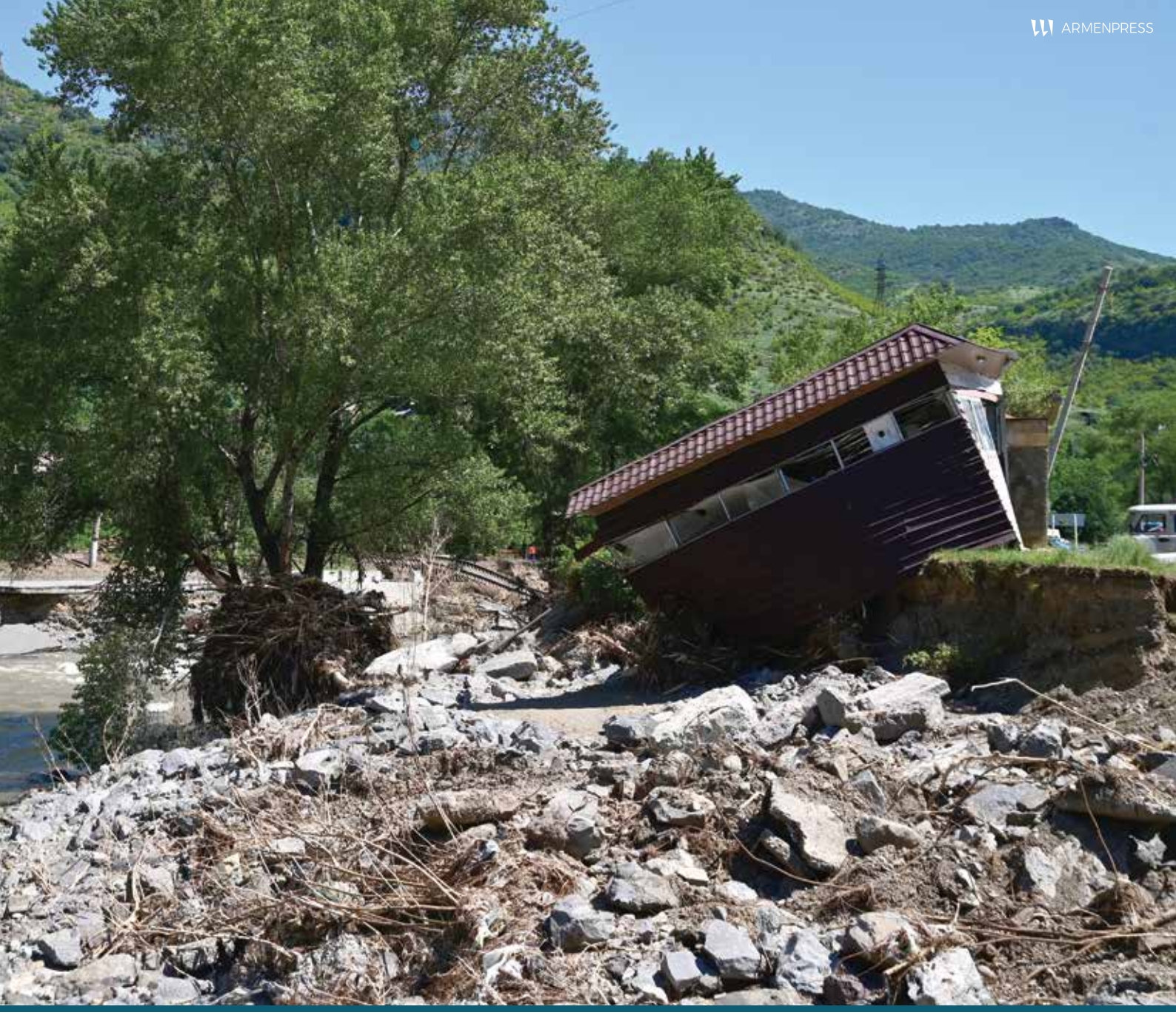
Increasing areas exposed to chemical pollution in the Debed River basin and coastal agricultural lands: the large-scale flooding has led to exposing coastal areas and agriculture lands to chemical pollutions. Floodwaters mixed with chemicals from waste heaps, particularly those located near the Akhtala River, adjacent to Aramyants Castle, and tailings dams that flowed into the basin, contaminating coastal areas and agricultural lands. It is likely that chemicals and heavy metals have settled at the bottom of the Debed river.

There are reports, pending verification, that a substantial amount of waste was poured into unfit agricultural lands due to the rupture of a waste pipe belonging to Teghut CJSC.

Risks of collapses and landslides: various sections of the M6 highway are at increased risks for collapses and landslides, caused by, inter alia, the loosening of the ground due to the uprooting of a large number of trees. Currently no comprehensive assessment and has been conducted to evaluate the impacts of these landslide bodies on environment and ecosystem. A detailed study is necessary to assess the status of landslide-prone areas after the flood.

To mitigate the risks in these vulnerable areas the soil mass should be removed. Cleaning

74 Source Copernicus Risk and Recovery Mapping activation with SERTIT.



up this soil mass, that detached from the landslide body and altered the course of the river, will help restoring river to its original course and widen the revierbed, increasing its capacity. This measure will reduce the landslide risks triggered by the floods.

Loss of biodiversity: the Debed river basin has been widened, in some areas by two to three times, causing significant damage to the habitats of various species. Nests and habitats of numerous animals were submerged or completely destroyed, likely affecting animal migration corridors leading to the river's mouth. Displaced animals are currently under stress, searching for their own habitats or trails, moving erratically on sections of the M6 highway, increasing their vulnerability. Migration of certain species, such as reptiles, to higher ground, where villages are located, may have resulted in the deaths of large numbers of species.

Notable impacts include:

- **Mammals:** nests and dwells areas of species, such as the European water vole (*Arvicola terrestris*) and the Transcaucasian water shrew *(Neomys (schelkovnikovi) teres*), are primarily located near riverbanks, with all nests within the impact zone damaged. Additionally, 29 species dependent on the Debed River for food and habitat, may experience secondary effects on their populations.
- **Birds:** the floods have affected 3 species: Kingfisher *Alcedo atthis* (35-45 pairs),

Corn Crake Crex crex (30-50 breeding individuals), and *Eurasian Nightjar Caprimulgus europaeus* (10-15 pairs).

- **Fish:** species like *Capoeta capoeta*, *Barbus cyri* and *Luciobarbus mursa* are particularly vulnerable, as their spawning period coincides with the floods leading to the loss of the spawning opportunities. Additionally, the altered hydrological conditions of the water deprived fish of food resources, significantly disrupting their natural behavior.
- **Reptiles and Amphibias:** 21 species of lizards, snakes, and turtles have been affected, with *Testudo graeca* (listed as "Vulnerable" by the Red Book of Armenia (RBA) and the International Union for Conservation of Nature (IUCN)) especially impacted. The flood disrupted the reproductive period of four amphibian species, potentially destroying their clutches and reducing their population.

Air pollution: the recovery efforts in the disaster area will involve a large amount of heavy equipment, which is expected o cause a large amount of emissions and dust release into the atmosphere.

Water pollution: while there was a risk that household equipment and drowned wild and domestic animals could have been washed into river, with sewage flows also having exposure risk to the river, an in-depth monitoring of the sanitary and hygienic situation of the Debed River, conducted by the health sector, showed no increase in water pollution (based on the physicochemical parameters). An in depth investigation (hydro-chemical, hydro-morphological and hydro-biological) should be conducted to assess the impact of flooding event on water quality and aquatic life.

Damage and Loss

The damage (Table 53) are related to uprooted trees along the riversides while the loss (Table 54) is related to debris removal. Due to the absence of a clear input data and methodology, it was not possible to estimate the loss of biodiversity or the costs resulting from change in stream morphology. Further studies are required to assess these impacts, as presented in the next heading.

Table 53. Summary of damage at community/settlement level (replanting of trees along riverbank)

Consolidated Community	Settlements	Quantity of trees	Cost in USD per unit[75]	Total cost in USD
Noyemberyan	Ayrum	142	5.55	788.10
Alaverdi	Akhtala	519	5.55	2,880.45
	Shnogh	276	5.55	1,531.80
	Alaverdi	986	5.55	5,472.30
	Odzun	394	5.55	2,186.70
Tumanyan	Tumanyan	133	5.55	738.15
Pambak	Pambak	-	5.55	
	Vahagnadzor	33	5.55	183.15
	Dzoraget	108	5.55	599.40
Gyulagarak	Gyulagarak	378	5.55	2,097.90
Total		**2,969**		**16,477.95**

75 The cost of one tree is approximately 5.1 USD, and the cost of willow tree cuttings is around 0.4 USD, based on data from the ARM Forest Department. This includes the cost for the management of trees along riverbanks, as well as promotion, restoration, and conservation efforts. The cost for debris removal (loss) is based on estimates from an Armenian private company specializing in debris removal, with an average cost of 18 USD per cubic meter, which includes the use of heavy machinery. Due to the absence of a standardized methodology for calculating disaster-related damage to wild flora, and limitations in Armenia's 2005 Law on "Compensation rates for the damage caused to fauna and flora as a result of environmental violations"—which only specifies timber value without accounting for the tree's role in regulating ecosystem services (such as carbon storage, biodiversity support, soil stabilization, and water quality regulation)—the PDNA team focused its assessment solely on the cost of replanted trees.

Table 54. Summary of loss at community/settlement level (removal of debris/deep cleaning)

Consolidated Community	Settlements	Volume (m^3)[76]	Cost in USD per m^3	Total costs in USD millions
Noyemberyan	Ayrum	195,460	18	3.52
Alaverdi	Akhtala	108,670	18	1.96
	Shnogh	46,940	18	0.84
	Alaverdi	57,310	18	1.03
	Odzun	28,040	18	0.50
Tumanyan	Tumanyan	3,500	18	0.06
Pambak	Pambak	-	18	-
	Vahagnadzor	8,060	18	0.15
	Dzoraget	10,100	18	0.18
Gyulagarak	Gyulagarak	25,890	18	0.47
Tashir	Tashir	77,000	18	1.39
Total		**560,970**		**10.10**

Assessment of Disaster Impact

The loss of valuable land due to landslides, changes in the river course and debris accumulation will significantly affect the livelihoods of local communities. Reconstruction efforts will drive demand for construction materials, which implies an increase in quarrying activities. This, in turn, will further deplete natural resources and increase the risk of additional landslides, thereby intensifying existing vulnerabilities in the affected regions.

The Sector Recovery Plan

Sector Recovery Vision

The recovery needs within the environment sector encompass two main components:

- **Restoration of Damaged Natural Assets:** this involves direct actions to repair and rehabilitate the natural environment, including reforestation, debris removal, and stabilization of riverbanks to address the immediate damage incurred;
- **Environmental Recovery Actions:** these are broader interventions aimed at strengthening environmental governance, enhancing legal frameworks and policy structures, and mitigating long-term environmental risks and vulnerabilities. These actions also focus on improving climate resilience to better withstand future disasters.

Reconstruction and Recovery Needs

The environment recovery efforts primarily focus on ecosystem-based adaption for integrated flood risk management, particularly addressing landslides risks. Key actions include conducting further studies on the long-term

76 Costs for debris removal from the housing and transport sectors are included in their respective chapters. The volume of debris was calculated based on the number of hectares identified by the remote sensing team, SERTIT, and then converted into cubic meters (with the following assumptions: soil, metal, and mud deposits at a thickness of 1 cm, and wood debris at a thickness of 30 cm).

impact of changes in the river course and potential water pollution in the Debed river. Additionally, the recovery plan involves the rehabilitation of damaged trees and bushes through re-vegetation of riverbanks, and implementing soil conservation measures to reduce erosion.

Rehabilitation needs:

- **Tree replanting along riverbanks:** focus on varieties that reduce erosion risks, such as willow (*Salix caprea* and *Salix*) for their high moisture resilience and strong root system, Poplar tree (*Cottonwood – Populus*), ideal for extremely wet conditions, windy areas and coastal situation.

Recovery needs:

- **Debris removal:** implement comprehensive debris removal processes along affected areas.
- **Landslide and Rockfall Studies:** conduct detailed studies on active landslide and rockfalls areas, mapping risks, assessing capacities and implementing proper protective and preventive measures, to ensure the safe operation of regional infrastructures and buildings near dangerous areas[77].
- **River Course and Water Pollution Studies:** evaluate the long-term impacts of changes to the Debed river course and potential water pollution risks.
- **Ecosystem-based Flood Management:** conduct studies on ecosystem-based adaptation strategies for integrated flood risk management
- **Biodiversity Impact Study:** conduct in-depth study on impact of the floods on biodiversity.
- **Air Quality Monitoring:** install modern air quality monitoring equipment in Alaverdi, the most densely populated settlement, which also hosts a copper smelter factory.
- **Strengthening Environmental Governance:** enhance legal frameworks and policies to include fast-track debris removal and debris recycling strategies and solid soil conservation measures to mitigate erosion risks.
- **MoE Capacity Strengthening:** strengthen the MoE capacity in disaster response and environmental risk mitigation, with a focus on building climate resilience.

The Sector Recovery Plan

The recovery needs related to the damage primarily involve the restoration of tree cover lost to the floods, as well as conducting further studies on the environmental impact of the floods on biodiversity. These studies will also focus on the long-term effects of changes to the river course and the potential for increased water pollution in the Debed River.

The environment sector's recovery strategy comprises short and medium measures and activities sequenced according to prioritization criteria. This strategy includes:

- Restoring damaged natural assets, particularly tree cover and stabilizing high-risk slopes, along with the installation of modern air quality monitoring equipment. Supporting improved tree management (restoration, planting, and maintenance) along rivers, including incentives for restoration and conservation efforts;
- Conducting in depth studies on potential flood impact on biodiversity (fauna and flora) in the impacted areas;
- Strengthening of environmental governance mechanisms, legal frameworks and policies to include policies for fast-track debris removal and development of solid soil conservation measures to reduce erosion risks;
- Strengthen MoE through capacity building in disaster response mechanisms as well as efforts to mitigate environmental risks and vulnerabilities while bolstering climate resilience.

The Sector Recovery Needs Costing

The table below presents an overview of the estimated costs for the **recovery efforts** needed to address the damage and loss

77 Source: 2017-2025 Development Plan of Lori Marz of The Republic Of Armenia

sustained by the environment sector due to the flood and estimates to **10.52 million USD**. These figures account for both the short and long-term requirements necessary to restore natural assets, manage environmental risks, and build resilience against future disasters.

Table 55. Recovery needs assessment[78] for Environment sector (in USD millions)

Component	Total
Tree replanting and Tashir embankment rehabilitation (500 m)	0.02
Debris removal	10.10
Policies for fast-track debris removal and recycling	0.05
Study on ecosystem-based integrated flood risk management	0.15
Study on impact of the floods on biodiversity.	0.05
Installation of air quality monitoring equipment	0.10
Strengthen MoE through capacity building in DRR	0.05
Total	**10.52**

Implementation Arrangements

The recovery plan for the environmental sector, particularly focusing on tree replanting, debris removal, and landslide risk reduction, involves a multi-stakeholder approach:

- **Tree planting and replanting along riverbank** can be managed by ArmForest SNCO, which will guide the appropriate selection of tree species. Local municipalities will coordinate replanting process, engaging volunteers, NGO members, local population, contracted workers;
- **Debris removal and solid soil conservation measures** are critical for reducing erosion and landslide risks. These activities will require coordination with relevant stakeholders;
- **Feasibility studies and assessment** in landslide-prone areas will provide essential data to understand and mitigate future risks;
- **Flood-prone area management** will involve the restoration of riverbed, construction of coastal dams, and the strengthening of riverbanks with reinforced concrete constructions. This will be supported by implementation of flood and mudslide early warning systems, the development of flood risk management plans, and coastal forest planning, in alignment with hydro-meteorological forecasts.

78 Due to methodological limitations, prioritization of recovery actions in the environment sector was not assessed.

Disaster Risk Reduction Sector

Sector Summary

Disaster impacts in the Disaster Risk Reduction (DRR) sector are estimated at **2.35 million USD**, with **1.35 million USD in damage** and **1.0 million USD in loss**. Recovery and reconstruction **needs** are estimated at **14.92 million USD** whereas the activities proposed, given the cross-cutting nature of this particular sector, also include DRR needs for all the other affected sectors such as Transport, Community infrastructures, Housing, Agriculture, Health (Table 56).

In the Lori region, six hydrological observation stations suffered 0.09 million USD in damage, while two stations in Tavush sustained 0.03 million USD in damage. Extensive damage to retaining walls, particularly in Tashir, Alaverdi, and Dilijan, affected 1,156 running meters, with repair costs of 1.22 million USD (Table 56).

Table 56. Damage, loss, and needs in DRR sector (in USD millions).

Consolidated Community	Damage	Loss	Needs
Alaverdi	0.97	0.99	2.27
Dilijan	0.07	-	0.59
Gyulagarak	-	-	0.18
Ijevan	-	-	0.25
Noyemberyan	-	-	0.25
Pambak	-	-	0.17
Stepanavan	-	-	0.18
Tashir	0.19	-	1.22
Tumanyan	-	-	0.18
Nationwide	0.12	0.01	9.63
Total	**1.35**	**1.00**	**14.92**

Pre-disaster Baseline Information

Armenia, known for its diverse landscapes and rich cultural heritage, is highly vulnerable to natural disasters like earthquakes, landslides, floods, and forest fires due to its seismically active location and varied topography. The country's disaster risk reduction capacity is critical, however it faces significant challenges, especially as climate change is expected to increase the frequency and intensity of meteorological hazards.

Armenia's population stands at about 2.98 million, with 1.9 million living in urban areas, including 1.1 million in Yerevan. The northern regions of Tavush and Lori have more dispersed populations, many of whom live in remote, mountainous areas, complicating disaster preparedness and response. Poverty affects 30% of the population, mostly in rural areas, with seismic risks concentrated in cities. The economy is highly vulnerable, with a 20% chance each year that a major disaster could result in damage and loss amounting to 12.7% of GDP.

The geomorphological landscape in Lori and Tavush is rugged and mountainous, featuring steep slopes, deep ravines, and fast-flowing rivers like the Debed, Aghstev, and Dzoraget, which carve through narrow gorges and increase vulnerability to landslides and flash floods. Lori's elevation ranges from 1,300 meters in Vanadzor to over 3,000 meters in the surrounding mountains, including Mount Lalvar. Tavush, with elevations from 400 to 2,500 meters, is heavily forested, with steep slopes along the Tavush and Aghstev rivers. The fast-flowing rivers in these regions are dynamic, with their flow rates and water levels heavily influenced by seasonal precipitation, shaping the local landscapes and ecosystems.

Governance and Decision-Making

Disaster Risk Reduction in Armenia is governed by national legislation and the Disaster Risk Management National Strategy, marking a shift from response-focused actions to prevention, mitigation, and resilience-building. However, this transformation is ongoing, and not all aspects of DRR governance have been fully adapted.

Due to the current legal framework, which does not grant community administrations sufficient authority to manage DRR efforts, there are often delays in addressing the urgent needs of remote regions like Tavush and Lori. While local governments in these areas have developed some DRR capacity through partnerships with international organizations and NGOs, local populations have limited influence on decision-making. The integration of DRR into broader development policies is also still in progress.

Risks and Vulnerabilities, Including Existing Preparedness Plans

Armenia, especially the Tavush and Lori regions, faces several natural risks due to its varied topography and geological conditions, including earthquakes, landslides, floods, rockfalls, hailstorms, and forest fires. Landslides are a significant concern in Lori, where steep slopes and unstable geological formations, worsened by rainfall or seismic activity, threaten communities and infrastructure. In Tavush, high precipitation increases the risk of river flooding and flash floods.

Earthquakes are another major hazard in both regions, particularly for older, vulnerable infrastructure. The complex terrain also makes sudden rockfalls likely, especially in narrow valleys. During winter, heavy snowfall can cause avalanches and disrupt transportation, isolating communities. Despite these risks, disaster preparedness plans are underfunded and lack sufficient funding and resources.

Risk assessment in Armenia is primarily conducted at the national level:

1. **Seismic Monitoring:** the Regional Agency of Seismic Protection provides 24/7 monitoring, with data sent to the Crisis Management National Center under the Ministry of Internal Affairs.
2. **Hydrological Monitoring:** the Hydrometeorology and Monitoring Center

SNCO under the Ministry of Environment supervises hydrological and meteorological, as well as water quality monitoring and assessments. In the Debed and Aghstev river basins, 21 hydrological observation points monitor water levels twice daily, using mechanical tools like staff gauges. Water discharge is measured 25-35 times annually with current meters.

3. **Remote Sensing Risk Assessment:** remote sensing shows increased flood risks in areas near rivers due to insufficient protection measures. Landslide risks, particularly in Vahagni and Pambak, have risen with recent heavy rains, threatening buildings, and roads along the Pambak River and Debed banks. Many structures, especially from the Soviet era, are not earthquake resistant. The absence of flood hazard maps and poor spatial planning further complicate land use regulation. Satellite images from the Copernicus EMS risk mapping reveal active landslide zones, threatening communities, and infrastructure in Akhtala–Tumanyan, Vahagni–Pambak, and nearby roads. Tailing facilities in Alaverdi, Nahataki, and Teghut are also at risk due to landslide and mudflow-prone areas.
4. **Community Disaster Preparedness:** local legislation allows community administrations to use 5% of their annual budget for emergency response, but disaster mitigation is managed by the central government. Local governments lack scientific and risk-informed decision-making capabilities. A 2017 UNDP initiative with the Ministry of Emergency Situations developed a community disaster risk management (DRM) plan, identifying hazards and vulnerabilities. While this plan focuses on emergency preparedness and response, it needs updating to include DRR and post-disaster recovery, as recommended in the 2023 DRR National Strategy.

Assessment of Disaster Effects

The May 2024 floods in Northern Armenia caused significant damage to road infrastructure along the Debed, Pambak, and Aghstev rivers. A Swiss team of specialists identified two main types of damage:

- **Retaining walls** were destroyed, particularly on the outer curves of rivers, washing away roads due to high water flow velocities and insufficient foundation design.
- **Bridges** were damaged by erosion and the failure of bridge piers in riverbeds, exacerbated by clogging from debris.

While the flood's magnitude contributed, inadequate infrastructure design also played a role. Provisional repairs lacked durable solutions, and some structures had pre-existing design flaws. The flood in the Debed River had an estimated return period of 100 years, making it essential to document for future reference.

In the Lori and Tavush regions, the flood severely impacted seven communities, including Alaverdi, Gyulagarak, Pambak, Tashir, Tumanyan, Dilijan, and Noyemberyan, with the most damage in Karkop, Alaverdi, and Tashir.

Three flood scenarios unfolded:

1. **Flash floods** in Alaverdi and Karkop, with water speeds of 3-10 m/sec and debris-laden floodwaters lasting several days.
2. **Riverine floods** in Tashir, where water flowed at 1-3 m/sec and quickly receded, allowing evacuees to return the next day.
3. **Pluvial floods** in Ijevan and Dilijan caused by excessive rainfall.

Approximately 2,300 volunteers, coordinated by the Ministries of Labor, Social Affairs, and Education, participated in the cleanup. The flood damaged or destroyed 269 homes, with 47 families still displaced. The Ministry of Internal Affairs' Rescue Service, involving

1,997 personnel, conducted rescue operations, evacuating 445 people (403 in Lori, 42 in Tavush).

Approximately 0.99 million USD was spent on food and other necessities for rescue personnel. Volunteers from the Armenian Red Cross Society, Crisis Management State Academy, and NGO Lori Rescue Squad also assisted in emergency response and early recovery efforts.

Infrastructure and Physical Assets

As a result of the flood, the infrastructure and equipment used for hydro-meteorological activities at the 8 hydrological observation stations managed by the "Armhydromet" SNCO at the Debed (6 observation stations) and Aghstev (2 observation stations) river basins have been extensively damaged. This includes observation system, bridges, rope crossings, various tools, and instruments. In some cases, these structures and equipment were completely washed away or became non-operational due to the flooding. The Hydromet staff conducted temporary recovery and reconstruction work, but the entire system should be fully modernized and enhanced with installation of new observation stations that is presented in recovery recommendation table. The extensive damage to these vital components has significantly impacted water monitoring and resource management activities. The initial assessment for the total cost of the damage across 8 water observation networks is estimated 0.12 million USD and the loss is estimated 0.008 million USD.

Table 57. Loss estimation in DRR sector (in USD millions)

Component	Loss	Public	Private
Hydrological observation recovery	0.01	0.01	-
Emergency response rescuers	0.04	0.04	-
Extra work/volunteers on early recovery	0.95	0.95	-
Total	**0.99**	**0.99**	**-**

Assessment of Disaster Impact

The recent disaster has exposed critical weaknesses in Armenia's DRR sector, particularly in early warning systems, risk modeling, and evidence-based decision-making. To address these shortcomings, several key actions are recommended:

- **Modernize Early Warning Systems:** implement timely and accurate alert systems, especially in remote areas;
- **Develop Advanced Risk Modeling:** use sophisticated analytics to identify high-risk zones and guide infrastructure planning;
- **Promote Evidence-Based Decision-Making:** ensure that interventions are targeted, continuously refined, and build long-term resilience.

Failure to make these improvements could lead to:

- **Increased Human Loss:** ineffective early warning systems may result in significant casualties during future disasters;
- **Ineffective Disaster Responses:** poor risk modeling and analytics could leave the country unprepared, leading to greater damage;
- **Eroded Public Trust:** insufficient DRR measures may undermine confidence in the government's ability to protect citizens and weaken social cohesion.

Challenges to Address:

- **Securing Resources and Building Capacity:** essential for implementing improvements;

- **Effective Coordination:** between government agencies, NGOs, international partners, and local communities;
- **Raising Public Awareness:** ensuring DRR strategies are understood, supported, and effectively implemented.

The Sector Recovery Plan

The sector recovery strategy includes:

1. **Strengthen Early Warning Systems:** modernize outdated sirens and integrate them into a multi-hazard framework for timely alerts, especially for remote communities;
2. **Improve Forecasting and Risk Modeling:** enhance capacities to better predict and mitigate risks;
3. **Enhance Community Engagement:** foster risk-informed decision-making and community involvement;
4. **Reconstruction:** focus on rebuilding and upgrading retaining walls as part of risk mitigation.

Key Measures to implement are:

- **Upgrade Prevention Mechanisms:** construct and maintain mudflow barriers and river channels to mitigate flood and landslide risks;
- **Modernize Early Warning Systems:** replace outdated Soviet-era equipment and integrate it into a comprehensive hazard observation and disaster alert system.

Reconstruction and Recovery Needs and Costing

The sector recovery cost is estimated at 14.92 million USD. These costs cover DRR needs, as a cross-cutting sector, for all affected sectors such as Transport, Community infrastructures, Housing, Agriculture, Health. Implementing the proposed solutions and strengthening disaster and climate risk observation, modeling, EWS capacities, along with enhancing technical capabilities of Hydromet system, will significantly improve disaster risk informed decision-making at all levels, including within the private sector.

Of the total estimated recovery costs 6.51 million USD are allocated for reconstruction, and 8.41 million USD are designated for recovery.

Table 58. Recovery and reconstruction needs assessment for DRR sector (in USD millions)

Component	Short-term Needs	Medium-term Needs	Long-term Needs	Total
Reconstruction Needs	**0.94**	**3.57**	**2**	**6.51**
Enhancement of EWS	0.5	-	-	0.5
Installation Automatic weather stations	-	-	0.18	0.18
Installation Automatic Hydrological observation stations	0.36	-	0.36	0.72
Installation Water Current Meter set	0.08	-	0.08	0.16
Installation of radio-location system	-	1.7	-	1.7
Retaining walls	-	1.87	1.38	3.25
Recovery Needs	**2.33**	**3.71**	**2.37**	**8.41**
Community DRM planning including trainings and simulation exercises	0.27	-	-	0.27
Establishment community volunteer forces with trainings and certification	-	1.5	0.6	2.1

Component	Short-term Needs	Medium-term Needs	Long-term Needs	Total
Development of GIS based Risk Index	0.2	-	-	0.2
Strengthening Regional Crisis Management Center (CMC)	-	0.2	-	0.2
Strengthening National CMC	1		-	1
Multi risk modelling	-	0.52	0.52	1.04
Risk mitigation and evidence-based decision making	-	1.25	1.25	2.5
Strengthen hydrological forecasting	0.2	-	-	0.2
Strengthen seasonal forecasts based on remote-sensing data and snow modelling	0.08	-	-	0.08
Improvement of weather forecast, and numerical weather prediction system	-	0.24	-	0.24
Health facility DRM planning and Hospital safety indexing	0.27	-	-	0.27
PDNA baseline unified data development and trainings	0.31	-	-	0.31
Total	**3.27**	**7.28**	**4.37**	**14.92**

DRR Sector Reconstruction

Considering the assessment results and the lessons from the 2024 floods, the following main reconstruction priority areas emerge:

- Enhancement of early warning systems,
- Automatic weather stations,
- Hydrological observation stations,
- Water current meter set,
- Radio-location systems,
- Retaining walls.

Restoration and Modernization of the Early Warning System: the assessment highlighted the need to modernize EWS in all Lori and Tavush communities. Data from the MIA identified gaps, leading to a recommendation to replace older sirens (C-28, LD-800, and MS-390) with newer C-40E models. This upgrade, along with improvements to regional and national crisis management centers, will enhance the EWS's effectiveness. The existing system integrates national, regional, and community-level alerts and includes a locally produced siren control system, approved by the MIA. Enhancements will also include developing Standard Operating Procedures (SOPs), legal provisions, and professional training. The estimated cost for these upgrades is 0.50 million USD.

Enhancement of Hydro-meteorological system: enhancing the weather observation and monitoring system is crucial for effective hydro-meteorological risk modeling in Armenia. The country has 45 meteorological stations, 36 of which were modernized with UNDP support from 2019-2022, and an additional 9 were upgraded in 2022 with government funds. Despite these improvements, the system lacks sufficient technical capacity for advanced risk modeling, especially in hydrological monitoring and flood forecasting, as demonstrated during the recent floods when only precipitation and water discharges increases were reported.

To address this, the recovery plan focuses on fundamentally modernizing and unifying the hydro-meteorological system for accurate hydro-meteorological observation, forecasting, risk modeling, and early warning. The government has prioritized this by allocating resources for three new radio-location systems to be installed in Southern and Central Armenia. However, two more radio-location systems are needed, including one in Lori. Additionally, five Automatic Weather Stations (AWS) should be installed at high altitudes to improve weather forecasting and early warning. The Debed and Aghstev River monitoring systems require modernization with 16 automatic radar level gauges and

hydrometers integrated into the existing data transmission system.

The total estimated cost for reconstructing and modernizing the hydro-meteorological system is 2.58 million USD, out of which 0.44 million USD is an short-term need, and 1.7 million USD is a mid-term need, and 0.44 million USD is a long-term need (Table 58).

Reconstruction of retaining walls: as a result of the flood around 1,677 m of Retaining walls were damaged in M6 highway[79] and 1,156 m in Alaverdi, Tashir and Dilijan communities[80]. It was decided to keep M6 highway retaining walls as part of transport sector given the specifics of the adjacent embankment which in a nutshell is a ground base for the highway, while for the community level it was agreed to move the reconstruction of retaining walls from Environment and Agricultural sector to DRR, considering them as flood protection asset.

The cost for reconstruction was discussed with MTAI road department and agreed to keep the cost of M6 highway construction which is equal to 1,700 USD per running meter which is equal to 6 m^3 of retaining wall (6 m^3 average means 5 m height * 1.2 thick * 1 m length = 6 m^3 roughly). For Tashir and Dilijan the height was calculated for 3 m while for Alaverdi it was calculated for 5 m height considering the specificity of Tashir, Aghstev and Debed riverbanks.

The calculation was done with consideration of the need for reconstruction of the damaged Retaining walls and with the need for additional meters for construction of new retaining walls. Particularly in Alaverdi the damage was 750 m and recovery need was calculated for 950 m costing 1.87 million USD, for Tashir the damage was 300 m and recovery need was calculated for 500 m costing 0.98 million USD, and for Dilijan the damage was 106 m and recovery need was calculated for 200 m costing 0.39 million USD, the calculation includes 10% allocation for *Build Back Better* principle in reconstruction with the total estimates 3.25 million USD for reconstruction of 1,250 m of retaining walls (Table 58).

DRR Sector recovery

The recovery section primarily focuses on capacity building and risk modeling activities. In light of the lessons learned from the flood, there is a significant need for capacity development to ensure risk-informed development, improved preparedness, effective response, and post disaster recovery at both regional and national levels. A key priority is strengthening capacities at the community level, through:

- Elaboration and revision of DRM plans, to include also training and simulations.
- Support in the establishment of volunteer forces, their training, and equipment.

The capacity building efforts at the regional and national levels should focus on the following areas:

- Development of GIS-based Risk Index,
- Multi-hazard risk modeling,
- Strengthening Regional and National Crisis Management Centers,
- Promoting risk mitigation and evidence-based decision-making,
- Strengthening hydrological forecasting, seasonal forecasts based on remote-sensing data, and snow modeling.
- Improving weather forecasting, and numerical weather prediction system,
- DRM planning for health facilities and implementing Hospital Safety indexing,
- Developing a unified PDNA baseline data and providing related training.

The overall needs in recovery for DRR are summarized in Table 58 with an estimated total of 8.41 million USD. Immediate short-term recovery needs are estimated to at 2.33 million USD, mid-term recovery needs at 3.71 million USD, and for long-term recovery needs at 2.37 million USD.

Community DRM planning: according to the Rescue Service, 48 out of 70 consolidated communities in Armenia have approved DRR plans, 15 are in development, and 7

79 Source Ministry of Territorial Administration and Infrastructures
80 Source FAO field assessment.

have not started. In the Lori region, 8 of 11 communities have approved plans, with 2 more in development. The Tavush region has 3 approved plans, and Ijevan's plan will be approved by the end of August.

Lori and Tavush communities represent 22.9% of the approved plans. Among the 9 disaster affected communities from river flooding, 6 have approved DRR plans, making up 12.5% of the total.

Given the flood's lessons and the current focus on emergency preparedness, updating and revisiting community DRM plans is critical. This will enhance disaster risk mitigation, improve collaboration with local partners, and ensure proper integration of risk mitigation and recovery actions. The update will include capacity building activities, such as trainings and simulations, and public awareness campaigns.

The cost to update DRM plans for 11 communities in Lori and 4 in Tavush is estimated at 0.28 million USD and is considered an short-term need.

Community-based rescue volunteer teams: to enhance civilian safety, reduce threats, and prevent disaster risk, organizing volunteer rescue teams is a key practice. Establishing community-based rescue teams is a priority in the DRR National Strategy Action Plan, following international standards like the International Search and Rescue Advisory Group (INSARAG) system.

Initially, each team will consist of 21 members (INSARAG Light Team). These teams, working with district authorities and legislative support, will handle primary reconnaissance, risk identification, monitoring of dangerous objects, search operations, basic emergency rescues, first aid, and early recovery support. Discussions are underway with 15 community administrations in Lori and Tavush regions.

The establishment process includes forming and equipping the teams, providing training and simulations, certifying, and collaborating with regional rescue services. Establishing 21 volunteer rescue teams in Lori and Tavush is estimated to cost 2.10 million USD.

Development of Hazard Risk Index system: in 2022, UNDP, in collaboration with the Hydro meteorological Service of Armenia, developed the Natural Hazard Risk Index system for Syunik and Gegharkunik regions. This GIS-based on-line tool and database identifies communities at risk from landslides, rockfalls, and mudflows. It uses data on water resources, infrastructure, reservoirs, geography, buildings, land cover, and weather to assess risk levels for each settlement.

Designed for local and regional decision-makers and the public, the tool aids in updating emergency plans, prioritizing resources, enhancing hazard mitigation, fostering community engagement, educating residents, supporting codes and standards, and informing long-term planning. It also evaluates Social Vulnerability by analyzing social, economic, demographic, and housing factors, indicating community risk levels with higher scores reflecting greater vulnerability.

Currently, the platform includes data for Syunik and Gegharkunik but can be expanded to cover all of Armenia, including Lori and Tavush regions. Developing the GIS-based Risk Index for Lori and Tavush is estimated at 0.20 million USD.

Strengthening Regional and National Crisis Management Centers: in 2023, reforms unified the Ministry of Emergency Situations, Migration Service, and Police into the Ministry of Internal Affairs (MIA). The MIA plans to consolidate the National CMC, 911 emergency call centers, Police operational management, and Ambulance services. There is a critical need to support the MIA in developing a unified vision for this integration to enhance risk mitigation, emergency preparedness, and response at both national and local levels.

The national and regional CMCs will be developed for better coordination in disaster risk mitigation, preparedness, response, and recovery. This includes equipping and modernizing crisis management centers and enhancing emergency systems through digitalization and modernization. An ArcGIS Enterprise architecture will be implemented to support efficient community planning, data sharing, and collaboration, improving

decision-making and resource allocation. The estimated costs are 0.20 million USD for Lori and Tavush regional CMCs and 1.0 million USD for the National CMC.

Multi Risk modeling, risk mitigation and evidence-based decision making: as Armenia faces geological and technological hazards, including earthquakes, landslides, flash floods, weather extremes, and industrial risks, there is a need for comprehensive risk analysis, modeling methodologies, and actionable information to support risk-informed development.

UNDP and the National Academy of Science have implemented a multi-risk profiling methodology to assess potential damage and loss from earthquakes, landslides, and mudflows. This approach will be extended to Lori and Tavush communities, providing detailed studies on fault lines, landslide zones, and mudflows. It will include creating micro-zoning maps, assessing hazard rates, and using GIS technologies for universal databases to guide community development.

The estimated cost for multi-risk modeling is 1.03 million USD, and for risk mitigation and evidence-based decision-making, it is 2.50 million USD.

Strengthening hydro-meteorological system: recent floods highlight the need to enhance early warning systems and forecasting accuracy. Upgrading outdated Soviet-era sirens and integrating them into a multi-hazard framework will improve disaster alerts, especially for remote areas. Additionally, modernizing weather forecasting with digital models offering 1-3 km resolution, compared to the current 9 km, will reduce errors and provide accurate, real-time data.

Upgrading systems with remote-sensing tools and snow modeling will improve weather predictions and hydrological monitoring, crucial for flood management and recovery. Installing hydrological monitoring and risk modeling systems in key river regions will provide accurate water level data and early warnings for floods or droughts. The estimated needs are:

- Hydrological Forecasting: 0.20 million USD,

- Seasonal Forecasts and Snow Modeling: 0.08 million USD,
- Weather Forecast and Prediction System: 0.24 million USD.

Health facility DRM planning and Hospital safety indexing making: strengthening emergency preparedness and response in health institutions is critical. UNDP, WHO, the Ministry of Health, and the DRR National Platform have applied the Hospital Safety Index assessment methodology in five Armenian hospitals during COVID-19. The results led to the development of a "Health Facility DRM Plan," endorsed for replication in other institutions.

With WHO support a priority is to assess healthcare facilities in flood-prone Lori and Tavush regions. This will involve evaluating at least 5 hospitals per region, conducting training, simulations, and public awareness campaigns. Based on the assessments, a DRM plan with risk mitigation and preparedness recommendations will be developed. The estimated cost for this initiative in Lori and Tavush regions is 0.27 million USD.

PDNA baseline unified data development and training: the PDNA process and data collection after the recent floods highlighted the need for localized mechanisms and trained staff. Enhancing PDNA capacities has been a priority for UNDP and ADB-funded DRR programs. Localized guidelines for the Housing Sector were effective due to existing baseline data. Similar efforts are needed for other sectors, focusing on accurate data collection, database management, unified recording systems, and electronic toolkits.

Key to this development is training and capacity building for data collectors, managers, and administrative staff at all levels. These improvements will benefit affected communities and have nationwide significance. The knowledge will be integrated into educational modules and curricula. The estimated cost for these improvements is 0.31 million USD.

Figure 11. Landslide Hazards Risk in the Affected Zone (area 1)

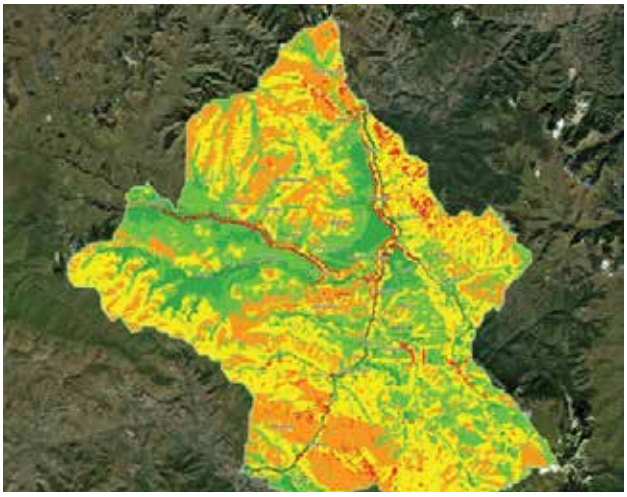
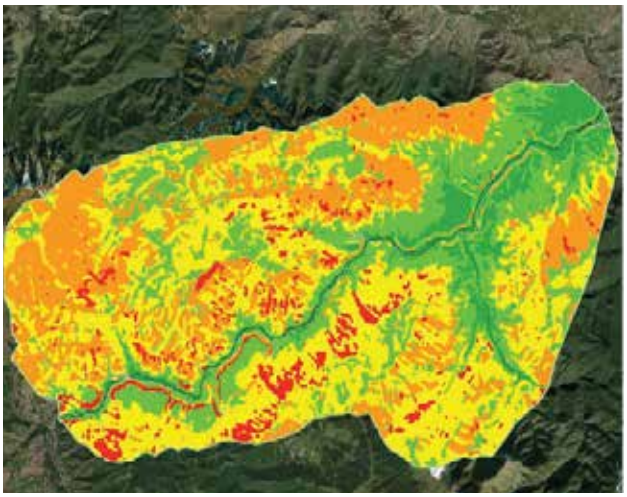


Figure 12. Landslide Hazards Risk in the Affected Zone (area 2)



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