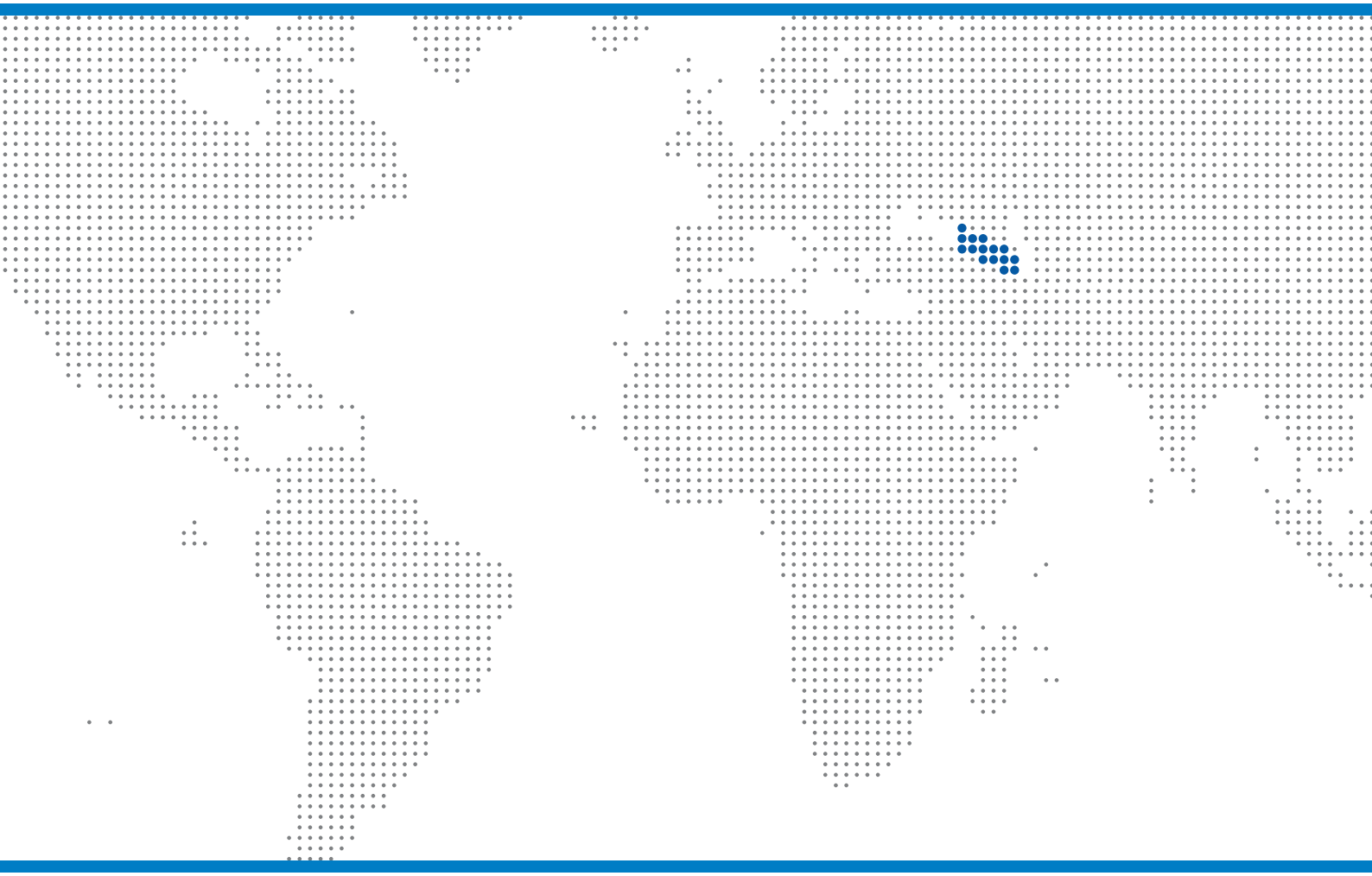
CLIMATE CHANGE AND SECURITY
IN THE SOUTH CAUCASUS



REPUBLIC OF ARMENIA, REPUBLIC OF AZERBAIJAN AND GEORGIA

Regional Assessment

ENVSEC
Environment & Security

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The European Union (EU) through its Instrument for Stability has provided support to the Environment and Security (ENVSEC) Initiative for contributing to regional stability through transboundary co-operation on adaptation to the consequences of climate change.

Within the framework of the project Climate Change and Security in Eastern Europe, Central Asia and the Southern Caucasus under the Environment and Security Initiative (ENVSEC), one of the four main activities aimed at identifying and mapping climate change and security risks in Eastern Europe, Central Asia and the South Caucasus in a participatory way, the conclusions of which are presented in the current report for the South Caucasus.

The Austrian Development Agency (ADA) has co-funded the project by providing financial resources for the project activities in the pilot region in the Dniester River Basin. Moreover, the ENVSEC initiative partners the Organization for Security and Co-operation in Europe (OSCE), the United Nations Development Programme (UNDP), UN Environment, the United Nations Economic Commission for Europe (UNECE) and the Regional Environmental Centre for Central and Eastern Europe (REC) contributed their own resources to the implementation of this project.

The Environment and Security Initiative (ENVSEC)

The Environment and Security Initiative (ENVSEC) is a partnership of five international organizations – the Organization for Security and Co-operation in Europe (OSCE), UN Environment (UNEP), United Nations Development Programme (UNDP), United Nations Economic Commission for Europe (UNECE) and the Regional Environmental Centre for Central and Eastern Europe (REC) – with specialized, but complementary mandates and expertise, that provides an integrated response to environment and security challenges. The mission of ENVSEC is to contribute to the reduction of environment and security risks through strengthened co-operation among and within countries in four regions: Central Asia, Eastern Europe, South Caucasus, and South-Eastern Europe.

The Environment and Security Initiative (ENVSEC) as a platform for co-operation provides multistakeholder environment and security assessments and facilitates joint action to reduce tensions and increase co-operation between groups and countries. Detailed information on ENVSEC is available at www.envsec.org

The assessments herein rely on the most recent statistical data available, while the recommendations take into account the latest developments and trends.

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ABBREVIATIONS AND ACRONYMS

ADA	Austrian Development Agency
CBD	Convention on Biological Diversity
EaPTC	Eastern Partnership Territorial Co-operation
EC	European Commission
ENPARD	European Neighbourhood Programme for Agriculture and Rural Development
ENVSEC	Environment and Security Initiative
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIZ	The German Federal Enterprise for International Co-operation
GWh	Gigawatt hours
HHMP	Hazardous hydro-meteorological phenomena
HPP	Hydropower plant
IDP	Internally Displaced People
IFAD	International Fund for Agricultural Development
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
mBS	Metres below sea level
NAPA	National Adaptation Programme of Actions
NATO	North Atlantic Treaty Organization
NOAA	National Oceanic and Atmospheric Administration
NGO	Non-Governmental Organization
OSCE	Organization for Security and Co-operation in Europe
REC	Regional Environmental Centre for Central and Eastern Europe
TACIS	EU Technical Assistance to the Commonwealth of Independent States
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	UN Environment
UNFCCC	United Nations Framework Convention on Climate Change
UNOCHA	United Nations Office for the Co-ordination of Humanitarian Affairs
USAID	United States Agency for International Development
WB	World Bank

GLOSSARY OF TERMS

Source: Except where noted, definitions come from IPCC, 2014: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, pp. 117-130.

Adaptation	The process of adjustment to actual or expected climate and its effects.
Adaptive capacity	The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.
Afforestation	Planting of new forests on lands that historically have not contained forests.
Biodiversity	The variability among living organisms from terrestrial, marine and other ecosystems.
Dangerously hot days	Days with temperatures above 27°C, which in combination with humidity results in even higher experienced temperatures. [UNDP]
Deforestation	Conversion of forest to non-forest.
Drought	A period of abnormally dry weather long enough to cause a serious hydrological imbalance.
Ecosystem	An ecosystem is a functional unit consisting of living organisms, their non-living environment and the interactions within and between them.
Ecosystem approach	The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. [CBD]
Energy intensity	The ratio of energy use to economic or physical output
Energy security	The goal of a given country, or the global community as a whole, to maintain an adequate, stable and predictable energy supply.
Extreme weather event	An extreme weather event is an event that is rare at a particular place and time of year.
Food security	A state that prevails when people have secure access to sufficient amounts of safe and nutritious food for normal growth, development and an active and healthy life.
Forced migration	A general term that refers to the movements of refugees and internally displaced people (those displaced by conflicts within their country of origin) as well as people displaced by natural or environmental disasters, chemical or nuclear disasters, famine, or development projects. [Columbia University]
Hazard	The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.
Heatwave	A period of abnormally and uncomfortably hot weather.
Hydrological drought	When low water supply becomes evident, especially in streams, reservoirs, and groundwater levels, usually after many months of meteorological drought. [NOAA]
Marz	Region. [http://www.gov.am/en/regions/]
Meteorological drought	When dry weather patterns dominate an area. [NOAA]
Permafrost	Ground (soil or rock and included ice and organic material) that remains at or below 0°C for at least two consecutive years.
Reforestation	Planting of forests on lands that have previously contained forests but that have been converted to some other use.

Resilience	The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation.
Risk	The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values.
Sensitivity	In IPCC reports, equilibrium climate sensitivity (units: °C) refers to the equilibrium (steady state) change in the annual global mean surface temperature following a doubling of the atmospheric equivalent carbon dioxide (CO2) concentration.
Vulnerability	The propensity or predisposition to be adversely affected.
Water security	The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability. [UN-Water]

SUMMARY

Climate change in the South Caucasus countries is clearly evident. Recent research confirms that average annual air temperatures are steadily increasing and extreme weather events, such as storms and heatwaves, have been intensifying over the last few decades. The South Caucasus countries are prone to a range of hazards such as landslides and floods, all of which are exacerbated by climate change, and which result in serious damage to infrastructure, casualties and economic losses.

At the political level, the South Caucasus countries are well grounded in global climate change politics. All three are Non-Annex I Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and, as such, support international efforts to hold the increase in the global average temperature below 2°C – a global target set at the Conference of Parties in Paris in December 2015. All three countries have submitted their Intended Nationally Determined Contributions (INDCs) to the UNFCCC, setting concrete emission reduction targets and committing to adaptation plans.

Armenia, Azerbaijan and Georgia have all developed national security strategies. Although none of them consider climate change as an explicit threat to national security, protection against natural and man-made disasters as well as the implementation of sound environmental practices, are recognized as important factors in ensuring people's safety, and on a larger scale, national security. The INDCs for Armenia and Georgia highlight the climate change threats to the security of such economic sectors as agriculture.

Climate change is gaining increasing attention among decision makers in the region in the development of national strategies and programmes related to poverty, sustainable development and renewable energy. Food security, the loss of biodiversity and the vulnerability of water resources are concerns across the region. A number of strategies and programmes have been implemented, but only a few included climate change adaptation measures, and climate change remains largely the concern of those involved in environmental protection.

Adequate climate change adaptation measures are lacking in the planning of other important economic activities in sectors such as energy, health or tourism in all three South Caucasus countries. Furthermore, climate change is not taken into account in important technical and financial measures such as construction standards or insurance schemes, and the impacts of climate change on most vulnerable groups, such as women, are not sufficiently considered in adaptation planning. None of the South Caucasus countries has passed legislation on climate change targeted to stimulate the development of adaptation measures.

Climate change disruptions in the hydrologic system are likely to result in tensions between upstream and downstream water users if water management fails to take these prospects into account. The water-agriculture-energy nexus is critical, particularly in coordinating between sectors at the national level and between upstream and downstream countries. There are currently no signed water treaties between any of the three neighbouring countries, but significant progress has been achieved in the preparation of bilateral agreements.

Recent political developments are likely to influence the current situation. Georgia ratified an Association Agreement with the EU, which requires co-operation across a number of sectoral policies, including climate change adaptation measures. And the Eurasian Economic Union, of which Armenia is a signatory, primarily aims at economic integration of its member states[1] by providing the framework for common transport, agriculture and energy policies but not necessarily directly addressing co-operation on climate change aspects of these policies.

1 The Eurasian Economic Union is made up of the Republic of Armenia, the Republic of Belarus, the Republic of Kazakhstan, the Kyrgyz Republic and the Russian Federation.

The economies of the South Caucasus countries remain fragile, and most of the climate change adaptation activities to date have been supported by external donors. Some national measures have been taken in Azerbaijan, where the Government invested in flood prevention activities, remediation and reforestation, but these remain few and far between.

Climate change affects the whole region, which includes extensive mountain ecosystems and remote coastal zones. The climate change implications for human security are likely to become more prevalent over time.

Ongoing institutional and municipal reforms may provide possibilities for concrete climate change adaptation measures to be implemented outside the region's capitals, but a lack of co-ordination between central administrative bodies and local municipalities and a gap in the knowledge and resources needed for climate change adaptation are challenges to progress.

Security risks induced by climate change are of national and regional concern. This assessment of climate change and security hotspots – based on the latest research findings and consultations with national experts – identifies areas where climate change has the potential to undermine socioeconomic systems, threaten infrastructure or livelihoods, or compromise security by exacerbating political or social tensions. These areas include:

Regional/transboundary

- Northern Armenia and southern Georgia
- The north-west Azerbaijan and north-east Georgia border area (Alazani/Ganykh river basin)

National

- Yerevan and Ararat Valley (Armenia)
- Lake Sevan (Armenia)
- Southern Armenia (Armenia)
- South-eastern Armenia (Armenia)
- The Kura-Ara(k)s lowlands (Azerbaijan)
- Baku and Absheron peninsula (Azerbaijan)
- Adjara and the Black Sea coast (Georgia)
- Tbilisi (Georgia)
- The Mtskheta-Mtianeti region (Georgia)
- The Kakheti region (Georgia)
- North-west Georgia

This study recommends that the Governments of the South Caucasus countries take swift actions from the local to the regional level to tackle the impacts of climate change and the implications for security. Some of the proposed areas of intervention, including those matching the priorities of the Environment and Security Initiative, will need strengthened transboundary co-operation as well as more consistent and targeted international support.

1. METHODOLOGY

The overall goals of the climate change and security assessment are to identify and explain how climate change may exacerbate threats to security, and to propose effective measures in response. Achieving these goals requires a clear understanding of the current political, socioeconomic, and environmental conditions, trends and driving forces. These are likely to vary across the countries in a region, and may vary significantly within countries or transboundary ecosystems. The comprehensive survey of these underlying factors is therefore an important element of the climate change and security assessment, and is based on an examination of the publications and routine reporting of national, regional and international organizations, and on academic studies and journal articles.

An understanding of how climate change may affect political, socioeconomic, and environmental conditions depends in part on an understanding of current and projected climate change, and entails the identification and analysis of the effects of rising and extreme temperatures, changing precipitation patterns and extreme weather on resources and livelihoods, and on security. The most recent Intergovernmental Panel on Climate Change (IPCC) reports, the countries' national communications to the United Nations Framework Convention on Climate Change (UNFCCC), other country or river basin studies and inputs from multi-stakeholder consultations all inform this analysis.

The assessment of the effects of climate change on vulnerability focuses on security implications, and identifies how the hazards related to climate change, in combination with other cumulative pressures, may affect the environmental, socioeconomic and political conditions, and how these changed conditions may affect security and stability within and across borders. This assessment necessarily includes a consideration of the climate change adaptation capacity and resilience of governments, institutions and key sectors. It also examines how climate change and the other pressures play out in socioeconomic and environmental terms at the local, national and regional levels.

The definition of "security" in the context of climate change keeps evolving over time much like the Intergovernmental Panel on Climate Change definition of "vulnerability". These modifications of the meanings of the terms do not indicate loose usage but rather the refinements of understanding of the complex relationships among the many contributing factors, and the respective points of view of the agencies and institutions conducting assessments. A sampling of definitions demonstrates how different organizations have grappled with the security terms relevant in the context of climate change and security assessment.

The Food and Agriculture Organization of the United Nations (FAO) noted in a 2002 report that "food security" is a flexible concept, and that some 200 definitions have appeared in the literature. In 1996, the World Food Summit determined that food security existed, "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". The IPCC defines the term as, "A state that prevails when people have secure access to sufficient amounts of safe and nutritious food for normal growth, development and an active and healthy life."

In a 2009 statement, the World Economic Forum defined "water security" as, "the gossamer that links together the web of food, energy, climate, economic growth and human security challenges that the world economy faces over the next two decades". UN-Water provides a comprehensive definition of water security: "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability."

A 2011 Brookings Institution paper notes that, "Although there is a vast literature and much discussion about what constitutes 'energy security', there is no consensus on a definition," but asserts that, "At the most basic level, energy security means having access to the requisite volumes of energy at affordable prices." The International Energy Agency expands on this definition to include the concept of uninterrupted availability of energy sources, and distinguishes between long-term and short-term security. The former "mainly deals with timely investments to supply energy in line with economic developments and environmental needs", while the latter "focuses on the ability of the energy system to react promptly to sudden changes in the supply-demand balance." In the IPCC definition, energy security is, "The goal of a given country, or the global community as a whole, to maintain an adequate, stable and predictable energy supply."

Other categories of security include personal, physical, human, national and others, each with their own range of definitions and applications. In the consideration of potential climate threats to security, the assessments strive to be as explicit as possible about the nature of the security at risk.

The approach used during the climate change and security assessments follows the Environment and Security Initiative general approach for developing integrated climate vulnerability assessments and consists of three phases:

1. Desk studies: Conducting desk studies and developing a preliminary assessment of the main climate-security implications and sites in the project countries of a region

2. National and regional consultations: Holding national and regional multi-stakeholder consultations based on the desk studies and preliminary assessment reports

3. Joint analysis: Preparing regional a joint analysis, a final assessment report and a visual synthesis of climate change-security issues and hotspots, and communicating climate change and security implications and areas of concern, priorities and recommendations to policymakers, state institutions and the public

The vulnerability assessment also considers the adaptive capacity of the countries and the region as a whole, and may include an evaluation of financial and institutional capacities and of regional co-operation processes. The IPCC applies five criteria for assessing vulnerability which are listed below:

1. Exposure of a society, community, or social-ecological system to climatic stressors. If a system is not at present nor in the future exposed to hazardous climatic trends or events, its vulnerability to such hazards is not relevant in the current context.

2. Importance of the vulnerable system(s). Views on the importance of different aspects of societies or ecosystems can vary across regions and cultures. However, the identification of key vulnerabilities is less subjective when it involves characteristics that are crucial for the survival of societies or communities or social-ecological systems exposed to climatic hazards. Defining key vulnerabilities in the context of particular societal groups or ecosystem services also takes into account the conditions that make these population groups or ecosystems highly vulnerable, such as processes of social marginalization or the degradation of ecosystems.

3. Limited ability of societies, communities or social-ecological systems to cope with and to build adaptive capacities to reduce or limit the adverse consequences of climate-related hazard. Coping and adaptive capacities are part of the formula that determines vulnerability. While coping describes actions taken within existing constraints to protect the current system and institutional settings, adaptation is a continuous process which encompasses learning and change of the system exposed – including changes of rule systems or modes of governance. Severe limits of coping and adaptation provide criteria for defining a vulnerability as key, since they are core factors that increase vulnerability.

4.Persistence of vulnerable conditions and degree of irreversibility of consequences. Vulnerabilities are considered key when they are persistent and difficult to alter. This is particularly the case when the susceptibility is high and coping and adaptive capacities are very low due to conditions that are hard to change. Irreversible degradation of ecosystems, chronic poverty and marginalization, and insecure land tenure arrangements are drivers of vulnerability that in combination with climatic hazards determine risks which often persist over decades. In this way, communities or social-ecological systems (e.g. coastal communities dependent on fishing or mountain communities dependent on specific soil conditions) may reach a tipping point that would cause a partial or full collapse of the system. Inability to replace such a system or compensate for potential and actual losses and damages is a critical criterion for determining what is "key".

5. Presence of conditions that make societies highly susceptible to cumulative stressors in complex and multiple-interacting systems. Conditions that make communities or social-ecological systems highly susceptible to the imposition of additional climatic hazards or that impinge upon their ability to cope and adapt, such as violent conflicts are considered under this criteria. Also, the critical dependence of societies on highly interdependent infrastructures (e.g power supply [or] transport) leads to key vulnerabilities [in] systems where capacity to adapt is low.

These IPCC criteria provide guidance on how to evaluate the relative importance of various areas of vulnerability. The ENVSEC climate change and security assessment considers these criteria in defining the corresponding vulnerable areas (climate change and security hotspots) and the context-specific implications for security.

1.1. Phase 1: Desk studies

The desk studies consider the underlying political, socioeconomic and environmental conditions; the current and projected climate change; the climate hazards and stressors; and the impact of climate change in the context of the vulnerability of specific places in the region. The desk studies culminate in the identification of climate and security hotspots.

1.1.1. Survey of underlying political, socioeconomic and environmental conditions

A comprehensive survey of the underlying socioeconomic, political and environmental conditions in the countries and the region as a whole entails the examination and description of the range of factors that may influence the interplay of climate and security. These factors include the following:

- The geopolitical situation and broad security influences
- Climate change politics and mainstreaming
- Governance
- Social dynamics
- The economic situation
- The availability and condition of natural resources
- Agriculture and food security
- Energy production and security
- The water-agriculture-energy nexus
- Critical infrastructure

1.1.2. Current and projected climate change

The relationships between rising global temperatures and a host of secondary effects are increasingly well understood. Climate trends and projections are available at the global, regional, national and sometimes local levels. Such trends and projections usually consider the following:

- Average annual and seasonal temperature
- Number of hot days and nights
- Frequency of heatwaves
- Average annual and seasonal precipitation
- Number of days above and below precipitation thresholds
- Number of extreme weather events

Among the reliable sources of climate information are the following:

- Intergovernmental Panel on Climate Change publications, including special reports and the parts of the Fifth Assessment Report published in 2013-2014, and international online resources with climate data and climate change models
- National communications to the United Nations Framework Convention on Climate Change
- Country statements, positions and presentations
- National policies, programmes and plans related to environmental issues, natural resources and adaptation to climate change
- Official data from international organizations
- Peer-reviewed international research

An understanding of the climate trends and projections for a country and a region provided the basis for the analysis of climate change hazards and risks in this study, and for the analysis of likely regional consequences on security.

1.1.3. Climate hazards and stressors

The identification and analysis of hazards resulting from climate change is an essential step in the climate change and security assessment. Some of these hazards come in the form of sudden events, and some arise slowly over time. The long-term effects of rising temperatures and disrupted precipitation patterns may diminish pastures, interfere with irrigated and rain-fed agriculture and energy production, change sea levels and compromise human health. For either sudden or slow onset effects, the hazard analysis considers the potential environmental, socioeconomic and political consequences of these hazards. The array of hazards under consideration included the following:

- Melting glaciers and the formation of potentially dangerous glacial lakes
- Floods, flash floods and other climate-related disasters
- Sea-level rise and enhanced coastal flooding
- Desertification and loss of usable land
- Hailstorms, cold waves, dust storms
- Droughts and heatwaves
- Wildfires
- Changes in the hydrologic cycle; too much and too little water; major seasonal shifts
- More frequent and severe extreme weather events

1.1.4. Impact and vulnerability assessment

The analysis of the role of climate change as an additional stressor examines how natural hazards caused or intensified by climate change may affect the existing environmental, socioeconomic and political conditions. It considers the likelihood of the climate risk and the potential exposure to hazards, and explores the implications for security.

Some of the relationships are fairly straightforward, and some are highly complex. Floods or extreme cold waves, for example, may cause immediate human and economic losses, may trigger an energy or food crisis and may threaten livelihoods. Changes in the hydrologic cycle, in contrast, may cause environmental degradation over time with repercussions for the economy and food and power production for a growing population in the coming years. The security implications may be far-reaching and complicated by other factors.

The levels of identified risks are likely to rise over time, especially in the absence of adaptation, and therefore the timeframe for the analysis is an important factor in the vulnerability assessment. The IPCC Fifth Assessment Report uses three distinct time frames – the present, near term (2030-2040) and long term (2080-2100) – in its evaluation of climate risks. By taking a similar approach, this assessment aims to help alert policymakers to the prospect that a low-level present risk has the potential of becoming a high-level long-term risk, even when long-term projections of the underlying security conditions may not be feasible.

The IPCC describes risk as "The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values." In its enumeration of key climate-related risks, the IPCC offers descriptions, including the following:

- Systemic risks due to extreme weather events leading to breakdown of infrastructure networks and critical services such as electricity, water supply, and health and emergency services
- Risk of mortality and morbidity during periods of extreme heat, particularly for vulnerable populations and those working outdoors in urban or rural areas
- Risk of food insecurity and the breakdown of food systems linked to warming, drought, flooding, and precipitation variability and extremes, particularly for poorer populations
- Risk of loss of rural livelihoods and income due to insufficient access to drinking and irrigation water and reduced agricultural productivity

This assessment considers the structural, socioeconomic and environmental consequences of climate change, and covers a broad range of perceived risks and context-specific security concerns:

- Livelihood insecurity (urban and rural)
- Human and economic losses
- Additional pressure and competition over scarce natural resources
- Seasonal or persistent water shortages and possible energy and water insecurity
- Damage to infrastructure; industrial safety concerns, including stability of tailings
- Diminished ecosystem services
- Biodiversity disruptions and possible loss of fish stocks, pastures and genetic resources
- Increased social tension and conflict
- Changes in trade patterns and economic impacts
- Increased rates and wider geographic spread of diseases, and declines in human health
- Loss of sources of income and increased poverty or diminished well-being
- Decreased physical security and possible growth in crime
- Displacement and increased migration
- Loss of land and cultural and natural heritage

According to the IPCC definitions, a hazard is "the potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources" and vulnerability is "the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected." In ranking risks, the IPCC considers the hazard and the vulnerability of the exposed society or systems, and applies the following criteria:

- Magnitude
- Probability that significant risks will materialize and their timing
- Irreversibility and persistence of conditions that determine risks
- Limited ability to reduce the magnitude and frequency or other characteristics of hazardous climatic events and trends and the vulnerability of societies and social-ecological systems exposed

The examination of climate change as an additional stressor also considers the adaptation capacity of the countries and the region as a whole, and includes evaluations of financial and institutional capacities, regional co-operation processes, resilience and national climate change policies and plans.

1.1.5. Climate change and security hotspots

In this report, climate change and security hotspots are areas with ongoing tensions or environmental concerns where climate change is expected to undermine social or economic stability, threaten infrastructure or livelihoods, or compromise security by exacerbating political or social tensions, conflicts or instability.

Defining climate change and security hotspots

This project identifies and assesses climate change and security hotspots across Eastern Europe, Central Asia and the South Caucasus. These hotspots are identifiable in geographic terms, and are characterized by ongoing tensions, environmental concerns or both. In each of these hotspots, climate change through one or more pathways is expected to undermine social or economic patterns, threaten infrastructure or livelihoods, or compromise security by exacerbating political or social tensions, conflicts or instability. Areas with weak institutions or lacking the effective mechanisms for transboundary environmental and security co-operation are especially vulnerable.

The analysis of hotspots, which has been discussed with stakeholders in the countries during several consultations, recognizes the value of natural resources both economically and in terms of security, and considers the tensions associated with the value of resources. Such tensions may arise from criminal activity conflicting with legitimate uses or from questions of who can use a resource, and how. How climate change may affect these situations is of particular interest.

The identification of hotspots started with a review and analysis of existing information on environmentally sensitive areas. The sources included the Environment and Security Initiative assessments in the region, national communications, international studies on climate change and security and interviews with national and regional experts. Stakeholders at national and regional consultations reviewed the initial designations, and refined the assessments.

The hotspots included here reflect the judgement of the project analysts and the stakeholders, informed by the following considerations:

- Existing or prospective vulnerability to climate change
- Existing instability or security risks
- Analytical conclusions regarding the connections between climate change and security
- Other existing political, socioeconomic and environmental factors

1.2. Phase 2: National and regional consultations

A series of multi-stakeholder national meetings in each of the three South Caucasus countries to discuss and complement the preliminary findings of the assessment followed a participatory approach that ensured that the voices of key-stakeholders including Civil Society Organizations representatives were heard. The participants in the meetings comprised experts from various ministries or other national institutions, academia, nongovernmental, regional or international organizations.

Work sessions in the meetings focused on country-specific issues raised by background papers and expert presentations. Discussions concentrated on the relationship between climate change and security, and on how that relationship is playing out in the country.

Participatory mapping exercises supported the identification of vulnerable areas. The perception of risk from the country perspective is an integral part of this determination, as are national political sensitivities. The participatory mapping process accounts for these national views in a way that a vulnerability assessment based on a desk study alone cannot.

The regional consultations brought together experts, policymakers and representatives of the ENVSEC organizations. These consultations attempted to reconcile national perceptions of climate change across the region, and to identify regional commonalities and differences. The goals were to try to reach agreement on what the problems are, to combine the national assessments into a regional synthesis assessment and to identify the issues that require a regional approach.

1.3. Phase 3: Joint analysis

In developing the regional synthesis report based on the preliminary assessment and the multi-stakeholder consultations, ENVSEC takes account of international knowledge, practitioner expertise and available technologies; incorporates the national concerns expressed by the countries; and seeks a regional consensus on hotspots.

1.4. A note on the limitations of the methodology

The assessments here rely heavily on the available data and on the findings of assessments or studies conducted by other organizations and institutions. Where possible, national stakeholders verified the data during the consultation process. Climate change and security risks are based in part on perceptions and on climate change scenarios, both of which tend to be uncertain. The analyses may be limited by weaknesses in the data and uncertainty in the projections.

In addition, identifying geographic hotspots in some areas and presenting the security implications in a neutral manner can sometimes be a challenge for the international community. In this regard the climate change and security assessment may not report fully on the details of those regions that are experiencing protracted conflicts or that are very sensitive about certain areas, issues or resources.

2. EXISTING POLITICAL, SOCIOECONOMIC AND ENVIRONMENTAL CONDITIONS

This chapter surveys the underlying socioeconomic, political and environmental conditions in the countries and the region as a whole, and examines the range of factors that may influence the interplay of climate change and security.

2.1. The geopolitical situation and broad security influences

The South Caucasus has been affected by serious ethnic and territorial tensions since the dissolution of the Soviet Union. The fall of the Soviet Union in 1991 and the subsequent declarations of independence of Armenia, Azerbaijan and Georgia triggered armed conflicts in Abkhazia, South Ossetia and Nagorno-Karabakh. To date, disputes remain largely unresolved despite continuous international mediation.

Mediation efforts take place within two separate frameworks. The Co-Chairmen of the Conference on Nagorno-Karabakh under the auspices of the OSCE (Organization for Security and Co-operation in Europe, Minsk Group), co-chaired by France, the Russian Federation and the United States, is tasked to work towards a political solution to the conflict in and around Nagorno-Karabakh, involving Armenia and Azerbaijan.

The Geneva International Discussions address the consequences of the 2008 conflict in Georgia. The discussions are co-chaired by the OSCE, the EU and the United Nations, with participation from representatives from Tbilisi, Tskhinvali, Sukhumi, Moscow and Washington.

In the conflict between Armenia and Azerbaijan over Nagorno-Karabakh, a ceasefire was negotiated in 1994, but a peace agreement has not been signed. The situation on the line of contact remains volatile, and continuing armed clashes result in fatalities each year. In August 2008, the conflicts in Abkhazia and South Ossetia culminated in a military confrontation between Russia and Georgia.

2.2. Climate change politics and mainstreaming

The UNFCCC and its Kyoto Protocol, which the South Caucasus countries have ratified, provide a platform for national and regional climate change political discussions. The countries have also ratified a number of other international treaties such as the Convention on Biological Diversity and the United Nations Convention to Combat Desertification, and the Convention on the Conservation of European Wildlife and Natural Habitats, all of which consider climate change as a thematic priority. Under the UNFCCC framework, the countries regularly submit their National Communications[2] to the Convention. These serve as the main reference documents for assessing their greenhouse gas inventories, mitigation and adaptation measures, and the progress towards their commitments. In accordance with the requirements for Non-Annex I Parties, each of the three countries of the South Caucasus region has submitted their Intended Nationally Determined Contributions to the UNFCCC, highlighting their support to the post-Kyoto Protocol agreement adopted at COP21 at the end of 2015 in Paris, France. The INDCs provide concrete political commitments for emission reduction targets and outline adaptation measures.

All three countries have developed and adopted national security strategies[3] and, while none of the South Caucasus countries consider climate change as an external threat to national security, protection from natural and man-made disasters, as well as the implementation of environmentally sound social practices, are recognized as important factors in providing safety for people and, on a larger scale, ensuring national security. However, climate change threats to national security, or specifically to the security of economic sectors such as agriculture, are highlighted in the INDCs for Armenia and Georgia. Armenia´s INDCs state that, “the country’s need to ensure its national security, necessitates the prioritization of climate change adaptation” (Government of the Republic of Armenia, 2015). Georgia´s INDCs underline the relationship between the impacts of climate change on agriculture and food security (MoENRP 2015).

None of the three South Caucasus countries has enacted any flagship legislation on climate change that could support adaptation measures. Their concerns are scattered across different sectoral policies and laws. Climate change is recognized by Armenia in a series of general national strategic papers[4] that highlight the particular vulnerability of water resources. In Azerbaijan, strategic programmes on socioeconomic development and poverty reduction[5] also recognize the challenges posed by climate change. In Georgia, climate change is noted in the regional development strategy.[6] This recognition of the challenges posed by climate change is an important achievement, but it remains a generalized concern. All countries would benefit from streamlined comprehensive climate change policies and clearly assigned responsibilities among government institutions. Such efforts are already supported by EU-funded regional projects, the results of which have yet to be seen.

Recently, the South Caucasus countries have started to voice their political commitments, particularly on climate adaptation policies. Armenia has committed to adopting a climate change adaptation strategy and to developing a national adaptation plan. The other two countries are taking a more cautious approach.

Major national efforts aimed at climate change mitigation measures are under way and low emission strategies are developed, particularly for reduction of greenhouse gas (GHG) emissions in the energy, transport, agriculture and forestry sectors. A variety of practical steps are being taken such as the development of a GHG inventory system. All three countries have legal mechanisms in place for the implementation of projects within the framework of the Clean Development Mechanism - one of the instruments defined by the Kyoto protocol, set to stimulate emission reduction projects worldwide.

There is a strong emphasis on the development of renewable energy strategies in all three countries. In 2007, the Government of Armenia approved the National Programme on Energy Saving and Renewable Energy. The programme was the first of its kind and resulted in a cross-sectoral assessment of energy savings and renewable energy potential in the Armenian economy. It also recommended actions for energy optimization. Azerbaijan has also adopted a number of energy related programmes.[7] It announced a renewable energy in electricity target of 20 per cent by 2020. In 2008, the Government of Georgia approved the Renewable Energy State Programme to regulate and support the construction of new renewable energy projects.

As part of their commitment to local sustainable energy use, several cities of the South Caucasus have joined the Covenant of Mayors – a European movement working with local and regional authorities to increase energy efficiency and the voluntary use of renewable energy sources. In Georgia, Tbilisi, Rustavi and Gori committed to reduce energy consumption by 20 per cent; in Armenia, 10 cities are signatories to the Covenant, including larger cities such as Yerevan, Gyumri, Hrazdan and Ashtarak, which also pledged to reduce greenhouse gas emissions by 20 per cent; and in Azerbaijan the city of Icherisheher joined the movement in 2012.

In mitigating climate change, the countries of the South Caucasus region are undertaking considerable efforts in various sectors such as waste management, forestry, transportation and construction. However, the results of these are yet to be seen. At the policy level, the countries are aiming to adopt low-emission development strategies and national mitigation action plans. Fewer efforts are being made, however, to design and implement climate change adaptation measures.

At the subregional level, the EU Eastern Partnership provides a framework for political engagement and practical projects on natural resources and ecosystems in the South Caucasus. Political engagement is particularly strong in Georgia through the EU-Georgia Association Agreement, which has enhanced co-operation in some 28 key sector policy areas, including climate action. The EU ClimaEast

2 Armenia: Third National Communications on Climate Change issued 2015; Azerbaijan: Third National Communication to the UNFCCC issued in 2015; Georgia: Third National Communication to the UNFCCC issued in 2015.
3 Republic of Armenia National Security Strategy approved in 2007. Republic of Azerbaijan: National Security Concept approved in 2007. Georgia: National Security Concept of Georgia approved in 2005. Updated concept on national security was adopted in 2011.
4 Republic of Armenia Sustainable Development Program in 2008; Strategic Program of Perspective Development for 2014-2025.
5 Azerbaijan 2020 Development Concept: A Look into the Future; State Programme on Poverty Reduction and Sustainable Development in the Republic of Azerbaijan for 2008-2015.
6 The Georgia Strategy for Regional Development for 2010-2020.
7 State Programme on the Use of Alternative and Renewable Energy Sources (2005-2013); State Programme for the Development of a Fuel Energy Complex (2005-2015); Strategy for the Development of Renewable and Alternative Energy Sources (2012-2020); Strategy for Renewable energy for 2015 – 2030 (to be approved).

project, funded by the European Union to assist the Eastern Neighbourhood Partnership Countries and Russia in climate change mitigation and adaptation, also provides technical support to climate change policies in these countries.

2.3 Governance

Good governance is a critical factor in a country's capacity to respond effectively to climate change. The World Bank applies six main indicators, among other factors, the development of its adaptive capacity index – an attempt to quantify and summarize a country's potential to respond to climate change. The IPCC (2007) reports that, "The specific determinants of adaptive capacity at the national level represent an area of contested knowledge,". Furthermore, it states that, "Some studies relate adaptive capacity to levels of national development, including political stability, economic well-being, human and social capital and institutions."

In the South Caucasus, democratic governance practices are relatively new in all three former Soviet republics, which are still going through a political and economic transition. National elections are guaranteed by the countries' constitutions. Members of the National Assembly of the Republic of Armenia and the National Assembly of Azerbaijan (also known as Milli Mejlis) are elected for five-year terms. In Georgia, the Parliament of Georgia is elected for a term of four years. The constitutional changes, which have been endorsed by the majority of voters in Armenia in the referendum in December 2015, will abolish direct presidential elections transferring this right to the National Assembly.

Azerbaijan follows a semi-presidential political system, where the primary executive power lies with the President. An amendment introduced to the Constitution of Azerbaijan after a 2009 referendum lifted the two-term limit for the President. Changes were also made to the Constitution of Georgia in 2010, shifting primary political powers from the President to the Prime Minister. The changes were enacted after the presidential elections in 2013.

Governance indicators for the South Caucasus countries in 1996, 2006 and 2013 suggest that the rule of law – an indication of the strength of national governance – is steadily improving in all three countries. Improvements were most significant in Georgia, which went from being the lowest ranked of all three countries in 1996 to the highest in 2013. Despite improvements, however, the rule of law, including judicial independence, remains weak in the South Caucasus.

According to the latest data from Transparency International, the level of corruption remains high across the ex-Soviet republics. On a scale from 0 (highly corrupt) to 100 (very clean), Transparency International in 2014 gave Armenia, Azerbaijan and Georgia scores of 37, 29 and 52 respectively, indicating that much improvement is still needed in preventing corruption (Transparency International, 2015).

Over the last decade, Armenia has undertaken a number of important steps to combat corruption. The government developed an anti-corruption strategy, its Implementation Action Plan for the period of 2009-2012 and established a special implementation monitoring committee. As part of these efforts, in 2013 a corruption assessment in Armenia was conducted (Anti-Corruption Strategy Implementation Monitoring Commission, 2013). Since then, reforms adopted with the aim of modernizing the state have yielded improved legislative bases such as a new Criminal Code, a new Electoral Code and a new law on Public Service (Government of the Republic of Armenia web site).

In 2012, the President of Azerbaijan endorsed an Anti-Corruption Plan (2012-2015) and established a Commission on Combatting Corruption. The full results of these efforts have not yet been reported.

Anti-corruption measures and administrative reforms have proved to be particularly efficient in Georgia where corruption, including bribery in the public administration and day-to-day corruption, have decreased drastically (UNDP, 2008a). Anti-corruption measures were followed up by the National Anti-Corruption Strategy, adopted in early 2010, and an action plan approved later that year. Figure 1 provides an overview on selected governance indicators for the South Caucasus countries for 1996, 2006 and 2013.

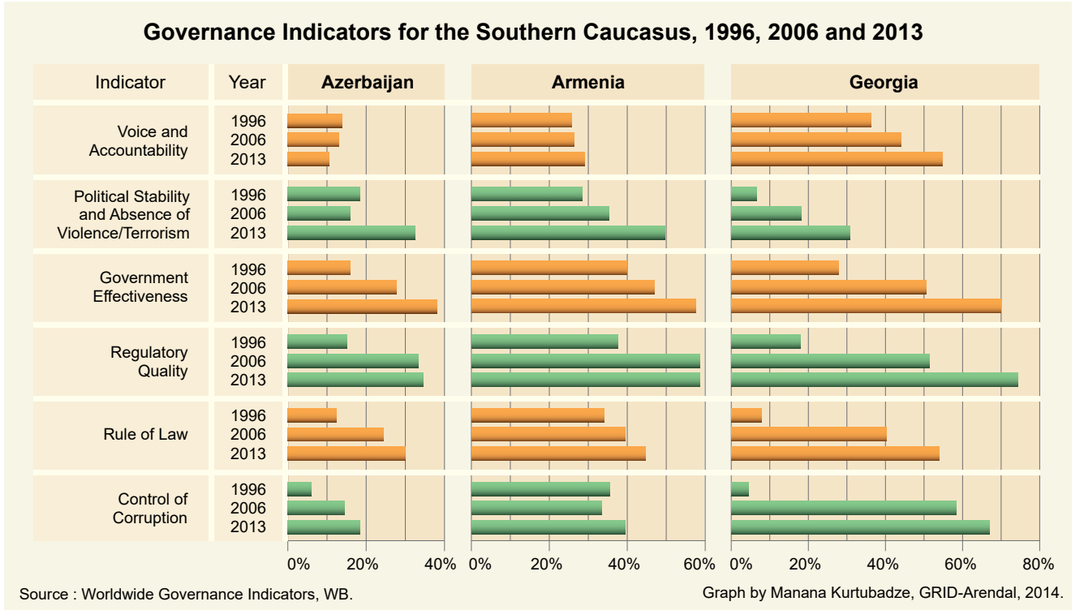


Figure 1: Governance Indicators for the South Caucasus, 1996, 2006 and 2015

2.3.1. Local governance

Public sector systems have been developed over the last two decades. Central government and local governance systems have undergone substantial reforms, in some cases within a very short time. Attempts at decentralization and developing more effective self-governance structures are taking place in all three countries, assisted by international programmes such as the Local Governance Programme in the South Caucasus, implemented by the German Federal Enterprise for International Co-operation (GIZ). Assessments are conducted within the framework of the European Commission´s Neighbourhood Policy.

Local governance is important for the design and implementation of climate change adaptation activities. There are attempts in the South Caucasus to develop climate change initiatives at the lowest administrative level. Georgia has started the process of building district capacity on climate change adaptation and mitigation. There are, however, no records of similar activities in Armenia and Azerbaijan.

In Armenia, legislation provides the necessary regulations for effective local governance[8] structures, but enforcement is a challenge since the Armenian authorities have not yet defined the powers of local authorities. Consequently, shortcomings in local authorities' capacities limit their ability to deliver public services. Armenia continues to strengthen self-governance structures through different means including Judicial Code amendments that provide greater independence for judges by redefining the duties of the different branches of government (EC, 2015).

In Azerbaijan, the central government carries the main governing role, which unfortunately leaves limited space for local governance. The capacity of local municipalities for development and social mobilization varies widely among rural municipalities and larger urban areas. In their attempt to increase their influence and address the needs of local communities, municipalities face a number of challenges such as a lack of financial and human resources and the inability to involve and communicate with stakeholders (Tovuz et al., 2005).

In Georgia, in 2006, a self-governance reform consolidated more than 1 100 local self-government units into 69 units and devolved a number of important powers including some dealing with water-related issues – to local authorities. In 2014, the new Local Self-Government Code brought together a number of regulations on self-governance. As a result of the reforms, a self-governing city status was granted to those cities with population in excess of 15 000. In addition to the five existing, self-governing cities (Tbilisi, Rustavi, Kutaisi, Poti and Batumi), a further seven cities were granted self-governing status (Telavi, Ozurgeti, Zugdidi, Ambrolauri,

8 Law on Administrative and Territorial Division, 1995; Law on Local Self-Government, developed in Armenia and adopted by the National Assembly on May 7, 2002; Law on Self-Government in Yerevan, 2008; Amendment to the Law on Local-Self-Government, 2013.

Gori, Mtskheta and Akhaltsikhe). Fiscal decentralization is another positive outcome of the reforms, which will result in more financial resources to local governments.

Major reforms to central and local governance and the ongoing fight against corruption as well as cross-sectoral dialogue, are essential for tackling emerging issues such as climate change. However climate change concerns have not yet been prioritized by national governments. Cross-sectoral dialogue is particularly important in the water management sector where overuse of water resources in one sector deprives other sectors. The implementation of renewable energy strategies is another area, which requires cross sectoral-dialogue in order to provide safeguards for natural resources and carefully consider scenarios of water availability.

2.3.2. Environmental activism

The South Caucasus region has a long tradition of political environmentalism. Ecological issues have caught the attention of significant sections of the population and become rallying points for popular movements. In Armenia, in particular, environmental movements have been a feature of domestic political life since the 1980s, when the republic was still part of the Soviet Union, and continue to gain important successes. In 2005, the civil society movement was instrumental in influencing a transportation project intended for the Shikahogh Reserve in southern Armenia. In 2012, the Mashtots Park Movement was initiated by civil activists concerned by the illegal construction of a commercial space in a city park in Yerevan. These examples demonstrate that there is a strong power of civil society to mobilize on issues where ecological concerns are high.

If such popular political support can be leveraged in all three countries, this would help create a platform for international collaboration in dealing with climate change at the regional level. However, as Vicken Chetarian (2009) has pointed out, environmental movements in the South Caucasus have historically developed nationalist agendas, thus limiting the impulse to engage in regional dialogue on transnational ecological matters. This illustrates the fact that growing environmental stresses could escalate political tensions at the local and national level within a state, as well as jeopardize relations with neighbouring states over environmental concerns. There have been cases of tension between civil society and the private sector concerning a number of development or business projects in the region. If environmental matters are not placed higher on the political agenda they could lead to social tension.

2.3.3. International frameworks for environmental governance

The social and political effects of climate change must be acknowledged and addressed in a timely manner through democratic processes. The stipulations of international environmental conventions such as the United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (the Aarhus Convention) provides the framework for such processes. Armenia, Azerbaijan, and Georgia are all signatories to the Aarhus Convention. This international legal instrument obliges parties to the Convention to ensure environmental democracy by facilitating citizens' access to information, to decision-making processes and to legal rights with respect to environmental matters. Consistent implementation of the Aarhus Convention is a prerequisite for democratic environmental governance and overall economic development, particularly in co-operation with other economic sectors. Other international environmental conventions such as the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, can similarly assist in the management of local, national and transboundary hydrological systems that affect the security of the region.

2.4. Social dynamics

The examination of social dynamics in the region facilitates an understanding of the human capacity for dealing with climate change impacts, and for the insecurities and challenges these impacts may cause. Knowledge of education levels, the percentage of employed and unemployed, the distribution of wealth and income, and vulnerable groups based on age or gender can guide policy makers in identifying the scope of adaptation measures that may be necessary and that are feasible. Future projections compared to the current situation will also help estimate what contribution could be expected for adaptation. Figure 2 provides an overview of the population density in the region in 2012. The map shows that the main urban areas – Baku, Tbilisi and Yerevan – are densely populated, and therefore the potential risk induced by climate change is greater.

Figure 2: Population density in the South Caucasus in 2012

2.4.1. Socioeconomic migration

The political upheavals of the 1990s and 2000s, and the dissolution of the Soviet Union resulted in economic hardship, inter-ethnic violence and armed conflicts that contributed to mass internal and outbound migration. Today, however, the three South Caucasus countries are relatively homogeneous ethnically: Armenia's population is 98 per cent ethnically Armenian; in Azerbaijan national minorities constitute 9.4 per cent of the population and; apart from the break-away territories, ethnic Georgians account for 83 per cent of the population in Georgia, while two national minorities, the Azerbaijanis and Armenians make up a further 6.5 and 5.7 per cent respectively (National Statistics Office of Georgia).

Migration patterns are mostly linked to economic conditions, with people seeking better opportunities abroad – mainly in the EU, the US and in the Russian Federation (MPC, 2013). Emigration can weaken local resilience towards climate change vulnerabilities, and in particular, make it more challenging for women. Immigration in all three countries has also been increasing recently because of new economic opportunities. For instance, Azerbaijan receives workers from the Middle Eastern countries and from South East Asia (MPC, 2013). Overall, however, the total number of immigrants remains low.

2.4.2. Urbanization

South Caucasus countries show different population growth rates. While Georgia has a negative population growth rate (UN DESA, 2015), Azerbaijan has had an average population growth rate of about 1.11 per cent over the last five years, and the population is expected to reach about 10 million by 2020 (UN DESA, 2015). In comparison, Armenia has a much lower population growth rate, estimated at 0.18 per cent (UN DESA, 2015). Over the last two decades, all three countries have undergone increasing urbanization. Driven by the lack of economic opportunities in the countryside, people have migrated to the capitals in search of jobs and a better life. Unfortunately, given the absence of an official registration system, these patterns are difficult to back up with statistics. The growth in population for each of the South Caucasus capitals is illustrated in Figure 3.

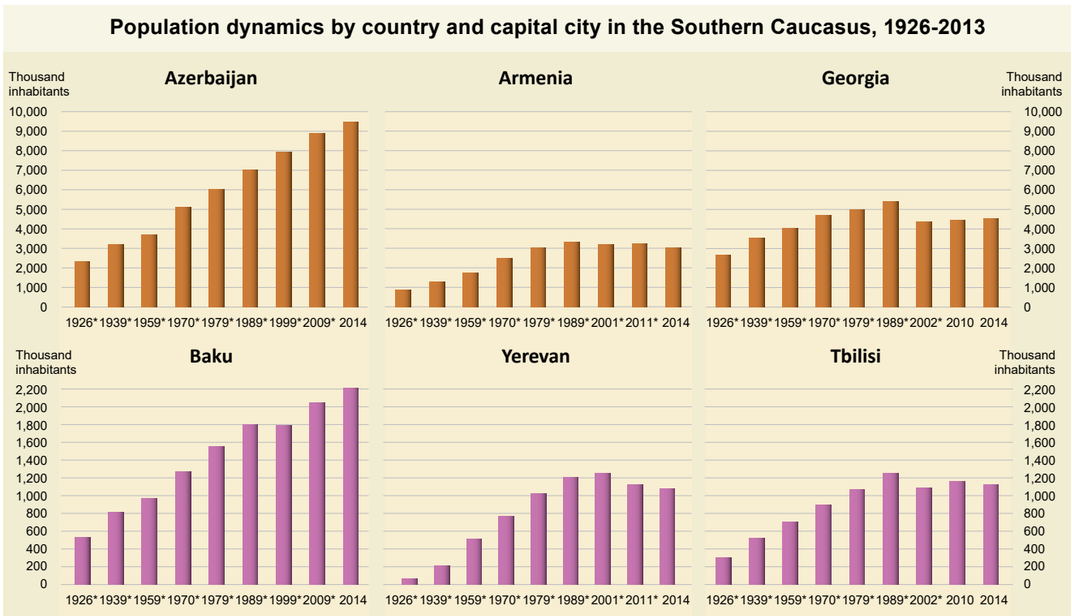


Figure 3: Population dynamics by country and capital city in the South Caucasus, 1926-2014

Armenia is characterized by considerable urbanization, with 63 per cent of the population living in cities (National Statistical Service of the Republic of Armenia). In Azerbaijan and Georgia, the urban population exceeds the number of people residing in the countryside: 53 per cent and 57 per cent respectively live in cities (State Statistical Committee of the Republic of Azerbaijan, National Statistics Office of Georgia). The population density is high in the three capitals. Baku, in particular, is growing fast and the city boundaries are expanding at a higher rate than the other two capitals. Densely populated areas are particularly vulnerable to adverse environmental effects such as climate change. In Baku, rising sea levels pose a high-risk threat (Helms et al., 2005). The high population density of Baku and the Absheron Peninsula may exacerbate the risks. With the assistance of the World Bank, Baku is working on a detailed land management plan (WB, 2015c), which will address a variety of urban expansion needs.

A similar situation exists in Tbilisi, with the rapidly developing capital being affected by major environmental issues. In 2004, ENVSEC highlighted Tbilisi as an environmental and security priority area due to its uncontrolled urbanization (ENVSEC, 2004). In 2009, the General Long-Term Plan of Development of the Capital City was approved. This plan expanded residential areas and the development of residential infrastructure at the expense of adjacent forest and agricultural areas (ENVSEC, 2011). The 2009 General Plan is currently being revised and the new plan for the city's development is expected to consider all possible climate change implications and scenarios to avoid serious disasters such as the Vere River floods in 2015.

In the South Caucasus, access to public services, such as solid waste management, the provision of potable water, a functioning sewage system and a reliable electricity supply also need to be taken into consideration in identifying vulnerable groups. Stark differences exist between the capital and urban centres and rural areas where access to utilities is limited, only available at certain times or disrupted due to unpaid bills (Pearce, 2011). Due to limited financial resources, household purchasing power is restricted, and necessary services such as access to electricity are not always accessible.

2.4.3. Environmental migration

Climate change is likely to affect different populations and areas in specific ways. The effects will vary by location, and according to the specific sensitivities of the affected communities. Similarly, the ability of communities to respond to climate change and to cope with the consequences will vary by each community's specific political, economic, environmental and social circumstances, and where the ability of communities to respond is low, environmental migration may result. The migration policies in the future may significantly influence security, but the range of possibilities is wide: restricted migration would likely increase domestic economic and environmental pressures and instability, and more open migration would likely have the opposite effects.

Migration due to environmental factors has been observed within the South Caucasus countries. As this migration does not have any special legal status in the South Caucasus, it is difficult to determine the numbers involved. Migration and climate are related in two major ways: environmental degradation induced by climate change or extreme natural hazards can force people to move; migration as a result of other factors can put added pressure on natural resources in destination areas. Since the 1980s, for instance, about 1 600 families have left the Upper Svaneti in Georgia due to extreme weather events (UNDP, 2015). Changes in migration are discussed in 5.1.9.

2.4.4. Education

All three South Caucasus countries inherited well established educational systems that produced almost 100 per cent literacy across the region. The comprehensive teaching and learning opportunities throughout secondary and higher education together with exposure to opportunities outside the countries results in the development of vibrant and dynamic societies. Challenges remain, however, and all three South Caucasus countries are continuously working on education reforms to improve managerial and financial conditions and to enhance the quality of education.

2.4.5. Poverty and welfare

A multidimensional definition of poverty in the South Caucasus context can include factors such as incomes, access to utilities and consumption of durable goods (Pearce, 2011). Poverty levels remain high, particularly in rural areas. In Armenia and Georgia, the proportion of the population living below the poverty line is high: 32.0 and 14.8 per cent respectively. Official unemployment rates are also high, especially in these two countries. Income for households derive from salaries, pensions and remittances from abroad, which are reported as a strong driver of macroeconomic growth in Georgia and Armenia (Dermendzhieva, 2011). People rely on natural resources and subsistence farming to make their living. In Georgia, in particular, agriculture accounts for a significant proportion of household incomes in rural areas. Because salaries are low, people tend to have multiple jobs and responsibilities, or work longer hours for little compensation, which leads to high levels of overall dissatisfaction among the employed population. Table 1 provides a demographic overview of the region.

Table 1: Demographic overview of the three South Caucasus countries

	Georgia	Azerbaijan	Armenia
Human Development Index ranking (1)	79 (2013)	76 (2013)	87 (2013)
Population (thousands)	3 714 (2015) (2)	9 477 (3)	3 004 (2015) (4)
Labour force (thousands)	1 991 (2014) (2)	6 284 (2014) (3)	2 106 (2015) (4)
Population growth rate (%) (5)	-0.39 (2010-2015)	1.11 (2010-2015)	0.18 (2010-2015)
Urban pop (%); Urbanization rate (%)	57% (2); -0.37	53% (3); 1.64	63% (6); 0.34
Unemployment (%)	12.4 (2014) (2)	N/A	18.5 (2012) (4)
Population below poverty line (%)	14.8 (2012) (6)	6 (2012) (6)	32.0 (2013) (6)
Life expectancy at birth (years)	72.9 (2014) (2)	74.2 (2014) (3)	75.0 (2014) (4)

Source: (1) UNDP (**http://hdr.undp.org/en/data**), (2) Georgian National Statistics Office, (3) The State Statistical Committee of the Republic of Azerbaijan, (4) National Statistical Service of the Republic of Armenia, (5) United Nations, Department of Economic and Social Affairs, (6) World Bank, available at **http://data.worldbank.org/country/**

2.5. The economic situation

The countries' economic conditions are among the most important determinants of their financial capacities to address climate challenges, to adapt their affected sectors to new circumstances, and to maintain a path to a green economy via economic modernization, and thus to reduce their contributions to global climate disruption.

The implementation of climate change adaptation measures requires a great deal of financial support. To date, the South Caucasus countries have relied heavily on donors for their climate adaptation initiatives as most of their resources are directed at primary national needs such as social security, health and education (Shatberashvili et al., 2015). Resources for emergency situations are often lacking and, as a result, many vital tools such as early warning systems are not functioning adequately. Climate change may significantly hinder development of important sectors of economy in the future.

All three countries of the South Caucasus suffered significant economic hardship after the collapse of the Soviet Union and the break-up of the central planning system. Regional conflicts and the absence of export markets exacerbated the situation. The majority of industry stopped functioning and infrastructure deteriorated. The GDP decreased by roughly 50 per cent during the first five years of independence, poverty levels reached between 60 and 80 per cent, and unemployment increased significantly. Since 1994, all three countries have shown signs of macroeconomic recovery (see Figure 4) and progress in the implementation of structural reforms. Loans from international organizations were used to cover budget deficits and to finance reforms. The South Caucasus states have laid the ground for a free market economy, including lifting restrictions on foreign currency exchange policy and unimpeded repatriation of profits accrued abroad.

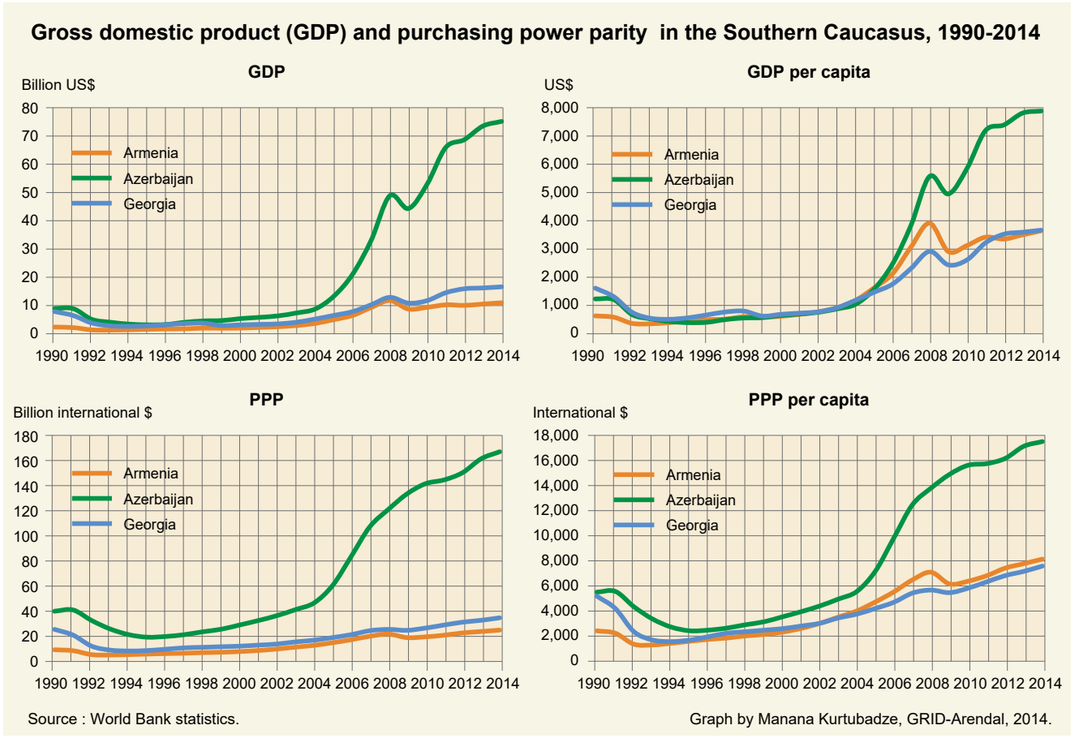


Figure 4: Gross domestic product (GDP) and purchasing power parity in the South Caucasus countries since, 1990-2015

Today, all three countries are linked to global economic markets through their energy, food, mining and oil sectors, and their national economies are all affected by fluctuations in global prices. The main economic sectors of heavy industry and extraction are export-oriented. This is particularly notable in Azerbaijan where the oil and gas sector accounts for 39 per cent of GDP. The 2008 global economic crises severely affected all three countries. The post-crisis recovery has been challenging, particularly for Armenia, where GDP has not yet reached pre-crisis levels. The recent fall in oil prices provides a further challenge to the recovery in countries such as Azerbaijan, which has seen rises in consumer prices as a result. Overall economic development is also affected by decline in non-tradable services such as construction, which in all three countries contribute significantly to the overall economy.

Armenia´s GDP is growing, and is forecast to continue to grow (WB, 2014). However, economic recovery, following the 2008 crises, is still slow, partly as a result of economic uncertainties such as fluctuations in global commodity prices. Recent annual growth rates were lower than predicted: 2.5 per cent in 2015, compared to 7.2 per cent in the previous year (WB, 2013b; WB, 2014; WB, 2016). The World Bank forecasted a growth rate of 2.2 per cent for 2016. The slowdown in growth is due to a combination of internal and external factors. Much needed structural reforms have been affected by recent changes of governments. Levels of foreign direct investment in export industries (mining and agro-industry) have been low. The post-crisis recovery has also been undermined by declining metal and mineral prices, and through reduced demands from Russia, the main trading partner within the Eurasian Economic Union (WB, 2014). The share of the GDP by sector in Armenia is shown in Figure 5. Agriculture plays an important role in terms of employment, food security, and export industries. Therefore, preparing for climate change, which has a direct effect on agriculture, is vital for economic security. Furthermore, development of the mining industry, potentially one of the main drivers of trade, requires careful attention and planning for the sector.

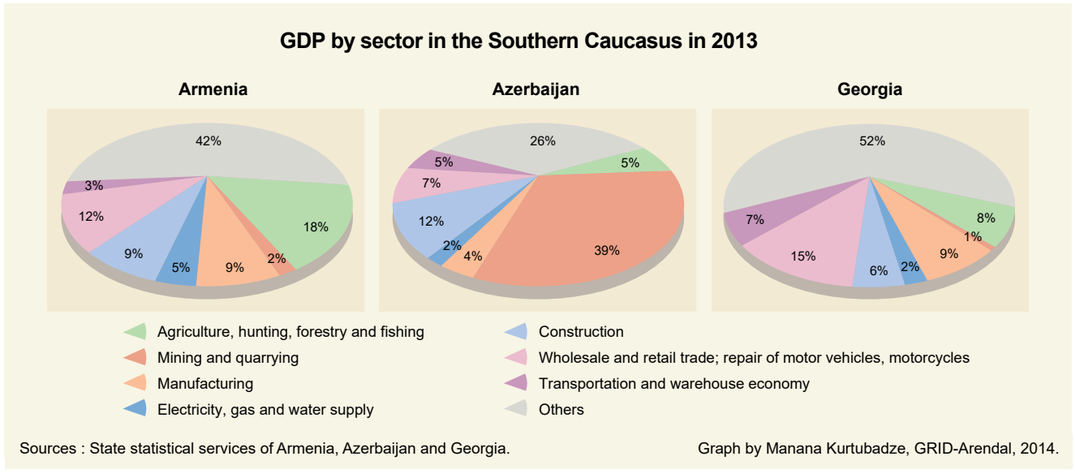


Figure 5: GDP by sector in the South Caucasus in 2013

The recovery of Azerbaijan´s economy started in 1994 after a number of production sharing agreements were signed with leading Western oil companies for the exploration of oil and gas. Industrial output increased, and the gradual privatization of state property continued. Azerbaijan's double-digit economic growth between 2006 and 2008 was largely due to oil exports through the Baku-Tbilisi-Ceyhan Pipeline. Azerbaijan's dependency on oil production meant that as a result of the global financial crisis and the subsequent drop in oil prices, economic growth slowed to almost zero in 2011 (WB, 2013c). Over the past few years, the Government has worked to integrate the country into the global economic market, to attract increased foreign investment, and to diversify its economy (ECS, 2013). As of today, Azerbaijan´s GDP is growing and forecast to grow further, although at a slower rate than before the economic crises (WB, 2015b). In 2015, the annual GDP growth reached 2 per cent and was forecasted to decline to 0.8 per cent in 2016 (WB, 2016). Low oil prices – around US $30 a barrel – will be a new challenge for the national economy.

Azerbaijan has also achieved measurable results in diversifying its economy outside of the energy sector: the non-oil related sectors of the economy grew by almost 10 per cent in 2011, (ECS, 2013). The share of GDP by sector in Azerbaijan is shown in Figure 4. Currently, the economy is driven by oil and gas production, chemical and petrochemical industries, metallurgy, mechanical engineering, textiles and the food industry. Agriculture is a key sector of the non-oil economy (WB, 2013c), therefore, the effects of climate change require particular attention by the government.

Similar to other countries in the region, the Georgian economy collapsed as a result of civil war and the loss of access to

common markets in the Soviet Union. In the 1990s, industrial output fell by 70 per cent and exports by 90 per cent. The economy and financial system were further weakened by the Russia-Georgia conflict in 2008. More recently, Georgia has achieved robust economic growth: averaging 6.1 per cent in 2012 (WB, 2013a). This was largely as a result of structural reforms that stimulated the inflow of capital and investment. Georgia also suffered from the global economic crises and still faces difficulties in its recovery. In 2015, economic growth was down to 2.5 per cent – from 4.6 per cent in 2014 (WB, 2016). The World Bank forecasted a 3 per cent growth rate in 2016 (WB, 2016). Much progress has been made in improving the business environment in Georgia. It now has the region's highest rating for ease of doing business, according to the World Bank (2015). The reforms have also helped to strengthen public finances, upgrade infrastructure and liberalize trade, although further efforts are still required to bolster the economy. Challenges to economic growth are partially linked to internal and external factors such as prices on commodities and devaluation of national currency.

The share of the GDP by sectors in Georgia is shown in Figure 5. In Georgia, economic growth is sustained by industry: mineral production, food processing and alcohol/beverage production; and construction that benefited from high levels of public investments. In addition, economic growth is supported by a growing financial intermediation (WB, 2013a). Georgia has also managed to achieve success in promoting tourism. Revenues from the tourism sector rose by 56 per cent in 2012 (WB, 2013a). The agricultural sector's share of GDP has declined significantly from 12.8 per cent in 2006 to 8.4 per cent in 2012 (WB, 2013a). Although it produces a relatively small share of total GDP, the agriculture sector remains an important sector in Georgia, given that agricultural production accounts for 45 per cent of rural household income and subsistence agriculture accounts for 73 per cent of rural employment (WB, 2013a). Georgia has undergone extensive reforms to its business environment and has made remarkable improvements in its investment climate. Strategic development plans for the coming years include promotion of the agriculture and energy sectors.

2.6. The availability and condition of natural resources

Natural resources such as land, water and biodiversity are essential for livelihoods. Their equitable and sustainable use is a precondition for the peaceful coexistence of communities and for national security. Scarcity, degradation or over-exploitation of natural resources can, however, lead to tension or impede important economic activities such as agriculture. Climate-induced degradation of natural resources in combination with unsustainable management may increase the overall risks to security and stability.

The South Caucasus, has a diverse landscape. It includes high-elevation, temperate and lower-elevation mountains stretching across all three countries. Subtropical plains and hilly landscapes are found mainly in central and south-east Azerbaijan, the latter containing most of the intensely irrigated areas (Ahouissoussi, 2014). The high-elevation, temperate, semi-arid mountain landscape is found mainly in Armenia, in southern Georgia near the Armenian border, and in some areas of Azerbaijan: in the northeastern portion of Nakhchivan, the northern areas near the Russian border on the northern slopes of the Greater Caucasus, and in the southeast near the Iranian border (Ahouissoussi, 2014). The landscape and climate provide suitable conditions for agriculture. Husbandry dominates in high altitude regions, particularly along the southern face of the Greater Caucasus, which runs through northern Georgia and Azerbaijan. Forest resources provide a range of ecosystem services such as carbon storage, habitat and water purification, and protection from soil erosion. In particular Georgia is endowed with forest ecosystems, which cover about 43 per cent of its territory while forest ecosystems account for about 11 per cent of Armenia and Azerbaijan. However, these precious resources are under constant pressure from high rates of deforestation. Wood is an important resource for domestic energy, cooking and the timber trade. Forests fires, often linked to droughts, are a constant threat.

All three countries rely heavily on land resources for agriculture, which provides food security and contributes to macroeconomic growth.[9] However, much of the agricultural land is being affected either through degradation, desertification and/or unsustainable land management practices.

Much of Armenia´s land is prone to desertification[10] as a result of human activities such as unsustainable farming practices, overgrazing, deforestation and climate change. Land degradation and desertification rates will likely accelerate with rising temperatures and decreasing precipitation. Climate change is expected to decrease soil moisture by 10-30 per cent by 2030 (MoNP, 2015). In addition, Armenia´s agrarian reforms – which involve dividing up large farms into smaller ones – have led to land abandonment and the degradation of potential agricultural resources.

Similarly, in neighbouring Azerbaijan, land degradation is linked to poor land use and agronomic practices (particularly soil tillage), overgrazing and deforestation (Ahouissoussi, 2014c). Land degradation is also caused by erosion and salinization, which destroys fertile productive agricultural land, particularly in the Kura-Ara(k)s lowlands.

Georgia's land resources are subject to impacts of multiple factors including climate change. Loss of productive land is one of the most acute problems facing the Adjara region of Georgia (MoEP, 2015). Due to increasing levels of wind erosion and water shortages, productive agricultural land is losing soil moisture and humus. Furthermore, research has revealed that the average humus content in the soil in Shiraki, in the Dedoplistskaro district of Eastern Georgia, decreased from 7.5 per cent in 1983 to 3.2 per cent in 2006 (MoEPNR, 2009).

All three South Caucasus countries are linked by transboundary water resources forming significant interdependencies between states. (See Figure 6.) The transboundary Kura-Ara(k)s river basin is shared by three countries. This interdependency, together with effective water management, dictates each country´s access to secure supplies of water for their domestic demand (household use), and for the energy and agricultural sectors.

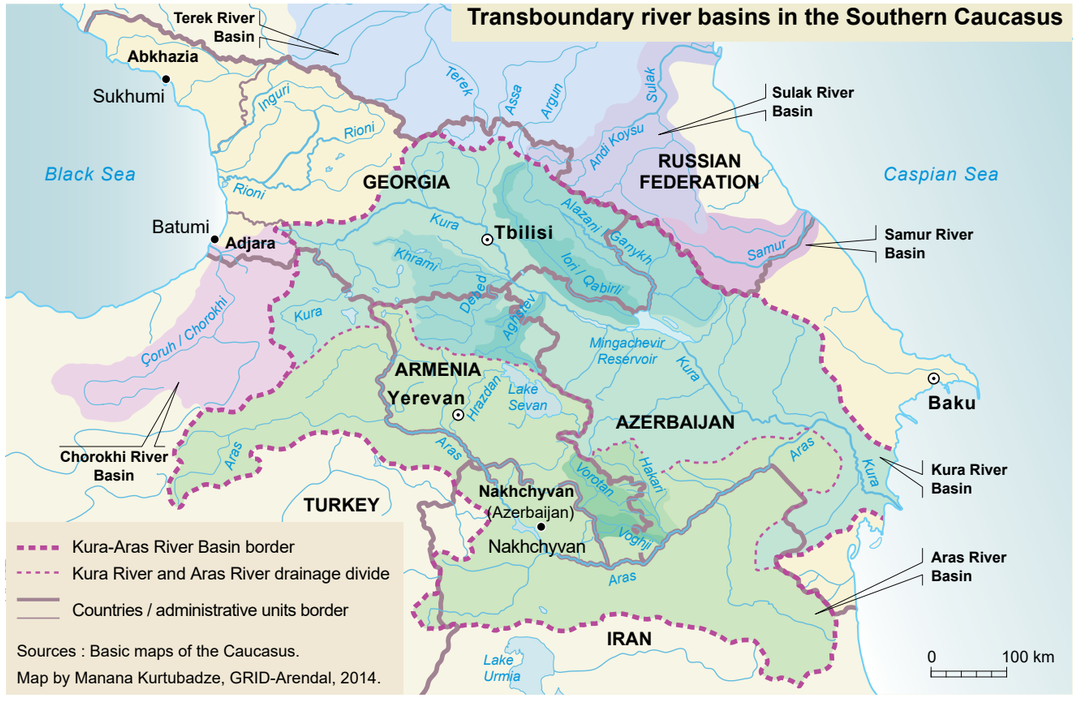


Figure 6: Transboundary river basins in the South Caucasus

Upstream pollution, overuse and conflicting uses of transboundary water – all critical issues for the region – are likely to be exacerbated by climate change. The majority of rivers originate in Georgia, Turkey and Iran, flowing downstream to Azerbaijan, leaving the country with little influence over water issues such as pollution. Further exacerbation of challenges due to climate change could also result in the reduction of water flow, which in turn may lead to increased concentrations of pollutants.

Access to adequate water supplies, both in terms of quantity and quality, is a prerequisite for water security and remains a significant challenge for the South Caucasus countries. Access to safe domestic potable water and safe sanitation systems is critical. Only half of the Azerbaijani population is connected to a potable water supply network. In neighbouring Armenia and Georgia, these figures are higher with 87 and 73 per cent respectively (ten Brink et al., 2011). There is still a considerable difference between urban and rural areas as, for instance, only 20 per cent of the rural population of Azerbaijan is connected to a centralized potable water system (ten Brink et al., 2011). The South Caucasus countries also struggle with providing access to sanitation services, which are crucial for maintaining a safe

9 Armenia: Agricultural lands account for 69 percent; forestlands for 11.2 percent; and land of special protection areas, 11.1 percent of total land area in 2012 (National Statistical Service of the Republic of Armenia). Azerbaijan: Agricultural lands account for 49.3 percent and forestlands for 11 percent (MoENR, 2010). Georgia: Agricultural land covers 39.6 percent and forests covers 43 percent of the total territory (National Statistics Office of Georgia).
10 According to the National Action Plan to Combat Desertification (2002) 81.9% of the current territory of Armenia is prone to various degrees of desertification.

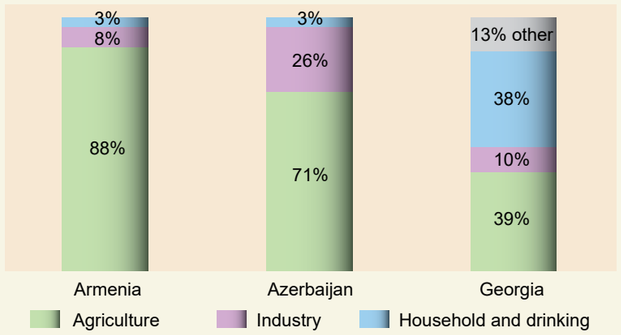
environment and human health. This problem is most critical in rural areas where only between 2 and 17 per cent of the population across the region are connected to centralized sanitation systems (ten Brink et al., 2011).

Supply and demand for water resources vary across the region. For now, water is generally in sufficient supply in upstream countries, but water stress is an issue downstream in Azerbaijan. Georgia has abundant water resources from around 26 000 rivers, totalling 60 000 km in length. Armenia and Azerbaijan, which are both arid countries, struggle with water shortages and unmet water demands for their economic activities. The hydrological network in Armenia is considerably smaller than in neighbouring Georgia, consisting of 9 500 small and medium-sized rivers, totalling 25 000 km in length (MoNP, 2010). In Azerbaijan, the hydrological network is even smaller: around 8 350 large and small rivers, 7 860 km in length (MoENR, 2015).

Fresh water resources are also concentrated in “extraordinarily complex” groundwater pools (Leummens and Mathews, 2013) that are recharged by precipitation, infiltration and condensation. Some of these groundwater aquifers are transboundary. Observations between 1981 and 2005 showed that the groundwater level in the Ararat Artesian Basin had fallen by up to 6.8 metres. This was caused by the overuse of groundwater (USAID, 2014).

Water management over the last 60 years has played a central role in the availability of water resources, but increased water extraction over several decades has caused a reduction in available water. A significant part of these extractions is used for agricultural irrigation systems, fisheries and forestry, particularly in Armenia and Azerbaijan (Figure 7). Azerbaijan´s water use is the highest in the region and is roughly six times higher than current use in neighbouring Georgia, where over 90 per cent of the irrigation network is not currently operational (Figure 8). Over the last five decades the irrigated land in Azerbaijan has increased from 880 000 hectares in 1955 to 1.439 million hectares in 2014 (Leummens and Mathews, 2013; State Statistical Committee of the Republic of Azerbaijan). The largest expansion in irrigated land occurred during the Soviet era; since the beginning of the century the annual increase has been about 0.2 per cent (State Statistical Committee of the Republic of Azerbaijan). In addition, water use for agricultural purposes has increased since 2000 in Azerbaijan, suggesting an increase in water-intensive crops (State Statistical Committee of the Republic of Azerbaijan). Such developments, together with population growth and increasingly arid climate conditions, will likely aggravate Azerbaijan´s water stress, where the water deficit is already reported to be on the order of 4-5 km^3 annually (Leummens and Mathews, 2013). Armenia´s demand for water is also mainly for agricultural use, albeit on a smaller scale. A significant portion of water losses in all three countries is due to old irrigation systems and out-of-date technologies. Efficiency in water management would reduce existing stress in water availability in all three countries.

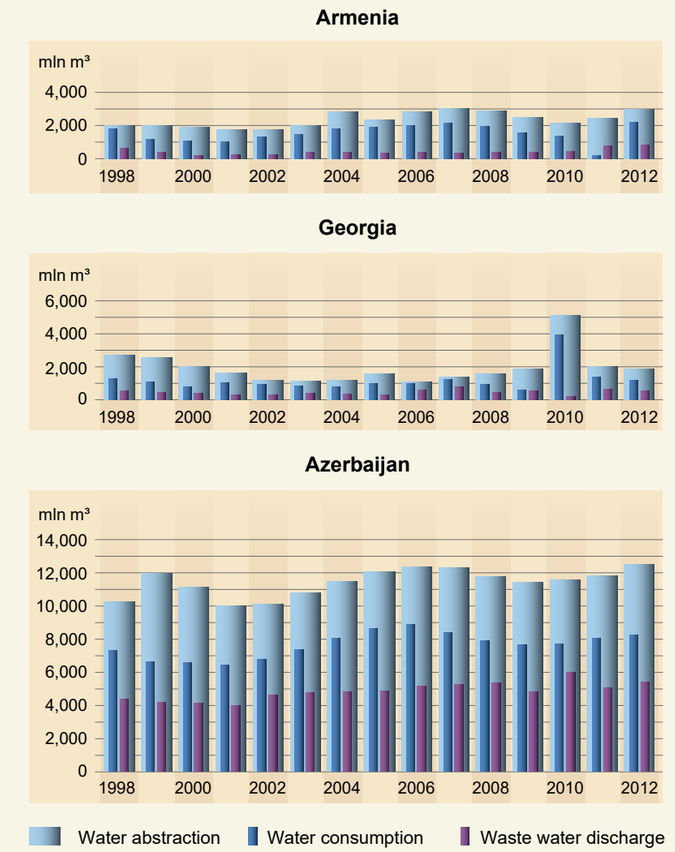
Water use by sector in the Southern Caucasus, 2012



Sources : National statistical services. Graph by Manana Kurtubadze, GRID-Arendal, 2015.

Figure 7: Water use by sectors in the South Caucasus in 2012

Water balance in the Southern Caucasus, 1998-2012



Sources : State statistical services of Armenia, Azerbaijan and Georgia.
Graph by Manana Kurtubadze, GRID-Arendal, 2014.

Figure 8: Water balance in the South Caucasus countries, 1998-2012

Significant water reservoir projects have been implemented in the Kura River basin in the twentieth century resulting in the construction of numerous large and small water reservoirs. Mingechevir and Shamkir reservoirs in Azerbaijan are by far the biggest artificial reservoirs in the region.

In Armenia, Lake Sevan, the largest lake in the Kura-Ara(k)s basin, is the most important water reserve for irrigation and hydropower generation. An increase in economic activity, mostly in the 1950s, led to a drop in water levels of 19 metres, as well as a loss of almost 40 per cent of the stored water. Even though the water level had increased by 3.5 metres by 2012, Armenia has not managed to restore the lake to its former capacity (Leummens and Mathews, 2013).

In South Caucasus, it is evident that the variation and reduction of hydrological flow is linked to climate-induced changes such as reductions in precipitation and increases in temperature (Leummens and Mathews, 2013). However, it is not clear to what extent these two phenomena have resulted in the depletion of water resources and to what extent the present water management practices are contributing to the overall depletion (UNDP, 2011).

It has been estimated that about 20 per cent of the water input in the Kura River is rain and 36 per cent is snow (Leummens and Mathews, 2013; Mammadov et al., 2009). In Armenia, snow is responsible for 20 to 40 per cent of river flow, making it highly vulnerable to predicted changes

in precipitation (MoNP, 2009). Low precipitation in combination with higher temperatures will most likely increase evapotranspiration in the future, particularly from natural and artificial reservoirs.

2.7. Agriculture and food security

Agriculture plays an important role in the national economies and is essential to subsistence farmers. At the national level, the agricultural sector, including forestry and fisheries, contributed 18.4 per cent of GDP in Armenia, 5.3 per cent in Azerbaijan and 9.4 per cent in Georgia in 2013 (National statistical services).

There is a great variety of agricultural products in all three countries. The main commodities are cereals, tree crops, vegetables and livestock. Wheat and corn are important for national food security in all three countries and are the most widespread cereals in terms of hectares planted.[11] Georgia is well known for its viniculture. Cotton was an important crop historically in Azerbaijan, but its importance has diminished in recent years.

Export commodities include beverages and fresh and canned fruits from Armenia; fresh fruits and sugar from Azerbaijan; and nuts from Georgia. However, the total value of food imports is higher than food exports. All three countries are dependent on imported cereals and other food products. According to the Food and Agriculture Organization of the United Nations, the cereal import dependency ratio has been increasing over the last decade, reaching 55.7 per cent, 37.7 per cent and 68.6 per cent for Armenia, Azerbaijan and Georgia, respectively in 2009-2011.

Over the last two decades the agricultural sectors in all three countries have been undergoing major reforms and institutional restructuring. However, poor agricultural infrastructure, inefficient marketing systems, outmigration, the ageing of the rural population and other important elements are major obstacles for development of the agriculture sector. In agriculture vulnerability reports undertaken by the World Bank, these factors have been evaluated as suboptimal in Armenia and Azerbaijan and poor in Georgia. Despite the fact that an increase in agricultural productivity is critical to reducing food insecurity and poverty in all three countries, a continuing decline in agriculture productivity is evident in Georgia. This can be partly explained by a reduction in the total sown area in Georgia, from 610 800 ha in 2000 to 290 800 ha in 2015 (National Statistics Office of Georgia) – leaving Georgia increasingly dependent on imported commodities and consequently decreasing the level of food security. In Armenia, there has also been a big reduction in the total sown area until 2010, however, after that the sown areas increased to 332 800 ha in 2014.[12] Unlike in neighbouring countries, the total sown area in Azerbaijan has increased considerably (from 1 041 542 ha to 1 684 248 ha between 2000 and 2013) leading to higher productivity of commodities such as cereals (The State Statistical Committee of the Republic of Azerbaijan).

Agriculture is among the economic activities most dependent on climatic conditions, and thus vulnerable to climate change. The impacts of climate change, such as desertification, soil erosion, pest outbreaks, changes in precipitation and climate-induced natural disasters will further decrease agricultural productivity and reduce food security. Currently, food security strategies in the South Caucasus countries do not adequately account for climate change impacts.

The Dietary Energy Supply indicator, a measure of food sufficiency, reveals that the calorie intake for inhabitants of the South Caucasus is on average above the required daily minimum: between 1 800 and 2 200 kcal/capita/day.[13] However, child malnutrition is evident in relatively high rates of stunting for children less than 5 years old (FAO, 2015). This can be explained by high poverty rates across the region. In Georgia and Azerbaijan, where almost half of the population lives in rural areas, agriculture is particularly important for livelihoods. Small-holder farmers usually have less capacity to respond to climate-induced risks due to poverty and, in some cases, a lack of knowledge. Therefore, it is likely that the rural poor will be more affected by erratic climate events.

Finally, political stability and the absence of violence, being among the governance indicators introduced by the World Bank, is an important measurement linked to overall national food security.[14] The scores of this particular indicator have improved over the years but remains low: 0.07 for Armenia; minus 0.41 for Azerbaijan; and minus 0.46 for Georgia[15] suggesting the importance of political factors for food stability.

11 Armenia: wheat and corn comprise 8 per cent of agricultural land. Azerbaijan: arable land is about 36 percent of the total agricultural land. Georgia: wheat and corn comprise 33 per cent of agricultural land (FAO data).
12 "The area of overall sown lands in Armenia in the year 2000 made up to 371 000 hectares till the year 2010, when there was a decrease to 283 600 hectares, however, later there was an increase again and in 2014 it made up to 332 800 hectares. The number includes the sown areas under grain and leguminous plants. National Statistical Service of the Republic of Armenia."
13 DES in Armenia is 2 814 (kcal/caput/day); in Azerbaijan is 2 988 (kcal/caput/day) and in Georgia is 2 799 (kcal/caput/day) for the period from 2011- 2013 (FAO database).
14 www.govindicators.org.
15 Compared to 1.33 for Norway and minus 2.23 for the Democratic Republic of Congo. Source World Bank.

The development of agriculture is receiving more attention than ever from policymakers across the region. A renewed focus on agriculture is one of the outcomes of the global financial crisis, with rising food prices and difficulties in securing grain imports in years of low production due to export bans in traditional grain supplier countries. A number of policies, strategies and subsidy programmes are therefore being introduced to strengthen food security, and increase food production and self-sufficiency.[16] For example, Armenia has set a goal to increase self-sufficiency for main commodities by between 10 to 15 per cent, during the period 2011-2020.

The international community actively supports the agricultural and rural development sectors in the South Caucasus region. In early 2015, the EU delegation to Armenia and the ADA launched the European Neighbourhood Programme for Agriculture and Rural Development (ENPARD), providing €25 million in support to the Government of Armenia to enhance agricultural and rural development. The ENPARD programme was also launched in Georgia in 2013, with a total budget of €40 million. Azerbaijan is interested in participating in the programme, but an agreement has not yet been reached.

Following the collapse of the Soviet Union, the South Caucasus countries took different approaches to land reform, and had different outcomes. Under the Soviet regime, both agricultural and non-agricultural lands were state-owned and agricultural production took place in large-scale industrial complexes. After the collapse of the Soviet Union the South Caucasus countries swiftly privatized both agricultural and non-agricultural land (including forests).

In Armenia, the 1990 agrarian reform and land privatization programme resulted in the break-up of large agricultural farms into 338 000 smaller farms (WB, 2012). Agricultural production fell dramatically and there was a decline in the number of livestock Armenian farmers also witnessed a 50 per cent reduction in the area of irrigated land and the use of fertilizers fell by two-thirds (WB, 2012).

Since the 1990s, three categories of farms have emerged in Azerbaijan: agricultural enterprises (legal entities), peasant farms (individual enterprises), and household/private farms (small plots or gardens) (WB, 2012). These land reforms stimulated growth from 1998 and even small farmers made a significant contribution to the economic recovery of the agricultural sector (World Bank, 2012d). In Georgia, 80 to 90 per cent of farmers own less than one hectare of land (World Bank, 2012b). In 1998, the reform process moved into its final phase and a decision was made by the state to use state own agriculture land through leasing option, with the leasing period up to 49 years. In 2005, after the adoption of a new privatization law, leasing agricultural land was prohibited. However, the law excluded some land categories from privatization such as pastures, agricultural forest land, and arable land, which could still be leased. These land categories still lack sufficient realistic management mechanisms (Gvaramia, 2013).

Across the region, government and institutional capacity to provide support for sustainable land management is generally lacking. Farmers often do not have reliable access to water for irrigation, and common grazing lands and pastures are in some cases overused and depleted of nutrients. Consequently, the issue of sustainable land management relates not only to ownership, but to proper land stewardship and capacity. Poor stewardship and the lack of capacity increase the vulnerability to climate change. Multiple stressors affect the land and reduce food and water security. Climate change is an additional stressor which in some locations could improve conditions – through an increase in precipitation, for example – but in other places more precipitation could be an additional stressor by exacerbating extremes such as floods and droughts.

The financial institutions in these countries are still developing and are not yet capable of ensuring agricultural production and food security in the face of climate change. There are some cases in Armenia, for instance, where there are minor subsidies for irrigation in place (WB, 2012; EDRC, 2007); Azerbaijan has also provided resources to the agricultural sector, primarily through subsidies on fertilizers, seed production, machinery, direct transfers based on area planted, and tax breaks for agriculture (FAO, 2013). The Government of Georgia recently put a farmer support programme in place (EU NP, 2012).

2.8. Energy production and security

The South Caucasus region plays an important role in Eurasian energy discussions, both in terms of regional energy policy and regional energy security. The South Caucasus is a strategic partner for the EU and Russia. The geographic location and potential fossil fuel and gas resources, particularly in the Caspian Sea and Central Asia, make the region attractive to international investors and governments, particularly in the context of global political crises such as the enduring crisis in Ukraine.

16 Armenia: (i) Sustainable Development Program for 2009-2021 (the Second Poverty Reduction Strategy); (ii) Strategy for Agriculture Development (2010-2020); (iii) Cattle Breeding Program, 2007-2015; (iv) Food Security Concept (2011) and Food Safety Strategy, 2010-2015, (v) Land Consolidation Concept (2011) Azerbaijan: An initial draft strategy on the development of the food and agricultural industry was prepared and submitted to state bodies and international organizations (FAO, World Bank, EU) (EC, 2015b) Georgia: (i) Food Safety Strategy (2011), Strategy for Agricultural Development in Georgia 2015-2020.

The Government of Azerbaijan made significant efforts to integrate the state into the global energy market. The country is now largely reliant on the exploitation of oil and gas reserves and is supplying the European market through the Baku-Tbilisi-Ceyhan crude oil pipeline and the Baku-Tbilisi-Erzurum gas pipeline. In 2010, Azerbaijan began exporting gas to Russia and in September 2014, the Southern Gas Corridor, running through Azerbaijan and Georgia, was officially launched. It supplies an estimated 10 billion cubic metres of gas a year to European consumers (EC, 2015b).

Unlike Azerbaijan, Armenia and Georgia have not yet discovered important oil and gas reserves, and are largely dependent on imports. Because of its central location, Georgia serves as an expanding transition corridor for oil and gas through pipelines and railway networks. To secure its position as an energy intermediary, Georgia has become a full member of the Energy Community, and now the country is on its way to implement EU rules on energy security.[17] However, to meet its own domestic demand, Georgia imported about 65 per cent of its total energy consumption in 2012. The share of gas in total primary energy supply is particularly high, and a remarkable increase was reported in 2011-2012 when gas imports almost doubled in comparison with the previous year (USAID, 2014b). Hydropower is an important energy source in Georgia, which could further strengthen national energy security.

Armenia, because it is landlocked and closed borders with two of its neighbouring countries – Azerbaijan and Turkey – receives most of its natural gas resources from Russia through the North-South Gas Pipeline and through the Southern pipeline from Iraq. Currently, Armenia is the only country in the region to produce nuclear energy, at the Metsamor Nuclear Power Plant about 30 km from the capital. According to 2014 data, it provides about 31 per cent of the country's energy supply. The power plant was scheduled to close in 2016, but in June 2014, the Public Services Regulatory Commission of Armenia extended the plant's licence to mid-2019. There are currently works being carried out in Armenia aimed at extending the service period.

Energy security is high on national political agendas in all three countries. While Azerbaijan is focusing more on securing new energy infrastructure[18] and diversifying sources of energy supply, Armenia and Georgia are aiming to develop competitive and secure energy sectors and increase domestic production. Figure 9 shows the energy balances of the countries for 1997-2014.

Energy efficiency and renewable energy sources are part of the policies of all three countries. They have all ratified the European Energy Charter Treaty and its Protocol on Energy Efficiency and Related Environmental Aspects that commits them to formulating and implementing policies for improving energy efficiency and reducing the negative environmental impacts of the energy cycle. In addition, in 2013, Georgia and Armenia joined the Eastern Europe Energy Efficiency and Environment Partnership which aims to significantly boost energy efficiency and the reduction of harmful emissions.

In light of international engagements to mitigate climate change and meet overall energy security targets, all three countries consider renewable energy to be an important resource and are working towards developing political structures to respond to those needs. They are making efforts to develop strategic renewable energy action plans, which, at times, take into consideration climate change scenarios.

The Government of Armenia is working towards establishing a legal[19] and financial basis for exploiting the diversity of renewable energy sources that show potential (ECS, 2015). The Energy Charter Secretariat estimated that Armenia can increase its renewable electricity production fivefold by 2020. In the Renewable Energy Roadmap overseen by the Armenia Resources and Energy Efficiency Fund,[20] Armenia has defined concrete short-term, midterm and long-term targets for the development of renewable energy as well as specific steps to achieve these targets. To date, the main political focus has been directed towards exploitation of hydrological resources, even though other renewable sources of energy such as geothermal, solar and wind have a lot of potential and may be even more suitable for climate changes scenarios. In addition to its existing hydropower infrastructure, Armenia is aiming to expand the number of small hydropower plants (HPPs). As of July 2016, there were 47 small HPPs under construction. So far neither ongoing nor future hydropower projects consider climate change implications in the long run.

One of the three priorities set in the energy sector in Azerbaijan is the development of renewable energy (ECS, 2013), which has been laid out in a number of legal documents.[21] The Energy Charter Secretariat also recommended

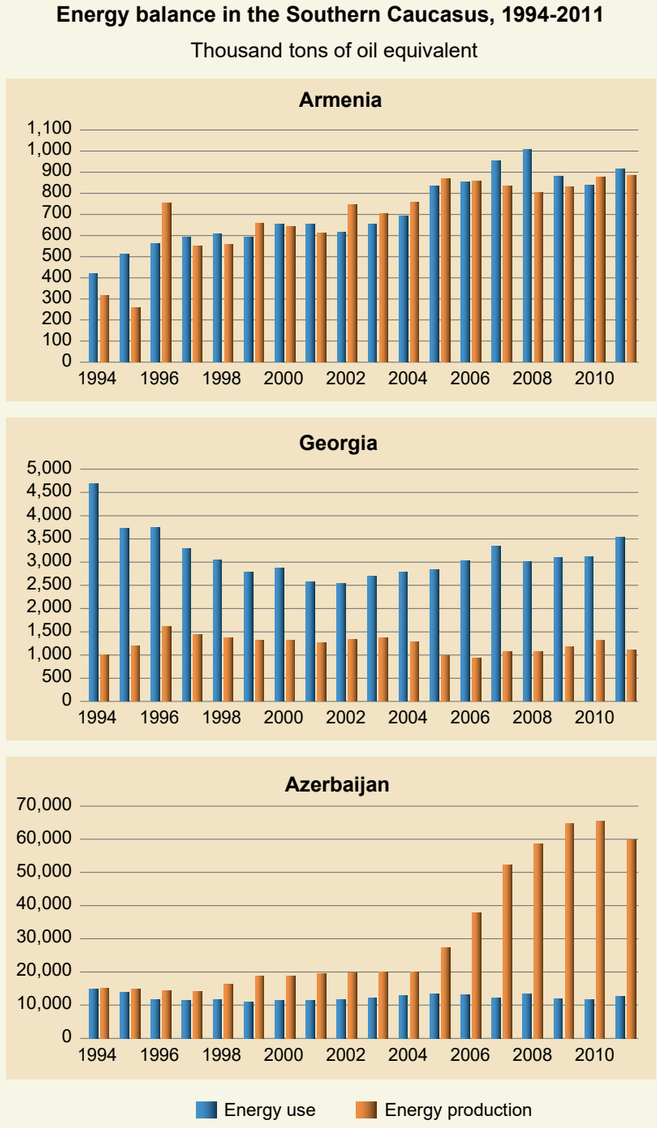


Figure 9: Energy balance in the South Caucasus, 1997-2014

that energy efficiency and renewable energy are given higher priority in the future. In 2009, Azerbaijan established the State Agency on Alternative and Renewable Energy Sources, which is responsible for developing a national strategic plan for alternative and renewable energy sources in collaboration with the Ministry of Industry and Energy.

Azerbaijan has already announced some targets for renewable energy sources – increasing the share of electricity production to 20 per cent, and increasing the share of all energy consumption to 9.7 per cent by 2020 (ECS, 2013). To date, the use of renewable energy sources has been limited to hydropower, but future plans are to exploit the

17 EU Regulation 994/2010 concerning measures to safeguard security of gas supply in the Energy Community framework; Directive 2005/89/ EC concerning measures to safeguard security of electricity supply and infrastructure investment; Directive 2004/67/EC concerning measures to safeguard security of natural gas supply; Directive 2009/119/EC Stocks of crude oil and petroleum products. Source: https://www.energy-community.org/portal/page/portal/ENC_HOME/NEWS/News_Details?p_new_id=13463.
18 Initiated discussions on AGRI (Azerbaijan-Georgia-Romania interconnector) project in 2010. Agreement signed in 2012 on construction of TANAP Trans-Anatolian gas pipeline between Azerbaijan and Turkey.
19 These include measures such as the Energy Security Concept of the Republic of Armenia (2013); specific laws on energy such as the Law on Energy Savings and Renewable Energy (2004) and the Energy Efficiency Law.
20 Armenian Renewable Energy Roadmap, prepared in 2011.
21 The State Programme on the Use of Alternative and Renewable Sources, 2004-2013 approved by the Azeri government (2004); National Strategy on the use of alternative and renewable energy sources in the Republic of Azerbaijan for 2012–2020 (started in 2011).

vast potential in solar, wind and geothermal energy, and several medium-sized solar power projects are under way (Malikov, 2015). Hydropower makes up about 86 per cent of all renewable sources in Azerbaijan (Malikov, 2015), but the share of its total electricity production is relatively small (Table 2). The total hydroelectric potential is limited, but the Government is planning to construct 61 small HPPs, which it considers to be economically viable. Considerations of climate change scenarios in these projects have not been taken into account as there is no specific legal basis regulating renewable energy sources.

Table 2. Electricity balance, 2013 (in GWh)

	Armenia	Azerbaijan	Georgia
Total production	**7710**	**23354**	**10059**
Oil	0	18	0
Gas	3173	21711	1788
Nuclear	2360	0	0
Hydro	2173	1489	8271
Wind	4		
Solar		1	
Waste		**134**	
Final consumption	**5404**	**15982**	**9074**

Source: **http://www.iea.org/statistics/**

Georgia already relies heavily on hydropower for electricity production and plans to satisfy 100 per cent of the country's demand for electricity from hydropower (The Government of Georgia, 2011). The emphasis for the Georgian energy sector is on national energy security and energy independence, and recently the government adopted a new energy strategy for Georgia for the period of 2015 to 2030.

Georgia has vast resources of almost all types of renewable energy – solar, wind, geothermal, hydro and biomass – but the top priority is given to the development of hydropower infrastructure. Currently, hydropower resources constitute about 92 per cent of total electricity production, but the share in the total energy balance remains limited (Gvilava et al, 2014). It is clear that Georgia has the potential to satisfy its national energy demands and, in addition, hydropower can be exported through existing grid networks to Turkey, Armenia, Azerbaijan and Russia to meet the growing regional energy demand (Gvilava et al, 2014; REC, 2014). Over the last few years, the priority was given to small and medium-sized HPPs. By early 2016, Georgia had attracted investors for seven large (with a capacity greater than 100 MW),[22] 13 medium (10-100 MW), and nine small (less than 10 MW) HPPs and 59 HPPs (of different sizes) are undergoing feasibility studies (Ministry of Energy of Georgia website). However, the lack of legislation, strategy and plans are considered important threats to the energy sector (Gvilava et al, 2014). It is hoped to be tackled by the recent political support.

Critical infrastructure such as transmission lines and generation plants in the energy sector are gradually ageing in the South Caucasus and require investment for their upgrade. In this respect, extreme climate events are another risk for ageing energy supply infrastructure.

As in neighbouring countries, climate change implications are not considered in the renewable energy sector in Georgia although there are a dozen HPPs in different stages of development.

22 Two large hydropower plants are under construction (completion planned for 2016 and 2018); 5 large hydro power plants are in the planning stage (completion envisaged between 2020 to 2022).

2.9. Water-agriculture-energy nexus

Water, food and energy are closely interconnected and key elements for addressing national and regional challenges and for achieving sustainable development goals. Water in particular, is critical to the security discussion as the food and energy sectors depend on secure access to water resources. The complex relationships between the elements of the nexus also have to be discussed in the context of climate change, which will have a significant impact on water flow and precipitation in the region. Water availability is forecast to decrease in the principal rivers across the region and competition for water resources will likely be high (UNDP, 2011). Tensions may rise within a country and between upstream and downstream water users if water is not managed in light of climate change scenarios. Therefore, it is critical to coordinate water use between different sectoral needs and national development programmes for agriculture, energy and households. Co-operation on water-related issues, however, is hindered by unresolved political, social and economic issues. There are currently no water treaties among the three countries.

Water-agriculture-energy nexus

- Water for Food: Irrigation, livestock, food processing
- Water for Energy: Heating, cooling thermal power plants, hydropower, irrigation of bioenergy crops, extraction and refining
- Energy for Water: Extraction and transportation, water treatment, desalinization, wastewater, drainage, treatment and disposal
- Energy for Food: Crop and livestock production, processing and transport, food consumption, energy for irrigated crops
- Food for Energy: Competition between bioenergy and food and fibre, production for water and land
- Food for Water: Impact on water supply, impact of run-off

Georgia has abundant water resources, but these are unequally distributed between the west and the east. Armenia has some shortages, and downstream Azerbaijan has limited water resources. The main transboundary basin, the Kura-Ara(k)s River basin, is primarily used for drinking water and agriculture in Georgia and Azerbaijan, and for agriculture, aquaculture and industry in Armenia. Armenia and Azerbaijan are both considered to be water-stressed countries (Leummens and Mathews, 2013). Water availability is particularly worrying in Azerbaijan, where water is in great demand for the high levels of economic activity and water flows are controlled by its upstream neighbours. Today, water shortages are estimated to be between 4-5 km^3 annually in Azerbaijan (Leummens and Mathews, 2013). The water deficit is projected to grow to between 9.5 km^3 and 11.5 km^3 by around 2050 (ADB, 2014a). Any further increase, or mismanagement in water resources in the upper Kura-Ara(k)s River basin, could lead to disputes between the countries (Leummens and Mathews, 2013).

Agriculture is the sector with the highest water consumption in Armenia and Azerbaijan, accounting for 88 per cent and 69 per cent respectively of total water consumption from natural resources in 2012.[23] In Armenia about 7.4 per cent of agricultural land is irrigated (Leummens and Mathews, 2013) and the west and central parts of Armenia, such as Aragatsotn, Armavir, Ararat and Kotaik marzes, are heavily dependent on irrigation. In Azerbaijan, 55 per cent of agricultural land is spread across the central part of the country, close to the Kura-Ara(k)s river; roughly 30 per cent of it is irrigated (Leummens and Mathews, 2013).

In Georgia, water consumption is more equally distributed between industry, municipal use and agriculture. Present agricultural activities account for roughly only one quarter of water consumption. There has been a dramatic deterioration in Georgia´s agricultural sector over the last two decades,[24] resulting in a decrease in irrigation,[25] particularly in the major wheat growing areas in Kakheti and Kvemo Kartli. Due to the priority given to food security at the national level, there are plans to rehabilitate the irrigation systems in these areas to meet the predicted increase in water consumption for agriculture. In addition, the future of Georgian energy security relies heavily on hydropower. Therefore, hydropower development projects, particularly in east Georgia, should be planned using a multi-sectoral approach, taking into account the impacts of climate change.

Co-operation in the management of water resources is of particular importance, both between national sectors and

23 Armenia: total water consumption 2 187 million m3, agricultural water consumption 1 931 million m3 in 2012; National Statistical Service of the Republic of Armenia; Azerbaijan: total water consumption 8 248 million m3; agricultural water consumption 5 731 million m3 in 2012; The State Statistical Committee of the Republic of Azerbaijan. Georgia: total water consumption 1 148 million m3; agricultural water consumption 362.5 million m3; National Statistics Office of Georgia.
24 The total area of irrigated land has decreased from 386 000 ha in 1988 to 24 000 ha in 2011 (Leummens and Matthews, 2013).
25 It was estimated that 8.5 per cent of the total agriculture area is under irrigation in 2011 (Leummens and Mathews, 2013; Ministry of Agriculture).

between governments. There is no legal framework regulating water allocation between the South Caucasus countries, but the water-food-energy nexus is a crucial dynamic in the region and needs to be taken into account for the sustainable management of water resources in the region. With the increase in the likelihood of hazards associated with glacial melting and water scarcity in some parts of the region, particularly in Azerbaijan, even more attention has to be given to the water-food-energy nexus in the South Caucasus. An additional factor to consider in the discussion about water availability and impacts on neighbouring countries is the availability and use of water resources for economic activities. Soviet legacies, ongoing anthropogenic impacts and upstream water pollution, combined with downstream water consumption are additional considerations.

In light of the expected impacts of climate change on water resources and given the importance of irrigation and hydropower development for the region, the countries cannot achieve long-term security working in isolation within separate sectors, particularly in the regional transboundary context.

2.10. Critical infrastructure

According to the IPCC (2014), "Critical national infrastructure is defined as assets (physical or electronic) that are vital to the continued delivery and integrity of essential services on which a country relies, the loss or compromise of which would lead to severe economic or social consequences or to loss of life."

South Caucasus infrastructure that is both critical and sensitive to climate change and extreme weather conditions includes:

- Mining facilities with active or historical tailings
- Hydropower stations and power transmission lines
- Small dams and irrigation systems vulnerable to damage
- Transportation and energy facilities, especially on the Black Sea
- Water management facilities
- Strategic roads and other major traffic routes
- Municipal sewage and water supply systems, and other vital services

Subsequent sections of this report provide the details and rationales on each of these sensitive and critical types of infrastructure and threats associated with climate change impacts and extreme weather conditions.

3. CLIMATE CHANGE IN THE REGION

Climate trends and projections are available at the global, regional, national and sometimes local levels, and usually consider the following:

- Average annual and seasonal temperature
- Number of hot days and nights and frequency of heatwaves
- Average annual and seasonal precipitation
- Number of days above and below precipitation thresholds
- Number (frequency) of extreme weather events

Among the reliable sources of climate information are the following:

- International Panel on Climate Change publications, including special reports and the Fifth Assessment Report, and international online resources with climate data and climate change models
- WMO and regional climate centre publications
- National communications to the United Nations Framework Convention on Climate Change
- Country statements, positions and presentations at international conferences
- National policies, programmes and plans related to environmental issues, natural resources and adaptation to climate change
- Peer-reviewed international research

An understanding of the climate trends and projections for a country and a region provided the basis for the analysis of climate change risks and hazards in this study, but the analyses may be limited by weaknesses in the data and uncertainty in the projections.

3.1. Trends

The overall trend for Western Asia, which according to the IPCC Fifth Assessment Report (IPCC AR-5), includes Armenia, Azerbaijan and Georgia, shows a slight decrease in mean precipitation over the last decades. At the same time, an increase in heavy precipitation has been observed as well as a steady increase in temperature (IPCC, 2014). Heatwaves are increasingly reported in all three countries, especially in urban areas (UNDP, 2011).

Due to its highland and continental climate, Armenia experiences hot summers and moderate winters. The climate is very diverse, with a warm and dry subtropical climate in the lowlands and a cold and wet alpine climate in the Lesser Caucasus mountain range. Armenia experiences uneven precipitation patterns largely due to its geographical location, with most rainfall occurring during spring and early summer. Annual average precipitation ranges from about 200-250 mm in the Ararat Valley and Meghri region to about 800-1 000 mm in the mountain areas, amounting to a national annual average precipitation of 592 mm (MoNP, 2015). Over the past 80 years, a significant increase in precipitation has been observed in the southern and north-western areas. However, over the same period the agricultural land in the Ararat Valley, considered as one of the driest regions in the country, has become even more arid. The annual precipitation has, on a national scale, decreased by close to 10 per cent over the past 80 years (MoNP, 2015). The annual average temperature is about 5.5ºC in Armenia (MoNP, 2015). Summers are temperate with average temperature of 16.7°C. In the Ararat Valley, summer temperatures vary between 24 and 26°C. The highest absolute temperature ever recorded in Armenia is 43.7°C. During the past 80 years, the mean annual temperature has increased by 1.03°C.[26] This increase is mainly evident in summer where the seasonal mean temperature has risen by 1.1°C, whereas the temperature increase during winter is insignificant (0.4°C). As a consequence, increases in the number of summer days (temperatures above 25°C) and tropical nights have been observed across the country with a decrease in the number of frosty days (MoNP, 2015).

The northern and southern regions of Azerbaijan, where the country's mountain ranges are found, are characterized by a temperate climate, with warm summers and moderate winters and a good amount of precipitation. These regions are favourable for agriculture. The central region has a steppe climate with hot summers and lower precipitation. Annual mean precipitation ranges from more than 1 000 mm in the mountainous regions in the north and south, and the humid coastal area in the far southeast, to less than 300 mm in the central region. The annual rainfall level has decreased considerably over the last decade along with the number of reported days with precipitation. Throughout the country, the decline in precipitation varies: a 14.3 per cent decline in the Kura-Ara(k)s lowland, which is an important agricultural area; a 17.7 per cent decline in the central part of the South Caucasus, Ganja-Gazakh; and a 17.1 per cent decline in Nakhchivan (MoENR, 2010). On average, precipitation levels have declined by 9.9 per cent over the past decade.[27] From 1991 to 2001, the mean temperature increased by 0.41°C; the annual mean temperature in Azerbaijan currently stands at about 11.5°C [28] (MoENR, 2010; UNDP, 2013). The average annual temperature increase from 1991 to 2001 is more than three times as high as the annual increase observed between 1961 and 1990 (0.36°C) (MoENR, 2010).

The climate of Georgia is diverse but consists mainly of humid and temperate subtropical conditions (MoENRP, 2015). The mean annual precipitation in Georgia is 1100 mm, while the mean annual temperature is 7.5°C (UNDP, 2011). The Black Sea coastal zone has a humid subtropical climate. The average annual temperature there is between 14°C and 15°C, with extremes ranging from -16°C to 45°C. Annual precipitation varies between 1 400 mm and 2 700 mm. The climate on the plains of Eastern Georgia is drier, with a subtropical climate in the lowlands and an alpine climate in the mountainous areas. The average annual temperature is between 10°C and 13°C on the plains, and between 3°C and 10°C in the mountains, with an annual precipitation of 400-1 000 mm and 500-1 300 mm respectively (MoENRP, 2015). Observed changes in temperature and precipitation in Georgia during the periods of 1961-1985 and 1986-2010 vary between western and eastern Georgia, but mean annual temperature have increased in both regions. The national annual average temperature has increased by 0.3°C in west Georgia and by 0.4-0.5°C in east Georgia. In general, precipitation in most regions of western Georgia increased, but in eastern Georgia decreased by 6-8 per cent (MoENRP, 2015). As a result of the rising mean temperature, the number of frosty days has decreased while the number of very hot days has increased in the period from 1986 to 2010. In 2006, Tbilisi experienced 28 consecutive days in which the temperature exceeded 35°C (UNDP, 2011; MoENRP, 2015).

3.2. Scenarios

A regional climate change modelling study carried out by UNDP in 2011 on climate change in Armenia, Azerbaijan and Georgia builds on, and adds to, the findings of the Second National Communications to the UNFCCC from all three countries. The scenarios in the regional assessment are constructed using MAGICC/SCENGEN modelling[29] and PRÉCIS outputs[30] applying the A2 scenario as defined by the IPCC.[31] The most recent National Communications (the Third National Communications from Armenia, Georgia, and Azerbaijan, 2015) present scenarios of various models.[32] The assessment in this report focuses exclusively on scenarios following the A2 storyline.[33]

For the period 2030-2050 (compared to 1980-1999), the temperature will most likely increase by 1-2°C in the South Caucasus. A considerable increase is predicted between 2050 and the end of the century, when the temperature is forecast to increase by 3-5°C (UNDP, 2011). In Arme-

26 Annual mean temperature 1935-2012.

27 The decline in precipitation throughout the country in the last decade (1991-2010) was about 19.8% in winter, 28.8% in spring, 23.9% in summer and 3.3% in autumn (MoENR, 2015).

28 Anomaly of temperature during 1991-2010 ranges between 0.2 – 1.5 °C (MoENR, 2015).

29 The MAGICC/SCENGEN modelling system comprises two models: the MAGICC component projects global mean temperature and the level of the sea rise based on various socioeconomic and emission scenarios, while SCENGEN uses the MAGICC results, plus outputs from a selection of GCMs, to pattern scale to a regional scale – spatial resolution of 2.50 x 2.50 (UNFCCC, 2014b).

30 PRECIS (Providing Regional Climates for Impact Studies) is a dynamic downscaling model with a spatial resolution of 25km x 25km (UNFCCC, 2014a).

31 The four IPCC scenario groups (A1, A2, B1 and B2) vary in assumptions of future economics, demographics and energy consumption. Altogether the four storylines have led to the construction of 40 scenarios. The four storylines vary in the outcomes: A1 is the most pessimistic followed by A2 and B1, with B2 being the least pessimistic in terms of the expected future emissions of GHG (IPCC, 2000). The storyline applied in A2 generally assumes slow development in all parameters and assesses the storyline of i) a world of independently developing, self-reliant nations; ii) a continuously increasing population; and iii) regionally oriented economic development with a smaller growth rate than the other storylines. The A2 storyline entails six scenarios in total (IPCC, 2000).

32 Armenia is using the CCSM4 climate change model (MoNP, 2015); Georgia is using the RegCM4 climate change model (MoENRP, 2015); and Azerbaijan is using the MAGICC/SCHENGEN 2.4 climate change model (MoENR, 2015).

33 A2 was chosen due to the outcomes of the four scenario storylines, which place A2 as the second most pessimistic scenario group in the estimation of future emissions. In order to aim for the most realistic scenario assessment it was hereby chosen not to use the most pessimistic storyline albeit still following a cautious approach, where a more pessimistic scenario is safest when planning for future adaptation and mitigation.

nia, the temperature is forecast to increase by 1.7°C by 2040, 3.2°C by 2070 and 4.7°C by 2100 (MoNP, 2015).[34] In Azerbaijan an increase of 5°C is expected by the end of the century but in Georgia the annual mean temperature is expected to increase by 3.5-4.9°C in the east and by 1.8°C-5.2°C in the west by the end of the century (UNDP, 2011; MoENR, 2015; MoEPNR, 2015).

The increase in mean annual temperatures is not expected to be even across the year but will likely vary between seasons. In Armenia, summer temperatures are expected to increase by 6°C while winter temperatures are expected to increase by 4.4°C by the end of the century (MoNP, 2015). In Azerbaijan, for the period 2021-2050, the number of days with mean temperatures above 10°C is expected to increase by up to seven times, with an additional 10 to 35 days per year. During 2071-2100 this figure is expected to increase by more than ten times from the baseline figure, with an additional 25 to 80 days per year (MoENR, 2015).[35] It is expected that Georgia will experience a rapid reduction in frosty days and an increasingly early onset of the vegetation period (growing season), but spring frosts will still pose a risk to crops in 2050. However, by 2100, it is likely that frosty days will only occur in the high mountains and that the vegetation period will increase by one month (MoENRP, 2015).

The UNDP regional assessment estimates a decrease in precipitation of between 20 and 31 per cent in Armenia, 5 and 23 per cent in Azerbaijan, and 0 and 24 per cent in Georgia by the end of the century (UNDP, 2011). However, the Third National Communication of Armenia comes to a different conclusion: it predicts a decrease in precipitation only during summer months, but an increase in precipitation for the rest of the year, resulting in an overall annual increase[36] (MoNP, 2015). According to the assessments conducted for the Second National Communication of Azerbaijan, precipitation is estimated to increase by 10-20 per cent by 2050 compared to the precipitation level in the period from 1961 to 1990. It forecasts an increase in precipitation of 20 and 80 per cent for western and eastern Azerbaijan, respectively, while in Nakhichevan, precipitation will likely increase by 20 per cent (MoENR, 2010).[37]

3.3. Extreme events: Dynamics and projections

The IPCC Fifth Assessment report (2014), estimates that heatwaves are likely to increase in frequency and duration in Western Asia, while the projected trend for extreme rainfall shows no general pattern for the region as a whole.

Extreme weather events or so called hydrometeorological hazards[38] such as droughts, hot dry winds, heatwaves, spring frosts or similar hazards have been becoming more frequent (see section 4.4). In Armenia, changes in frequency and intensity of hazardous hydro-meteorological phenomena (HHMP) due to climate change are observed up to 2011. During the last 30 years the total number of HHMP cases has increased by an average of 1.2 per annum and during the last 20 years by 1.8 cases annually – an increase of growth rate of climatic hazardous phenomena in parallel with the increase of climate change rates (MoNP, 2010).

Heat stress is expected to be the most serious, health-related impact of climate change in the South Caucasus (UNDP, 2011). The UNDP regional study (2011), projected the Heat Index[39] for three cities: Baku, Azerbaijan; Tbilisi, Georgia; and Vanadzor, Armenia. A dramatic tripling of the number of dangerously hot days by mid-century compared to 1961-1990 levels is expected (Table 3). In Baku, for example, it is projected that between 2020 and 2049 there will be about 2 400 dangerously hot days – an average of 83 days per year. By the middle of the century, 120 dangerously hot days per year are expected, of which the majority will likely be in the period between May and September. Public health is vulnerable to heat events and caution needs to be taken on dangerously hot days, when the incidence of strokes and cramps is likely to increase (UNDP, 2011).

34 Using the Community Climate System Model (CCSM4) (Gent et al., 2011).
35 In addition, the HadCM3 model forecasts a 1.5°C increase of temperature during the period of 2011-2040 and a 2.5°C increase for the period of 2041-2070 (MoENR, 2015).
36 There will be an increase in rainfall, while snowfall will decrease (MoNP, 2015). "Over the last 80 years, the climate in the northeastern and central (Ararat Valley) regions of the country has turned arid, while precipitation has increased in the southern and northwestern regions, as well as in the western part of the Lake Sevan basin" (MoNP, 2015).
37 According to the assessments conducted for the Third National Communication of Azerbaijan, precipitation is estimated to increase 0.4-0.8% in winter, 2.2-12.4% in summer and decrease -0.9- -1.7% in spring, -0.9- -1.9% in autumn (MoENR, 2015).
38 Definition of UNISDR http://www.preventionweb.net/english/professional/terminology/v.php?id=490.
39 As classified by the World Health Organization (UNDP, 2011).

Table 3: The projected number of dangerously hot days in the period 2020-2049[40]

	Baku	Tbilisi	Yerevan	Vanadzor
Very Warm	1858	1527	N/A	16
Hot	539	287	N/A	0
Very Hot	3	3	N/A	0
Extremely Hot	0	0	N/A	0
Total number of dangerous days	**2400**	**1814**	**N/A**	**16**

Source: (UNDP, 2011)

Climate change coupled with anthropogenic causes are leading to implications in urban environments. Temperature increases in Yerevan city may correlate with loss of green areas, which have decreased over recent years. In general, heatwaves have significantly increased in Yerevan over the last 30 years.

Heavy rainfall events represent one of the main causes of natural disasters in the region. Better monitoring and early warning systems are critical and, therefore, strengthening of the early warning capacity is important. Automated meteorological stations are scarce in the region. The large network of stations that existed in the region in the 1980s shrank drastically in the 1990s. During the last decade a few new monitoring stations have been put in place but the coverage of the network remains far from adequate.

Flooding of the Vere River basin, Georgia

One of the most recent natural disasters in Georgia occurred in June 2015 in the Vere River basin. In just a few hours, 180 mm of rain fell. Normally, the river runs through the centre of Tbilisi with a modest flow but on this day it turned into a torrent. The groundwater tables were high due to an unusually wet spring. The heavy rainfall simultaneously provoked a series of flooding, flash floods, rockfalls, landslides, mud slides and heavy erosion. Sixty landslides across an area of 32 ha, with a total volume of 1 million m^3, occurred in the Vere River basin as a result of the heavy rainfall. Flows from the landslides mixed with debris such as trees and blocked the river for a few minutes, during which time the water level increased by 2 to 3 metres. When the blockage broke, the flow continued towards Tbilisi at a speed of 450 m^3/s. The river tunnels in Tbilisi did not have the capacity to cope with the unprecedented volumes of water and debris. Nineteen people died, three went missing and at least 280 were left homeless. The flood also destroyed a large part of the zoo and nearly half of the animals died. Climate change may lead to an increase in frequency and magnitude of such extreme events that may cause similar or even more catastrophic disasters.

Source: Merab Alaverdashvili of the Hydrometeorological laboratory (in the Vere River, Tbilisi), Tbilisi State University; Merab Gaprindashvili of the Department of Geology, National Environmental Agency, Georgia; Hydrometeorological laboratory: https://www.tsu.ge/data/file_db/faculty_zust_sabunebismetk/Geography%202012.pdf

The melting of glaciers is forming temporary glacial lakes that can burst their banks during heavy rains causing severe damage. The number of glacial lakes increased by 50 per cent between 1985 and 2000. The risk of glacial lake outburst floods is high and poses a serious hazard for downstream settlements and infrastructure (MoENRP, 2015). Under global warming, glaciers may become weaker and trigger ice blocks falls leading to catastrophic hydrologic and geological extremes. In 2014, the break of Devdoraki glacier in Georgia together with mudflows and rockslides caused casualties and blocked important infrastructure (EUCP, 2014). Technical assistance by the European Union was provided to analyse the event and an early warning system was established with financial support from the EU (EUCP, 2014).

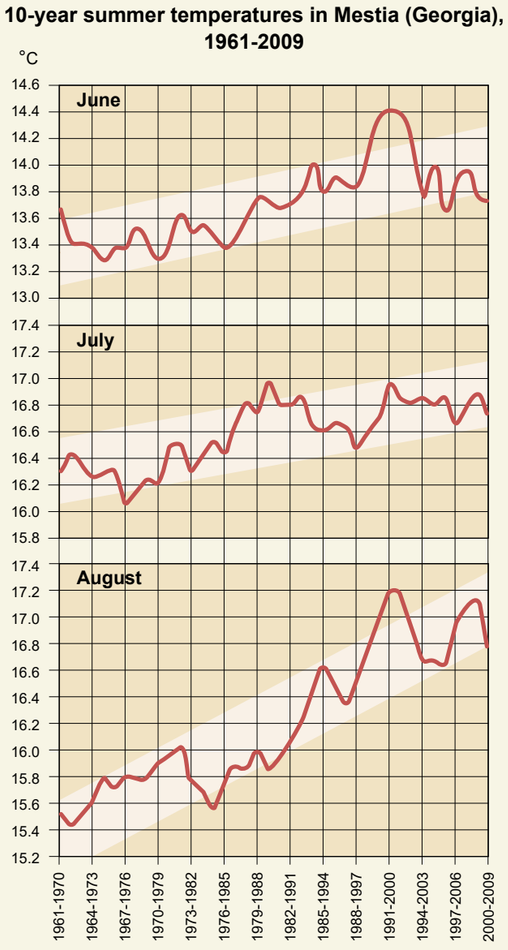
3.4. Slow onset events: Dynamics and projections

Shrinking glaciers are a growing concern in the region as they are sensitive to climate change and melting causes serious damage to downstream areas. Research based on satellite imagery[41] shows that glacier surface area in the region retreated by 10 per cent between 1985 and 2000 (Stokes et al., 2006). The glacier retreat is predicted to

40 Dangerous days are defined as days with temperatures above 27°C, which in combination with humidity results in even higher experienced temperatures (UNDP, 2011).
41 Using the observer sensors of Landsat Thematic Mapper and Enhanced Thematic Mapper Plus.

continue. It would further reduce river flows beyond the reductions expected from increases in temperature and decreases in precipitation. In the South Caucasus, glacial melting, coupled with decreasing precipitation, could pose a security risk through changes in overall water availability. Georgia has the highest numbers of glaciers, followed by Azerbaijan while there are no glaciers in Armenia.

Glaciers are retreating at a considerable rate in the Greater Caucasus Mountain Range. Research in Mestia, in the glacial region of Georgia (Figure 10)[42] indicates a varying but overall steady increase in summer temperatures, with a significant increase in August temperatures. In Georgia, all glaciers found on southern slopes have retreated due to climate change (Gobejishvili et al., 2011). Estimates suggest that glaciers in Kvemo Svaneti have lost as much as 25 per cent of their area, with a corresponding decrease in volume over the past half-century (MoEPNR, 2009). An analysis by Stokes et al. (2006) of 113 glaciers in the Central Caucasus reports that the mean rate of glacier retreat for this period was 8 m/year.



Source : Upper Svaneti adaptation strategy to the climate change, 2014.

Graph by Manana Kurtubadze, GRID-Arendal, 2014.

Figure 10: 10-year summer temperatures in Mestia (Georgia), 1961-2009

Research on Tviberi and Chalaati glaciers in Georgia also indicates retreat (Figure 10). The Chalaati glacier has been observed since the 1960s and is one of the most regularly observed glaciers in the country (Figures 11 and 12). Between 1974 and 2011 the glacier retreated 436 m, an average of 11.8 m/year. During the period 2004-2011, the annual average retreat was somewhat lower at about 9.0 m/year (Gobejishvili et al., 2011; Tielidze et al., 2015).

42 The summer temperatures are calculated for overlapping time periods i.e. 1961-1970, 1964-1973, 1967-1976, etc.

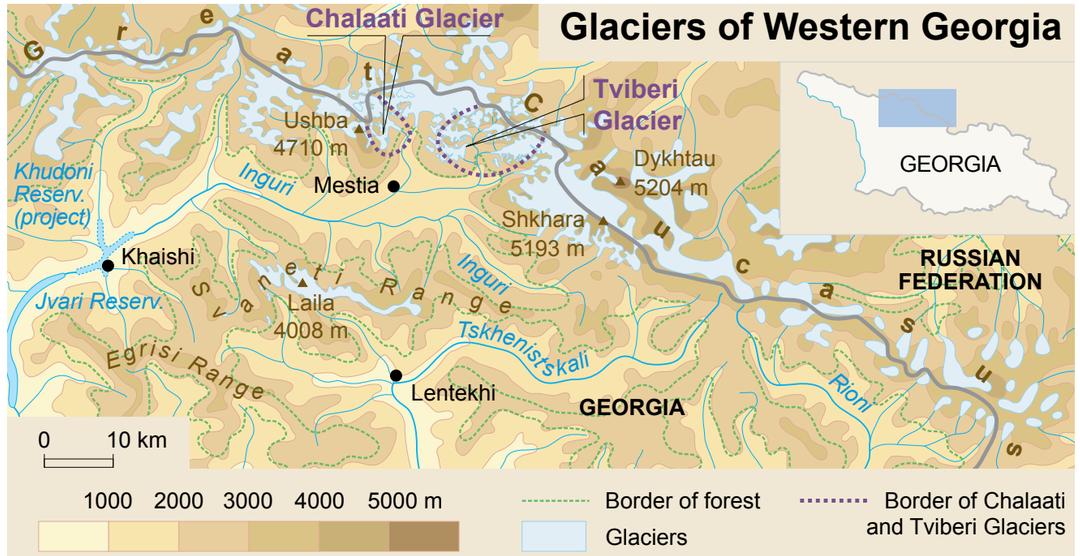
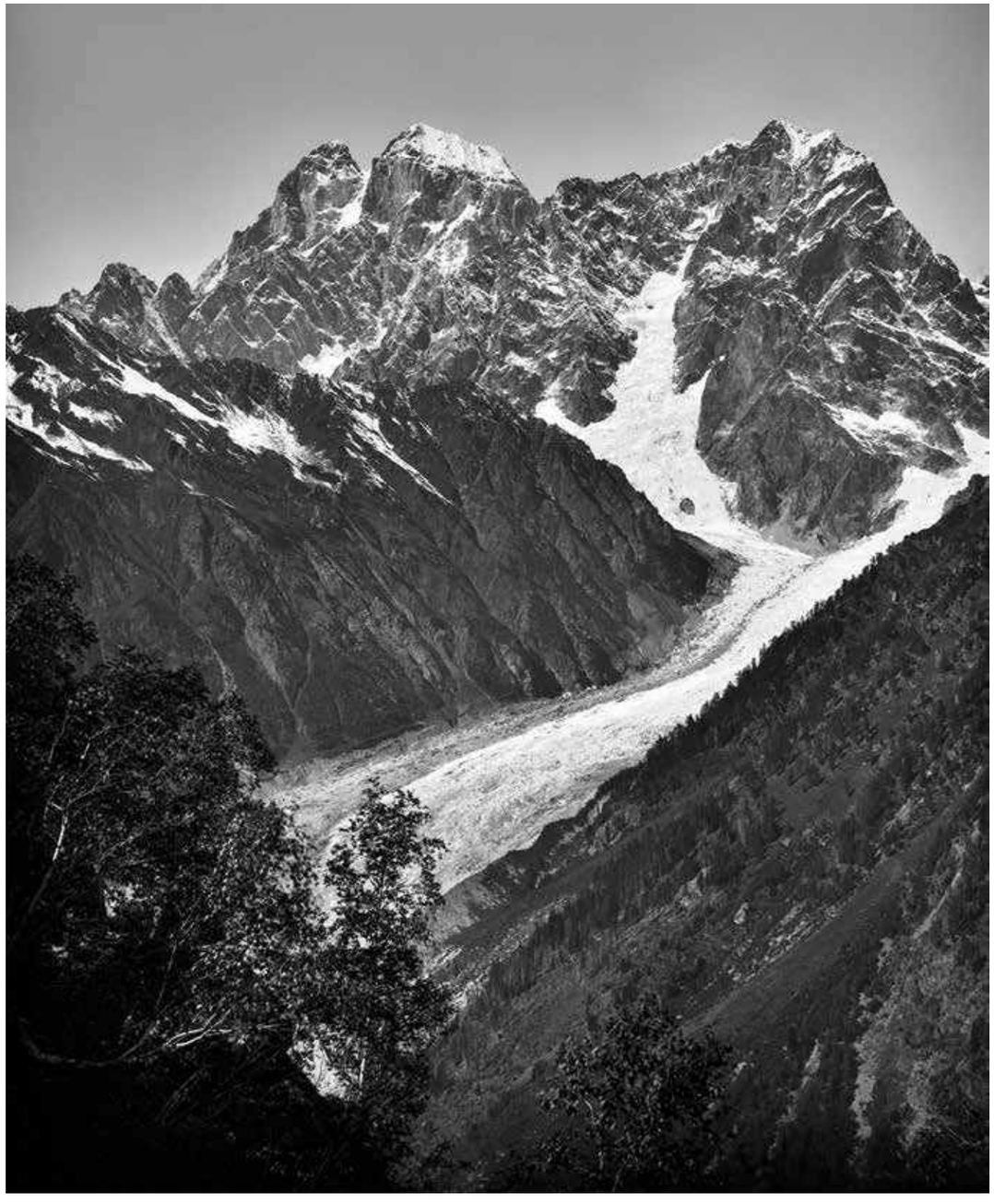


Figure 11: Glaciers of Western Georgia

Figure 12: Chalaati Glacier retreat between 1810 and 2011 (Upper Svaneti, Georgia).



1890 (Photo: V. sella) – 2011 (Photo: L. Tielidze).

Source: http://www.macromicro.it/eng/; Tielidze et al., 2015

The Tviberi glacier, located in the Svaneti region, is one of the largest in Georgia and provides a good illustration of the extent of glacial degradation resulting from climate change (Figure 13). Up until the early twentieth century, the Tviberi river basin glaciers were connected to each other and covered an area of 43.1 km^2. Today, the glacier covers an area of only 23 km^2. The largest section of the basin glaciers, Kvitlodi, separated from the main Tviberi glacier between 1958 and 1980; they are currently 800 to 900 metres apart. Another five smaller glaciers have also separated from the Tviberi glacier: the Seri, Asmashi, Toti, Iriti, Dzintari and Laskhedaiand Lichati glaciers (Gobejishvili et al., 2011). Between 1889 and 1987 the glacier retreated 4.34 km.

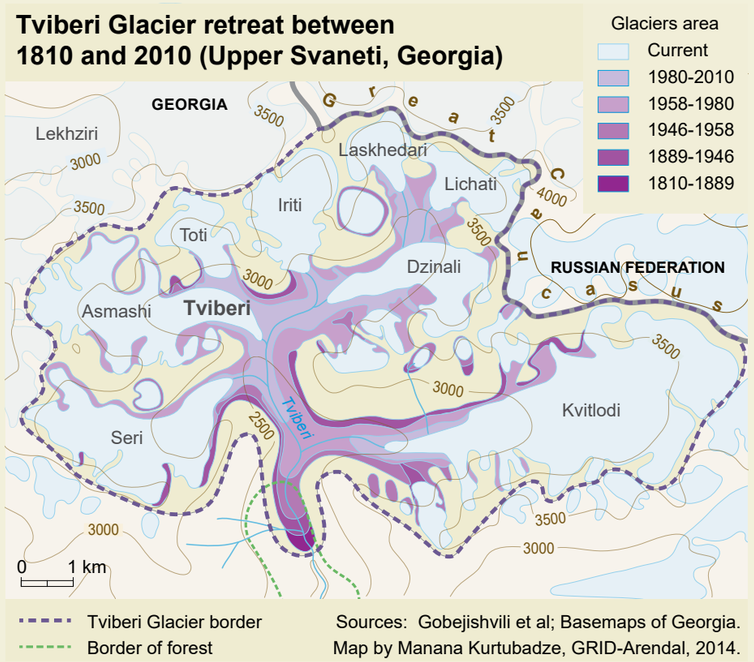


Figure 13: Tviberi glacier retreat between 1810 and 2010 (Upper svaneti, Georgia).

In Georgia, it is likely that glacier melt will have consequences for overall water availability. Most of western Georgia's rivers originate in the Greater Caucasus Mountain Range and are fed by melting snow and glacial water (MoENRP, 2015). Two examples of such rivers are the Inguri, which plays an important role in energy production through the Inguri dam, and the Rioni River, which is the largest water body in western Georgia. About 28 per cent of the Rioni River runoff originates from melting snow and close to 5 per cent comes from glacier melt (USAID, 2011).

The main glacial areas in Azerbaijan are found in the Gusarchay Basin in the Greater Caucasus. Over the last 110 years, the glaciers, which have an average lower limit of 3 500 metres above sea level, have decreased in size from 4.9 km2 to 2.4 km2 (MoENR, 2010).

The South Caucasus is prone to a variety of climate-related hazards. Meteorological extremes such as drought, severe frosts, hailstorms, strong winds and heavy precipitation lead to severe erosion, desertification, and more rapid disasters, such as landslides, flooding and flash floods. Human activities, including agriculture, mining, and forestry, exacerbate the risk of such hazards. These natural disasters often result in casualties, damage to infrastructure, agriculture and livestock and other significant economic losses to the statet. Figure 14 displays some of these estimated costs.

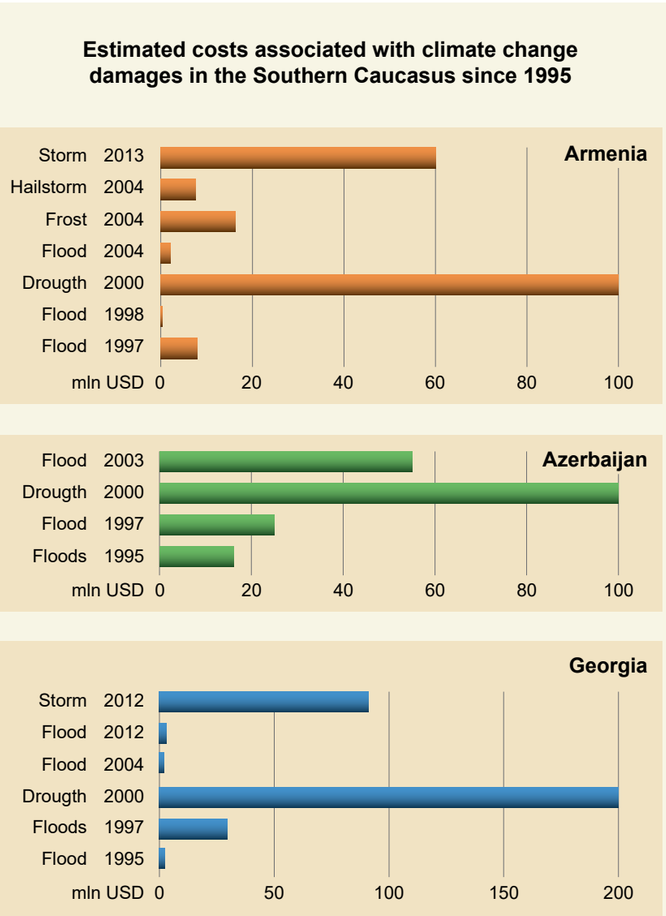


Figure 14: The estimated costs associated with climate change damages in the South Caucasus since 1995

4.1. Flooding and related hazards

All three countries are subject to flooding and flash flood events, which tend to occur in springtime following snowmelt and heavy precipitation. While these are naturally occurring hazards, studies indicate that the frequency and intensity of flooding has increased over the last two decades and that this is partially attributable to a warming climate and changes in precipitation (MoENR, 2015; MoENRP, 2015). Similarly, the mountainous regions of the South Caucasus are naturally prone to landslides and mud slides, and although climate change is not the main cause of these events, climate change, in combination with human activity, is responsible for the increase in frequency and severity of landslides and mud slides across the region. The widespread risk of landslides can be seen in Figure 15.

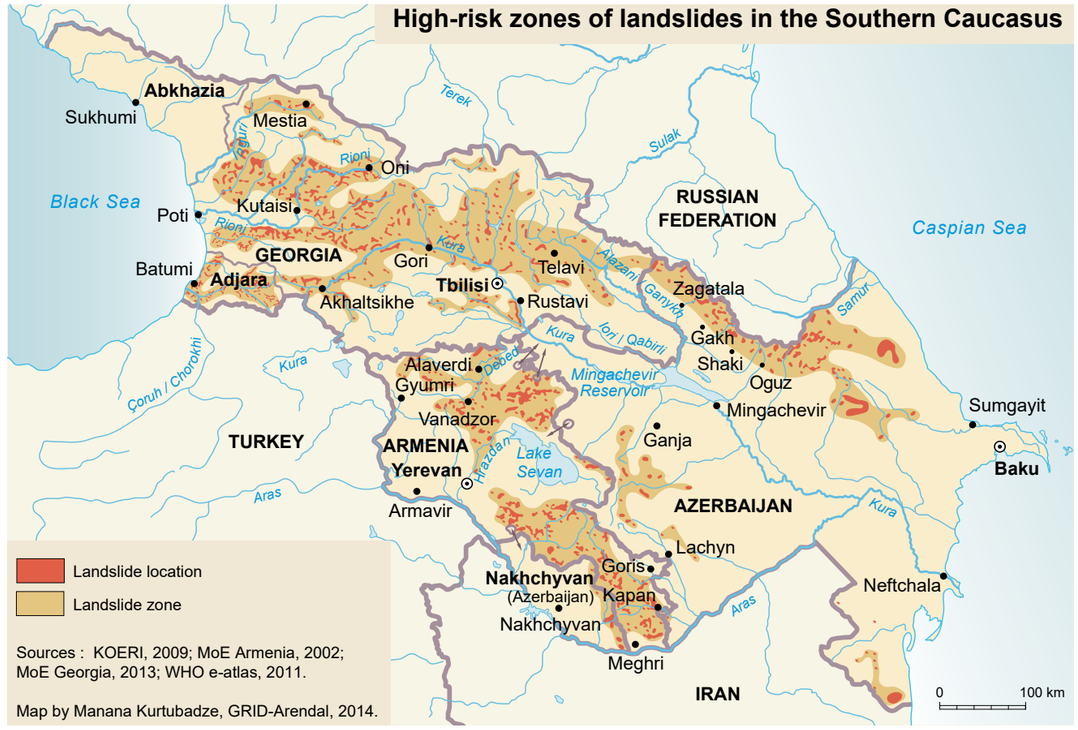


Figure 15: High-risk zones for landslides in the South Caucasus

In Armenia, 31 per cent of the country is at risk of flooding, which, along with landslides and mudflows, are natural hazards aggravated by climate change (GFDRR, 2009). Snowmelt contributes about 55 per cent of total river flow. Melting mainly occurs in spring and, at times, can increase the water volume in some river basins by up to ten times (MoNP 2010; MoNP 2015). It also results in seasonal flooding, which can cause significant damage to property and infrastructure. Floods also result in severe erosion. If snowmelt is combined with rainfall, the risk of flooding increases further. The areas that are most vulnerable to seasonal flooding are the Araks, Hrazdan and Aghstev river basins. In other river basins, such as the Meghri and Vedi, flash flooding is becoming more common every two to three years.

In general, floods are most common in the northern part of Armenia – the forested, mountainous areas – while the southern regions are more prone to mud slides (MoNP, 2015).

In Azerbaijan, on the southern slopes of the Greater Caucasus, the frequency of flooding is expected to grow (MoENR, 2015). During and after the Soviet period, structural engineering measures, such as reservoirs, dykes, and coastal protection structures, were constructed to control the spring-summer snowmelt floods in the Kura River basin (which have been natural occurring phenomena for many years). The scale of flooding decreased significantly with the construction of the Mingachevir and Shamkir reservoirs on the river Kura (built in 1953 and 1982 respectively) and the Aras reservoir on the river Aras (built in 1971). Also riverbed deepening works were undertaken during the Soviet period to help maintain the water ways for shipping purposes. However, the frequency of flooding in the Kura-Ara(k)s lowlands is once again increasing, which to a large extent, can be explained by siltation (Hasanova and Imanov, 2010). Since 1978, rising sea levels in the Caspian Sea have led to an increase in siltation in the Kura River, and consequently to an increase in flooding along the coastline. In 1993, large floods occurred as a result of siltation of the riverbed in the main channel of the Kura River. The southeastern and north-eastern branches of the river were not able to discharge the vast amount of water. Consequently, settlements, villages and agricultural areas as far as 200 km inland were flooded in the Neftchala region (MoENR, 2010; Hasanova and Imanov, 2010). According to researchers, approximately 15 per cent of the population of Azerbaijan lives under the risk of flooding. One third of the administrative regions, 8.4 per cent of populated areas, 3 per cent of industrial areas, 12 per cent of agricultural enterprises, and 14 per cent of roads in the country are periodically subject to flooding (MoENR, 2010).

In Georgia, about 70 per cent of the country, comprising of approximately 3 000 settlements, is considered to be at risk from geologic hazards. In these regions, landslides are the main cause of migration and were responsible for the third largest number of casualties between 1988 and 2007, following transport accidents and earthquakes (CFE, 2014b; WB & UNISDR, 2010). In Kvemo Svaneti, the incidence of landslides has increased by 43 per cent since 1980. (MoEPNR, 2009). The 2011 landslide risk assessment (GaprindashvilI, 2011) found that 17 per cent of the country is considered to be a high hazard zone prone to landslides, 39 per cent is a moderate hazard zone and 44 per cent a low hazard zone. While around two thirds of landslides occur in highland areas, mudflows and avalanches are more prevalent in mountainous areas (MoENRP, 2015). More than half of Georgia is at risk from avalanches, which, during the period from 1995 to 2012, caused the loss of 22 lives and significant economic losses (CFE, 2014b).

As in neighbouring countries, the risk of flash flooding and flooding in Georgia is high and increasing. Higher levels of precipitation predicted in western Georgia is likely to exacerbate the situation.

4.2. Droughts

The South Caucasus is more drought-prone than other parts of the world at the same latitudes, and evaporation exceeds precipitation by 140 mm (WB, 2006). In general, precipitation becomes scarce towards the eastern mountains and plains (300-800 mm per year), the more arid and drought-prone areas. In the South Caucasus, the most severe droughts, lasting for several months, were recorded in 2000 and in 2001. Meteorological droughts have been observed in all countries in one or more districts almost every year (in some steppe and semi-desert zones it is a permanent condition). The impacts of these climate-related extremes are wide-ranging, particularly affecting biodiversity, agricultural productivity and access to water. Droughts and heatwaves are detrimental to soil quality, intensifying land degradation, increasing evaporation from water bodies and threatening ecosystems such as forests. Droughts also impact the energy sector: during long heatwaves more energy is consumed for cooling buildings and more water is needed for cooling energy infrastructure. The impacts are felt particularly in the capital cities and on central energy generation facilities. Poor communities, dependent on natural resources, are affected through the agriculture-water nexus. Droughts will most likely become more widespread and intense according to existing climate change scenarios.

The Armenia Rescue Service identifies a number of drought-prone areas: Syunik, Aragatsotn, the Ararat Valley and Gegharkunik marz. When droughts occur with southern winds the situation is exacerbated. Such phenomena have been observed in Ararat Valley.

Azerbaijan experiences frequent droughts from the beginning of April, although the most severe conditions prevail during July through to mid-September. According to the national classification system, the Kura-Ara(k)s lowlands, and the Karabakh, Shirvan and Mugan plains experience dry periods for 50-90 days a year. Mountain valleys on the Ara(k)s plains of Nakhchivan, Jeyranchol and Gobustan experience frequent soil and atmospheric droughts, with dry periods sometimes as long as 115 days a year (WB, 2006).

In Georgia, the frequency, severity and length of droughts has increased during the past 50 years. In Dedoplistskaro, the frequency has now almost doubled but the duration of droughts has extended from 54 to 72 days, which further increases the impact on agriculture (MoEPNR, 2009). In 2000, Georgia experienced a six-month drought; the longest ever observed . The drought affected 700 000 people and reduced GDP by 5.6 per cent (CFE, 2014b).

4.3. Extreme weather events: Heavy precipitation, hailstorms, frosts and winds

The impacts of heavy precipitation, hailstorms, late frosts and winds on the economic sector are increasingly being recorded across the South Caucasus countries. If these events occur during the agricultural season they can be devastating for crops and consequently damage annual horticultural and agricultural yields. These extreme events can harm and weaken ecosystem resources and can result in heavy erosion, land desertification and soil degradation, affecting soil structure and humidity. They can initiate and/or escalate natural calamities such as landslides, mudflows or rockfalls.

Armenia is affected mainly by severe hailstorms, strong winds and episodes of heavy precipitation[43] – which have been gradually increasing over the last decade. The largest number of hazardous events was observed in 2004 and 2006 with 245 and 106 events respectively (MoNP, 2015). The highest frequency of hailstorms was reported in Shirak Valley, and of heavy precipitation in Tashir and the Ijevan marzes. Frost is an issue in Ararat Valley, the most important area for Armenia's agriculture.

In Azerbaijan, severe hailstorms were recorded in April 1997, May 2001, and May 2002 (Ahouissoussi 2014c). Even though there is little aggregated information available about winds in Azerbaijan, it is estimated that about 4.2 per cent of land desertification is caused by wind erosion (Kosayev and Guliev, 2006). Abnormally high winds were recorded in 1996, 2005 and 2006 (Ahouissoussi 2014c).

The frequency of hailstorms, frosts and strong winds has been increasing in Georgia, affecting the Kakheti and Adjara regions among others. The number of hailstorms has increased since 1995, with the most extreme and frequent hailstorms occurring in the eastern region of the country. Between 5 and 15 hailstorms are recorded annually and the damage they cause to agriculture is increasing. A hailstorm in 2012 destroyed most of the horticultural harvest in the Kakheti region, and caused severe damage to cultivated areas and perennial plantations. It is estimated that it will take at least three years for the damaged plants to recover. As a result of these events, municipality representatives in the Kakheti region recognized hailstorms as the most serious threat to local agriculture, especially to the viticulture sector (MoENRP, 2015). Spring and autumn frosts are of high concern in the Adjara region. High winds mostly affect the Kakheti region. In Dedoplistkaro, historical records show that the frequency of high winds (more than 30 m/s) has increased by five times since the beginning of the 1980s (MeEPNR, 2009).

4.4. Region-specific hazards: Sea level rise and enhanced coastal flooding

The South Caucasus region is located between two major water bodies: the Black Sea and the Caspian Sea and these ecosystems have an important influence on Georgia and Azerbaijan respectively.

One of the major concerns for Azerbaijan is the fluctuation in the Caspian Sea level, which poses a risk to about 850 km^2 of coastline and coastal human activities that are of great social and economic importance. Natural sea level oscillations involving long- and short-term cycles over centuries and a number of factors such as river inflow, precipitation, underground water flow and evaporation from the surface of the sea contribute to the water balance of the Caspian Sea. The implications of contemporary global warming for fluctuation in the Caspian Sea level are noted in several scientific papers (Ardakanian, 2013; Mammadov, 2015). However, it is still unclear how climate change will affect long-term oscillations. Earlier analyses of the long-term prognoses for sea level fluctuations are questionable because of conflicting results. Projections of sea level extremes are between -25.00 and -29.00 mBS (absolute level) (Rucevska et al 2011).[44]

Sea level rise has already had a negative impact on social dynamics, economic activity and infrastructure. The total damage caused by flooding attributed to the sea level rise has been valued at an estimated US $2.0-2.5 billion since 1978 (MoENR, 2010). Ten administrative regions in Azerbaijan, including the Absheron Peninsula which is home to 4 million people, are located on the coast. The largest cities of Azerbaijan – Baku and Sumgayit – and more than 75 per cent of industry, are situated along the coast (MoENR, 2010). Sea level rise could jeopardize infrastructure such as pipelines, railways, roads and public services, along with other resources. There are also state reserves, nature sanctuaries and national parks along the Caspian coast,

43 Over the past 10 years, the Armenian Ministry of Emergency Situations has recorded: 49 severe hailstorms, 29 strong winds, 26 floods, 14 abundant precipitation events, 2 frosts, and 3 droughts.
44 Note: Sea level extremes of -25.00 and -30.00 mBS can be accepted as the highest and lowest levels of the sea in the immediate future. A level of -28.00 mBS was taken as the zero level of the Caspian Sea by the USSR starting in 1961.

which will be affected by flooding. Another consequence of sea level fluctuations in Azerbaijan is the rise of groundwater and siltation of the Kura River delta. After 1993, a rise of groundwater – a direct result of fluctuations in the Caspian Sea level – caused flooding along the Kura River, inundating areas 200 km from the riverbed. The villages located along the river and the riparian areas of Salyan, Neftchala, Sabirabad and Shirvan are subject to frequent flooding. Large industries of national importance, farming facilities, gardens and housing are also often damaged (MoENR, 2010).

For Georgia, the Black Sea coastal zone is considered the most climate change-sensitive region in the country (MoEPNR, 2009). The Georgian coastal region is an important contributor to the regional economy, particularly as a transportation corridor, but is vulnerable to climate change and sea level rise (UNDP, 2013a). It is home to a great number of settlements and is comprised of a dense grid of railways, highways and pipelines that lead to and from port cities and terminals. The sea is not only rising, but is also affected by tectonic movements, tidal waves, floods and river sedimentation. During the previous century, the sea rose by 2.6 mm/yr on average (MoEPNR, 2009). In the period 1956-2007, the sea level along the coast of Georgia rose by 0.7m, which together with an increase in storms, led to an increase in damaging events (CFE, 2014b). During the current century it is projected that coastal erosion will increase in Adjara's Black Sea coastal zone (UNDP, 2013a). In 2005, a force-six storm lasting 25 hours washed away an 18 metre-wide stretch of beach near Batumi airport. In 2013, three heavy storms battered the Adjara shoreline. One of the most recent storms occurred in October 2013 and resulted in damage to the new boulevard in Batumi. The Georgian Black sea coastal area comprises two river deltas and populated flood-prone plains. The frequency of storms for the past 20 to 30 years has increased by almost 50-70 per cent (MoEPNR, 2009).

5. ASSESSMENT OF CLIMATE CHANGE AND SECURITY IMPLICATIONS AND VULNERABILITY

The vulnerability assessment, which includes an assessment of security implications, determines how climate change related hazards in combination with other cumulative pressures may affect the environmental, socioeconomic and political conditions, and how these in turn may affect security and stability within and across borders. Critical to the assessment is a consideration of climate change adaptation capacity – the potential for a system or a society to respond effectively to climate change – and resiliency; and how they apply to governments, institutions, key sectors (such as food and energy), infrastructure, social dynamics, income diversity and migration patterns at the local, national and regional level.

Some of the relationships may be fairly straightforward, and some may be highly complex. Floods or extreme cold waves, for example, may cause immediate human and economic losses (which may be difficult to estimate), may trigger an energy or food crisis and may threaten livelihoods. Changes in the hydrologic cycle, in contrast, may cause environmental degradation over a longer time period, with repercussions for the economy, and food and power production for the growing population in the coming years. The security implications may be far-reaching and complicated by a variety of other factors. (See Chapter 1, Methodology, for a complete description of the process.)

Within this assessment a series of national meetings in each of the three South Caucasus countries as well as a regional consultation meeting contributed to the participatory assessment of climate change and security implications and vulnerability. Stakeholders from various line ministries, and academic and civil society representatives gathered to discuss the most vulnerable economic sectors and socioeconomic challenges posed by climate change as well as the implications for security. Participants examined the issues from the viewpoint of human security: this encompasses economic, social and political security, food security, personal and community security, and environmental security. In all three countries participants identified agriculture, energy, infrastructure, water and industry as the sectors most vulnerable to climate change. Migration triggered by climate change was one of the biggest concerns in Georgia, while public health was identified as a major concern in Armenia.

5.1. Structural, socioeconomic and environmental consequences of climate change

5.1.1. Changes in human and livelihood security

The national and regional consultations highlighted how livelihood security depends on agriculture, energy and ecosystems and is therefore highly vulnerable to climate change. At present there are systematic risks to human and livelihood security from extreme weather events. Natural hazards are highly unpredictable in their timing and magnitude. Casualties are frequently reported across the countries and the impacts from climate change are, in most cases, expected to worsen as a consequence of the increasing frequency and severity of climate-related hazards. However, livelihood security is not only affected by extreme events but also by slow, incremental changes in climate conditions. The impact on human and livelihood security should, therefore, not only be assessed in terms of individual events but should also take into account longer-term changes. Protective mechanisms such as insurance or subsidies should be instrumental to overcome these impacts in the future; moreover, they need to be carefully designed to mitigate impacts induced by climate change.

Large urban centres, with a high density of people, are more vulnerable to extreme climate events such as floods, landslides, mudflows and sea level rise. In the South Caucasus countries adequate safeguards (such as construction standards, early warning systems, sustainable management practices) are limited. The 2015 flooding in Tbilisi serves as an example of the extent of exposure of urban populations to extreme events.

Dependency on natural resources is higher in rural populations. Poor communities, in particular, often depend on subsistence agriculture, and therefore their livelihoods are more directly affected by climate-induced events such as droughts, frosts and severe winds. Provinces with both a high exposure to climatic hazards and high poverty rates are consequently more vulnerable. In Armenia, Gegharkunik, an area particularly prone to natural hazards, also has a high poverty rate which makes the population more vulnerable. In Azerbaijan more than half of Azerbaijan´s poor live in rural areas (IFAD, 2015).

Agriculture is important for livelihoods across all three countries. In Georgia, for example, the majority of people are either employed in the agricultural sector or manage small subsistence farms, and are therefore vulnerable to the impacts of climate change such as loss of harvest and land degradation. The countries have limited financial resources to support farmers experiencing such problems or to implement measures (such as early warning systems) that will enable the agricultural sector to adapt to a changing climate. In Armenia, there are minor subsidies for irrigation (WB, 2012; EDRC, 2007) and Azerbaijan has provided assistance to the agricultural sector, primarily through subsidies on fertilizers, seed production, machinery, and tax breaks for agriculture (FAO, 2013). In Georgia, the government has provided some short-term support for machinery. While such initiatives are important, livelihoods dependent on agriculture remain vulnerable to both extreme and incremental impacts.

An analysis of social support insurance systems in the South Caucasus (Figure 16) shows the development of insurance schemes within the health and agricultural sectors in all three countries. Health insurance is more developed than agricultural insurance. Only in Azerbaijan do farmers have access to effective insurance schemes, and health insurance with both voluntary and mandatory options. South Caucasus health insurance schemes, in some cases, are lacking or do not function properly. Agriculture insurance is a voluntary system, and in many cases excludes farmers because they cannot afford the cost.

Social support insurance systems in the Southern Caucasus

Health Insurance	Armenia	Azerbaijan	Georgia
Voluntary	Since 1994, 2011	Since 1995	Since 1990, 2011
Mandatory	Planned in 2015	2008, planned in 2015	Since 2013
Not for everybody*	Since 1999	1994-2008	1995-2006, 2007-2012

Agriculture Insurance	Armenia	Azerbaijan	Georgia
Voluntary	Since 2007	Since 2011	09/2014 - 09/2015

Works / Worked with problems Agreed but does not work

* *For the population below poverty line, refugees, children outside of family care etc.*

Sources : WHO 2006, 2009, 2010; EU, 2011; Georgian government, 2014; Curatio 2014; Jadugishvili 2011; Several online magazines.
Graph by Manana Kurtubadze, GRID-Arendal, 2014.

Figure 16: Social support insurance systems in the South Caucasus

5.1.2. Additional pressures and competition over scarce natural resources

Impacts on forest ecosystems and forestry are anticipated in all three countries. The forest ecosystems are expected to shift boundaries and composition leading to new ecosystems. Forest fires, diseases and mass generation of pests are anticipated to increase and spread.

As forest resources in Armenia are limited, the main emphasis is on protection and reforestation rather than forest exploitation. Currently, forests are exposed to a variety of threats such as forest fires, illegal logging, diseases and mass outbreaks of pests. In the period between 2001 and 2010 wildfires destroyed about 1 200 ha of forest lands in Armenia.[45] The average rate of forest land destruction is currently about 60-65 ha annually. The climate change scenarios estimate that forest losses will be between 14 000 and 17 000 hectares by 2030 (MoNP, 2015), leading to further losses in biodiversity and the reduction of forest ecosystem services.

Pests are an additional concern. In Syunik marz, for example, forests have been subject to extensive pest damage (UNDP, 2012) and may also become vulnerable to invasive species. During the National Consultations, specific concerns were expressed about changes in forest ecosystems and, in particular, the displacement of treelines to higher altitudes.

Due to limited forest resources, Azerbaijan is prioritizing forest protection, rehabilitation and reforestation. In some locations, lower forest margins may move upward by 50-200 m. Changes are also expected in the distribution of species and forest productivity.

Forests in Georgia have a very high ecological and economic significance; together with water, they are considered the main natural resources in the country. Forest vulnerability to climate change was assessed in the Third National Communication, based on three selected forest areas: Adjara, Upper Svaneti and Borjomi-Bakuriani. Assessments indicate that the number of pests and diseases has increased and spread in Adjara and Borjomi forests, and that significant changes occurred in the distribution of species in Upper Svaneti between 1961 and 2010 (MoENRP, 2015). The climate change scenarios anticipate that the risk of fires, pests and diseases (including new disease types) will increase in Georgian forests.[46] The main timber producing provinces are Kakheti and Samtskhe-Javakheti. It is important to note, however, that official timber harvests are dropping across the country[47] and they are relatively small compared to the forestry sectors in the other countries. Forests are more under threat from illegal harvesting, unsustainable deforestation and overgrazing. These practices have two major implications for security: the adverse impacts on rural communities, which rely on forest goods; and the impact on ecosystem services such as maintaining soil quality, protecting soil from direct rainfall and limiting erosion.

All three countries face the prospect of serious climate change related impacts on terrestrial ecosystems, biodiversity and water resources.Coupled with the unsustainable use of natural resources such as overgrazing, pollution and deforestation, climate change is exacerbating the problem of land degradation through extreme weather events such as strong winds, heavy precipitation and increases in temperature.

The South Caucasus is recognized as one of the World Wide Fund for Nature's top 35 priority places, and Conservation International classifies it as one of the world's 34 Biodiversity Hotspots. Climate change, coupled with unsustainable resource management, will cause significant ecosystem shifts and, as a result, the population of many species with specific habitat requirements will likely decline in the South Caucasus. Species which are particularly vulnerable are those that are dependent on alpine habitats in the Lesser Caucasus and species confined to already fragmented habitats such as wetlands (WWF, 2008). Species directly linked to agriculture have so far received little attention. Bees, for example, have important ecological functions and are crucial for agriculture, yet are sensitive to climate change (such as hot weather, frosts and heavy rains) (Ahouissoussi, 2014). Habitats could be taken over by invasive species, at times affecting entire ecosystems and the human activities that rely on them.

Security implications related to transboundary water resources extend to all economic sectors and public services. In addition, water-related hazards, such as floods and flash floods accompanied by mudflows and riverbank erosion can directly expose people to danger. Changes in the hydrological cycle cause environmental degradation over time with serious repercussions for national economies. The uneven distribution of water resources and transboundary waterways expose countries to different challenges. Any efforts to store water through dams and reservoirs may affect water availability in neighbouring countries. Therefore, national and regional adaptation strategies are needed to ensure a fair and equitable use of existing water resources and to prevent climate change-induced, water-related hazards across the region.

There are notable reductions and changes in water flow, especially in downstream countries, which could result in conflicts between water users. Georgia's abundance of water resources means water scarcity is unlikely to be an issue for the country as a whole. However, these resources are unevenly distributed between western and eastern Georgia. The former has approximately three times more water available than the latter, and in eastern Georgia water scarcity is an issue in some areas. Moreover, the loss of glaciers in the Greater Caucasus is expected to trigger water scarcity problems by the end of the century (MoENRP, 2015).

The increasing temperatures, melting glaciers and changes in precipitation are evidently changing the hydrological cycle in the South Caucasus. In addition, the development of dams and reservoirs also influence the hydrological conditions of the area. Rising air temperatures increase evaporation, which in turn decreases the amount of water available for agriculture. In regions where precipitation is expected to decrease in the future, which is the case for most of the South Caucasus, decreased water availability can be expected (Leummens and Mathews, 2013).

The 2013 UNDP/GEF project – Reducing Transboundary Degradation in the Kura-Ara(k)s River Basin – carried out a transboundary diagnostic analysis of the area[48] (Leummens and Mathews, 2013). The study concluded that there is strong evidence of reduced hydrological flow in the region of the Kura-Ara(k)s river basin, particularly in Armenia. Observations from hydrological stations in the three countries showed an overall decrease – although the results varied across the region. These variations and reductions in hydrological flow can be largely attributed to economic development and global climate change, and have serious implications for national economic strategies (Leummens and Mathews, 2013).

The 2011 UNDP/ENVSEC project on climate change impact for the South Caucasus carried out a similar analysis of the Khrami-Debed River Basin (a transboundary river basin shared by Armenia and Georgia), the Alazani- Ghanykh River Basin (shared by Georgia and Azerbaijan) and the Aghstev River Basin (shared by Armenia and Azerbaijan). Calculated projections, based on scenarios for temperature and precipitation,[49] showed an expected decrease in river flow of 45-65 per cent, 26-35 per cent and 59-72 per cent, respectively, by 2100 as compared to 1961-1990 (UNDP, 2011). Reductions in river flow will have an impact on river pollution, increasing the concentration of contaminants.

In Armenia, hydrological observations are carried out in 86 rivers and four reservoirs (Lake Arpi, Lake Akhurian, Lake Aparan and Lake Azati) as well as in Lake Sevan.[50] The long-term vulnerability of water resources was modelled in the last National Communication. Under the A2 scenario, the water flows in Armenia will decrease by approximately 12 per cent by 2030, 24 per cent by 2070 and 38 per cent by 2100 (MoNP, 2015). It is also feared that groundwater resources will be depleted as a result of reductions in precipitation, and that the combination of these reductions will lead to changes in the hydrological regimes of rivers, which, in turn, could have a serious impact on aquaculture and water supply in general (MoNP, 2015).

In Azerbaijan, river flow is expected to decrease by 10-15 per cent by 2040, 15-20 per cent by 2070, and 20-25 per cent by the end of the century due to climate change (MoENR, 2015). Even if precipitation in Azerbaijan increases in the future, the increase in evapotranspiration caused by rising temperatures is expected to outweigh the increase in precipitation. The water deficit in Azerbaijan is therefore expected to double (from about 5.0 km^3 to 9.5-11.5 km^3) by 2050 (WB, 2006).

In Georgia, glacial melting has resulted in a significant increase in runoff. However, this increase is not expected to continue, as glaciers continue to shrink in size toward the end of the century (MoENRP, 2015).

5.1.3. Changes in agricultural productivity and food security

In the South Caucasus, agriculture is one of the economic sectors most sensitive to climate change, and the impacts are already being felt. Agriculture will be directly affected (both positively and negatively) by rising temperatures, changes in precipitation and an increase in extreme events, which will lead to a decline in water supply and an increase in the demand for irrigation (Ahouissoussi, 2014). Agriculture was described by all the working groups in the National Consultations as the sector most vulnerable to climate change.

Changing climatic conditions – increasing aridity and more extreme weather events such as droughts, hail storms, floods, heatwaves and strong winds – severely impact the agricultural sector. Land desertification and degradation, through erosion and salinization further deteriorate agricultural productivity. The complex soil degradation process is subject to water scarcity, winds, droughts and heatwaves, and flooding along rivers or old irrigation and drainage systems (Ahouissoussi et al, 2014).

The World Bank's study of agriculture vulnerability in the South Caucasus states that, "the most important risk to agricultural yields in the region is water availability for irrigation" (Ahouissoussi et al, 2014). The study demonstrates that under all climate scenarios, irrigation water shortages can be expected in six water basins by 2040: Ganykh in Azerbaijan, Alazani in Georgia; Upper Ara(k)s in Armenia; Samur/Middle Caspian in Azerbaijan; Eastern Lower Kur in Azerbaijan; and Lenkeran/Vilesh/Southern Caspian, in Azerbaijan (Ahouissoussi et al, 2014). These water basins include some of the most high-value fruit and vegetable

45 It should be noted that forest fire attribution to climate change is unknown.
46 It should be noted that the importance of these features differs across the provinces.
47 Volume of timber harvested in forests in Georgia dropped from 915 323 m^3 to 670 241 m^3 between 2008 and 2014.

48 Data and information presented in the updated TDA comes from national experts as well as publicly available sources such as publications and statistics for Armenia, Azerbaijan and Georgia (Leummens and Mathews, 2013).
49 Using the same methodology and climate change models as described in chapter 3.2.
50 The observations are carried out by the Armenian State Hydrometeorological and Monitoring Service.

production areas in Azerbaijan and Armenia, as well as some of the best vineyards in Georgia (Ahouissoussi et al, 2014).

The World Bank´s agriculture vulnerability assessment in Armenia shows that for many of the country's key crops, yields are expected to decrease during the period 2040 to 2050, relative to current yields under a Medium Impact Scenario[51] (Ahouissoussi et al, 2014b). Yields of rain-fed apricots and grapes, in particular, are expected to decline by 28 and 24 per cent, respectively. Yields of rain-fed grapes and potatoes are expected to decline by 12 and 14 per cent, respectively. In the mountainous region, however, yields of tomato and wheat are expected to increase in both irrigated and rain-fed systems (Ahouissoussi et al, 2014b).

In Azerbaijan, yields of all key crops are generally expected to decrease across agricultural regions as a result of rising temperatures and water stress. Yields of potatoes and cotton are expected to experience the greatest decline. Pasture yields, on the other hand, are predicted to increase significantly, particularly in the high rainfall and subtropical agricultural regions (Ahouissoussi et al, 2014c).

Yields of corn, grapes, mandarin oranges, potatoes, tomatoes, and wheat, both irrigated and rain-fed, are expected to decrease by 2040 (under a Medium Impact Scenario) in the eastern lowlands, western lowlands and western mountainous agricultural regions in Georgia. In the high elevation areas of Eastern Georgia pasture yields are predicted to increase by 87 per cent, which could make cattle farming a highly profitable sector in these areas (Ahouissoussi et al, 2014a).

Climate change can also bring some opportunities for the agriculture sector. Increased temperatures will likely prolong the vegetation seasons in some parts of the South Caucasus. It could enhance the productivity, if adaptation measures are implemented. In Georgia, the vegetation period lengthened significantly, especially in the Kakheti and Kartli regions, and the longer growing season could enhance productivity, provided that irrigation water is available (UNDP 2014).

Droughts are affecting agricultural productivity through their adverse effects on water availability and land productivity. During drought years, many small river tributaries dry up completely. Due to the 2000-2001 hydrological drought in the South Caucasus, Lake Sevan reached its lowest level since 1990. Azerbaijan's reservoirs sunk to historic lows, forcing the country to tap its underground reserves. By the spring of 2001, the Ara(k)s River was nearly dry, and the water flowing from the Kura River to the Ara(k)s River was at around 30 per cent of normal levels. Consequently, disruptions in sturgeon and salmon breeding were reported because the fish were unable to navigate upstream. The 2000-2001 drought was the most economically damaging drought recorded in all three countries, and hit especially hard in districts with high poverty rates. Severe crop losses in 2000 also created a seed shortage in the following year (WB, 2006). In an exercise conducted by the World Bank, about 6 per cent of participants from 12 villages in drought-prone areas in Georgia reported conflicts with neighbours over water supplies as a result of the drought (WB, 2006).

Outbreaks of pests and animal diseases directly linked to climate change will most likely increase and new types of pests and diseases are expected to emerge. This could also lead to severe impacts on agricultural productivity. In Georgia, zoonotic diseases (such as anthrax, foot-and-mouth disease, rabies, brucellosis and tuberculosis) have been reported in about 2 000 pastures and grazing paths. In Kvemo Svaneti, Georgia, the incidence of these diseases has increased over the past 15 to 20 years (Ahouissoussi et al, 2014a). Anthrax epidemics are seasonal – starting in livestock during the transportation period, peaking in July-August and lasting until September-November. It is most likely related to soil temperatures and soil moisture. Incidences of foot-and-mouth disease also increase with high temperature and moisture. The height of the epidemic (1996-2006) coincided with significant changes in the climate. There are other zoonotic diseases, such as brucellosis, tuberculosis and rabies, which are widespread across all regions of Georgia. However, no research to analyse the correlation with climate change has been conducted. Concerns over pests, diseases and invasive species linked to agricultural productivity have also been reported in neighbouring Armenia and Azerbaijan. In Azerbaijan, locusts and grasshoppers are the most important threat to agriculture. During infestations and outbreaks, the three main species of locust pests attack cereal crops, sunflowers, vineyards, vegetable crops, orchards and grazing land. Locusts are becoming even more prevalent due to exceptional weather events associated with climate change.

5.1.4. Economic changes

Climate change will affect national economies in the South Caucasus mainly by increasing the number of natural disasters. In addition to the economic losses, the countries will face pressure on their national budgets for emergency services and response measures. Climate change will hinder economic development in tourism and construction, and impacts on the forestry sector will be a concern for Georgia as this sector has high economic significance. The agriculture sectors are important to the national economies through maintaining the domestic food supply, through the contributions of exports and through employment in the sector, and jolts to agriculture will reverberate throughout the countries.

Studies of risks and losses caused by climate change are largely missing in the region. Even comprehensive agro-economic trends that consider climate change are difficult to obtain, but there are some attempts to value economic losses based on historical data. In Armenia, an agro-economic analysis of wheat flour supply found that minimal precipitation and extensive drought resulted in market losses of US $7 million (MoNP, 2015). Georgia's wine industry, faces a future of climate change impacts that may reduce grape production and damage wine tourism.

Considering the climate change trends, it is most likely that all economic sectors will face economic challenges.

5.1.5. Social tensions

In the current social, political and economic context, where political dialogues are limited and a large part of the population lives below the poverty line, stressors such as ecosystem degradation and depletion of resources will most likely create additional tensions and disputes. The scale of these disputes may differ at times, having local characteristics such as competition over land or water resources, whereas in other cases the disputes may involve national values such as loss of important forest ecosystems. The tensions may arise between small communities and private entrepreneurs who act in an unsustainable way. The extent of climate change as triggering factor in such potential disputes are largely unknown, but climate change will likely increase the chances of such tensions.

Reductions in transboundary water resources present a potential risk of disputes and conflicts. Water management or mismanagement in upstream countries may create serious problems in downstream countries, and frontier regions are particularly sensitive. The Sarsang dam and reservoir in Nagorno-Karabakh, for example, poses a danger to the whole border region in Azerbaijan. The Sarsang dam and reservoir were built in 1976 to secure drinking water for the local population, divert irrigation water to adjacent agriculture land and serve as the main source of energy. Since the early 1990s, hundreds of thousands of people living in the area have been deprived of quality drinking water, and moreover, water from the reservoir is mainly released during autumn and winter but reduced in spring and summer when the need for irrigation water is high. The result is acute shortages of irrigation water in six regions of Azerbaijan. In addition, technical conditions of the dam and the reservoir are weakening over time, structures are ageing and maintenance is insufficient – all of which creates a major threat to security (Council of Europe, 2015). The effects of climate change will likely increase the security implication.

The quality of water resources, especially in transboundary rivers is also an important issue since highly polluted water may become even more polluted with reductions in hydrological flow, affecting downstream countries. In this regard Azerbaijan is especially vulnerable.

Ongoing land degradation and ill-defined land tenure arrangements may exacerbate conflicts between farmers. The spread of pests and diseases across borders requires dialogue and joint measures among countries of the region.

Vulnerabilities to climate change differ for men and women and could add to existing gender inequality in the South Caucasus. General gender inequities are attributed to differences in lifestyle, cultural behaviour and the distribution of financial resources linked to migration patterns and access to jobs. Rural communities are likely to be more exposed to climate change than urban communities, where there are more opportunities for work, and greater access to education and public services. Poverty, a key determinant of vulnerability, is higher in the countryside than in urban centres and poverty rates are also higher among women (Figure 17). Women are, therefore, likely to be more affected when additional difficulties occur.

51 There were three climate change scenarios employed in this study: 1. Low impact; 2. Medium impact; 3. High impact.

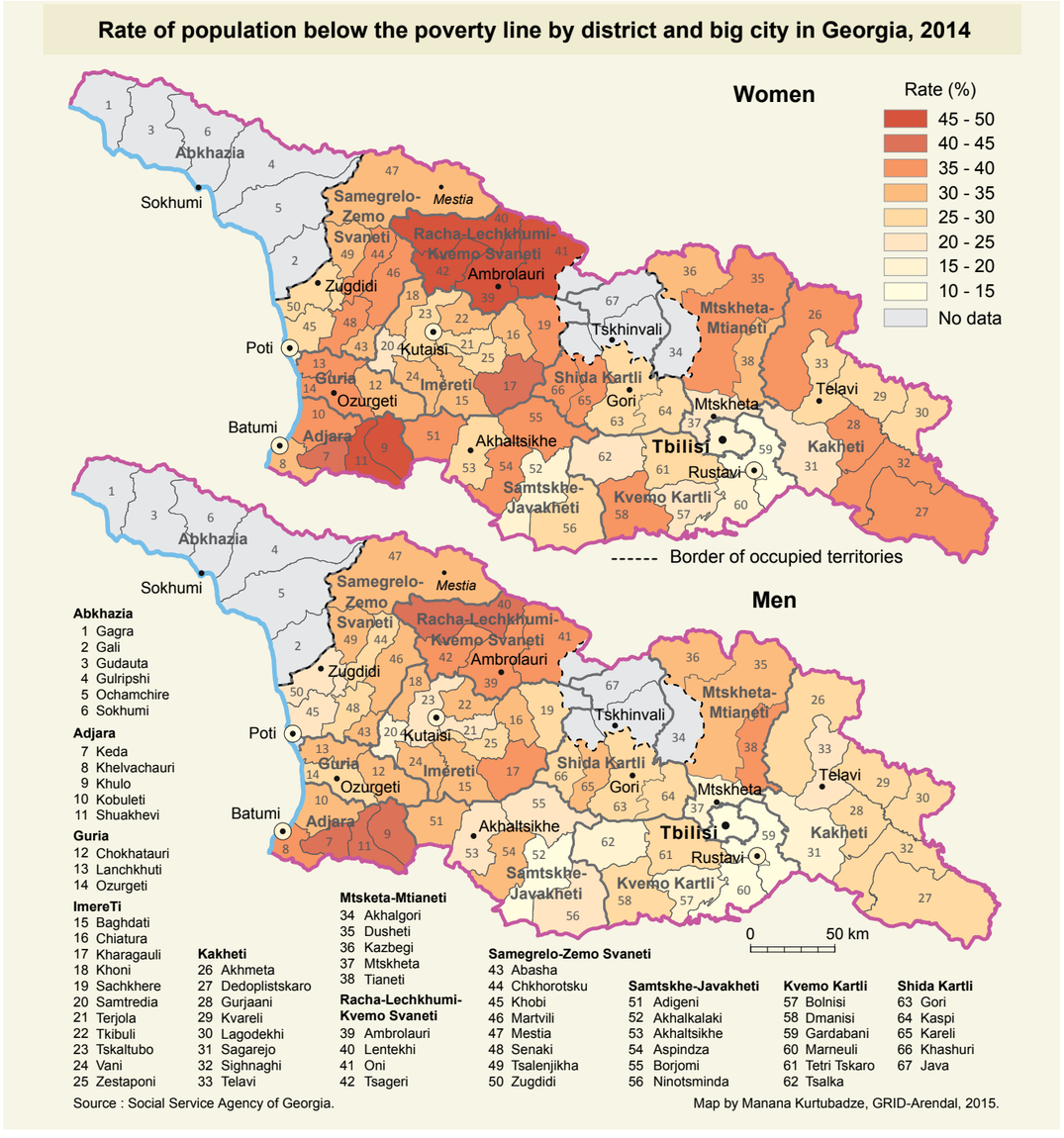


Figure 17: Rate of population below the poverty line by district and big city in Georgia, 2014

Rural communities have fewer opportunities for employment, and it tends to be men who migrate in search of better job opportunities elsewhere. While migration can help to enhance indirect economic development across the South Caucasus region, studies from Georgia have revealed that remittances have a limited impact on poverty and in reducing income inequality (Dermendzhieva, 2011). Outmigration also results in a loss of human capital and skews the gender balance in rural communities. The migration of young males reduces the overall resilience of rural communities, which are also left with a growing proportion of the elderly population who are more vulnerable.

In the South Caucasus, participation in the labour market and average monthly incomes are lower for women than for men (Khitarishvili, 2015). Traditional lifestyles and cultural behaviours are particularly strong in the countryside. While men are often responsible for generating income, women are responsible for securing basic household resources such as water, food and energy, which can be adversely affected by natural disasters or increased competition for natural resources as a result of climate change. Working conditions for women working in fields could also deteriorate with the rise in temperatures and harsher weather conditions.

In addition, the impacts of climate change on specific vulnerable groups such as women are not addressed in any government assessment or policy document (Shatberashvili, 2015). Further studies are needed in this area.

5.1.6. Infrastructure vulnerability

Infrastructure is critical to the functioning of a state. It can be exposed to sudden-onset climate-related hazards or slow-onset events such as gradually increasing temperatures and sea level rise.

Many climate-induced hazards such as landslides, mud slides and floods cause significant damage to critical infrastructure (such as roads, pipelines, industrial facilities and mines at high elevations) as well as to urban areas and settlements. Many urban areas in the region are located in mountainous terrain, which make them prone to natural disasters (such as the Tbilisi floods in 2015). These can have devastating impacts on large-scale infrastructure networks such as transportation routes, pipelines, and energy grids. For example, the landslide in Dariali Gorge, Georgia in May 2014, damaged the main gas pipeline supplying Armenia with gas.

Devastating damage to infrastructure due to hazardous events can also lead to pollution and contamination. In September 2013, an extreme weather event caused flooding of the Tskhenistskali River, inundating the area around Tsana, Georgia. Over 50 000 tons of arsenic waste material is stored on the site of an old mining factory that ceased operation in the early 1990s. As a result of the floods, the wall of the waste burial site was washed away, exposing the steel containers and increasing the risk of hazardous waste leakage. An immediate intervention was required to prevent a serious disaster. The increase in extreme weather events as a result of climate change exacerbates the risk of similar events being repeated in other areas. It is imperative that preventative measures are implemented in similar locations to protect human health and lives.

The impact of natural hazards on dormant infrastructure – legacies from the Soviet era – as well as remnants from previous conflicts, pose a significant security risk. Examples from other regions demonstrate the security concerns in areas covered by unexploded landmines. These can explode or be moved considerable distances as a result of floods or landslides. The explosion of a mine during a clean-up operation after flooding in Bosnia and Herzegovina in 2014 provides a stark example of the dangers (Alfthan et al., 2015). According to UNDP, over 30 000 unexploded landmines were recovered and disposed of during the emergency flood response in Bosnia in 2014 (UNOCHA, 2015). Disaster risk reduction measures in the South Caucasus region should consider these risks, particularly in areas covered by unexploded landmines.

Gradually increasing temperatures or slow-onset events will also likely weaken the quality of infrastructure. Climate-resilient construction standards are critical in planning future infrastructure projects, including transportation networks and hubs, and new industrial facilities or buildings. So far, construction standards, construction materials, engineering or physical locations of projects do not consider climate change implications. For instance, road construction using asphalt of low quality without taking impacts of climate change into account may contribute to security implications in the futur.

Climate-resilient construction standards are critical in planning future infrastructure projects, including transportation networks and hubs, and new industrial facilities or buildings. This is particularly true for industries planned for, or located in, high-risk areas. All industrial activities require additional technical security measures to ensure safe operation. It is important to ensure that mining companies are not exceeding loading capacities (such as for old dumps and tailing ponds) and that new tailings management facilities are developed using sound construction standards.

Natural resource extraction activities including mining play an important role in all three countries and, in some cases, have resulted in degradation of land and contamination of water resources. In combination with events caused or enhanced by climate change, such as heavy precipitation, landslides and mud slides, avalanches and strong winds, the extraction of natural resources can lead to severe impacts on human health and ecosystems (MoNP, 2015; MoENR, 2010).

Both Georgia and Azerbaijan will likely be impacted by sea level rise, and other marine related hazards (such as surges and storms). The Black Sea coast is exposed to tectonic movements[52] causing a significant change in the coastline (MoEPNR, 2009; UNDP, 2013a), although to date there are no documented cases of population displacement in Georgia as a result of sea level rise. In 2013, a magnitude-six storm destroyed power lines, caused accidents at several locations along a gas pipeline, and damaged homes and public buildings (UNDP, 2013a). The greatest impacts were observed in the Kolkheti Lowlands – an area which lies below sea level and stretches along the coast – in particular, around the city of Poti on the Rioni River Delta.

52 Rioni River estuary is sinking by 6.5 mm/year, while the coast area of Supsa-Kobuleti-Tsikhisdziri segment goes up by 1-2 mm/year, but Kakhaberi lowland where Batumi port is located, is sinking by 0.8 mm/year (USAID, 2016).

Azerbaijan's Caspian Coast is also exposed to sea level fluctuations and seasonal sea level rise. In Lenkoran, one of the most densely populated regions of Azerbaijan, there are around 850 households along a 40-km stretch of coastline affected by rising sea levels. In 1999, 672 houses in Lenkoran and 18 public buildings along the coast had to be evacuated due to permanent flooding (Kudat et al., 1999). The Caspian Coast is home to several million of people, along with 70 per cent of the country's industry (MoENR, 2010). Infrastructure and the energy sector were identified at the Azerbaijani consultation workshop as being particularly vulnerable to climate change; with concerns expressed over damage to roads, power lines and communication networks. The risk of sea level rise and the likely damage to essential infrastructure could pose additional risks to the security of the region and increase levels of migration and displacement.

Extreme weather events are likely to continue affecting the energy sector and its infrastructure, including electricity transmission networks. In Georgia there are frequent disruptions to electricity supply and the system requires substantial renovation. This was highlighted at the Georgian consultation workshop, where the energy sector and infrastructure were identified as being particularly vulnerable to natural hazards. The impacts on hydropower stations, transmission lines and infrastructure located along the coast were areas of particular concern.

5.1.7. Changes in the spread of diseases

During the national and regional consultations, participants expressed concerns related to human health, in particular, the direct or indirect impact of climate change on the security of human health. Direct impacts include for instance cardiovascular diseases brought on by heatwaves or the impacts of natural hazards; whereas indirect impacts include the spread of infectious diseases related to inadequate water, sanitation and hygiene. For instance, outbreaks of diarrhoeal diseases can occur after flooding if water gets contaminated with human or animal waste, or droughts can increase the risk of diseases associated with lack of water for hygiene. Water-borne, food-borne, vector-borne and rodent-borne diseases will most likely increase vulnerability of human health with a changing climate.

In Armenia, climate change will likely contribute to spread of water-borne, food-borne, vector-borne and rodent-borne diseases. Extremely dangerous infections such as plague, tularaemia, anthrax, western tick-borne encephalitis have been recorded in Armenia (MoNP, 2015). Warmer climates are likely to be contributing to a significant growth in acute gastrointestinal diseases and upper respiratory morbidity incidents (MoNP, 2015). It is also feared that warmer temperatures could have an impact on the extent of cardiovascular diseases and arbovirus fevers (such as Crimean-Congo haemorrhagic and tick-borne encephalitis). The National Consultation in Armenia notes that the country was declared malaria-free in 2011, but malarial mosquitos are still present in Armenia and cases of imported malaria have been recorded, highlighting the need to continue efforts to combat the disease (MoNP, 2015).

In Azerbaijan, diseases related to extremely hot weather events are likely to increase significantly by the end of the century. Baku and other large cities will be directly exposed to heatwaves, which are expected to have an impact on human health security (MoENR, 2015). The initial predicted rise in temperature (by 1.5°C -1.6°C between 2021 and 2050) is likely to have little impact on malariagenic conditions. A further rise in temperature between 2071-2100, however, is expected to lengthen malariagenic periods and increase the geographic scope of malariagenic conditions, which could move up to higher elevations. Since only 1.2 per cent of the population lives above 1 500 metres, the occurrence of new malaria hotspots is unlikely (MoENR, 2010; MoENR, 2015). Annually, over 11 000 people in Azerbaijan suffer from general acute gastrointestinal infections (MoENR, 2010). Transmissions are largely the result of the quality of water (both at springs and in supply systems) and food products. While these diseases were in decline for a long period, there has been a recent resurgence due to rising air temperatures, poor-quality drinking water, flooding of human settlements and the dilapidation of the sewage system (MoENR, 2010).

In Georgia, human health vulnerabilities in the context of the existing health care sector were analysed in the Third National Communication to the UNFCCC. It revealed that diseases fostered by a changing climate are unevenly distributed across municipalities (MoENRP, 2015). Special interest was given to diseases that are recognized by WHO as climate-dependent: diarrhoeal, water-borne, food-borne, vector-borne, rodent-borne, respiratory and cardiovascular diseases; as well as some pathologies related to extreme events such as psychic disorders and traumas, including radiation and thermal stroke-related pathological states. The regions where climate change is likely to have the greatest impact on human health are Ajara, Upper Svaneti, and Kakheti (MoENRP, 2015). An increase in infectious and diarrhoeal diseases is predicted in Dedoplistskaro[53] as a result of increases in temperature and a reduction in water supply. In Adjara, the incidence of diarrhoeal and infectious diseases and post-traumatic psychic disorders (as a result of hazardous events) is higher compared to the rest of Georgia. Infectious, vector-borne diseases, such as Leptospirosis and Borreliosis, which are uncommon or new to some regions, have been reported as result of changes in climatic conditions. Several cases of Crimean-Congo disease were detected in Borjomi in 2014. Incidences of cardiovascular diseases are higher in Tbilisi compared to other regions and increased between 2003 and 2013 (MoENRP, 2015). This relates to the rise in air temperature, the increase in the number of hot days and the decrease in precipitation (MoENRP, 2015). A significant increase in cases of cardiovascular diseases was also recorded in the Kakheti region. Moreover, widespread diseases may be of concern to other sectors such as the tourism sector (MoENRP, 2015). In general, the health care system has been improved as the country launched a Universal Health Care Programme in 2013. Over 90 per cent of the population now benefits from public health care coverage, where the state covers primary care, emergency care and some elective inpatient services (WHO, 2015a and b). However, the capacity of the health care system to address the additional pressures caused by climate change is limited, both in terms of the lack of existing protection measures such as health insurance schemes, and the ability to respond to outbreaks and treat new diseases.

5.1.8. Changes in income and poverty

The South Caucasus countries rely heavily on ecosystem services. Deterioration of those services will most likely affect households in direct and indirect ways. Direct impacts arise from destruction of properties including housing and land, and through activities dependent on natural resources such as subsistence farming or small tourism businesses. Indirect impacts are numerous. For instance, higher food prices and food insecurity will cause indirect implications particularly to poor households. Other impacts include the effects of reduced national budgets on public services. Thus, climate-related hazards will particularly affect poor rural areas and marginal households in urban areas in multiple ways. In addition, these households have less capacity to adapt.

In Georgia, given that agriculture production accounts for 45 per cent of household incomes in rural areas, and subsistence agriculture accounts for 73 per cent of rural employment, climate-induced disturbances are a critical factor for instability of marginal households. In Armenia, where the poverty rate reaches 32 per cent and agriculture is geared toward subsistence farming, climate challenges will undermine poverty reduction efforts (MoNR, 2015).

There could be some advantages for some activities such as tourism. Prolongation of the season and good tourism conditions could possibly help some people who are involved in the sector. For instance, the tourism sector in Georgia offers diverse natural recreation and cultural heritage sites in both cities and remote areas. Tourism has a growing importance for the national economy, reaching 6 per cent of GDP in 2015, and it also provides income for small businesses (USAID, NALAG, 2016). Some favourable conditions are foreseen for summer tourism seasons in some municipalities such as in the Borjomi area, but winter tourism will face some challenges (USAID, NALAG, 2016).

5.1.9. Changes in migration

Loss of livelihood, natural disasters, the destruction of physical assets, instability and limited access to resources can lead to forced migration. Vulnerable groups are usually more exposed to these hazards as they often depend on natural resources for their livelihood. Migrants are often forced to move to a new area where they have no social networks and little or no access to resources. Tensions may arise over natural resources such as water, pastures and woodlands between and within new communities where migrants resettle. An analysis of migration in the South Caucasus between 1988 and 2011 (Figure 18) shows how environmental and natural disasters led to large-scale migration, mostly within the region. Given the predicted impacts of climate change, levels of migration are expected to increase. References to migration due to environmental and natural disasters were made in all of the National Consultations. In Azerbaijan, migration was mentioned as an important climate change related concern.

53 Third National Communication from Georgia states that Dedoplistskaro is demonstrating more climate change than in other municipalities, but Kakheti has the highest indicator of cardiovascular diseases and hypertension. However, because Dedoplistskaro is prone to climate changes such as droughts and hot days, the frequency of cardiovascular and respiratory diseases is likely to increase (MoENRP, 2015).

Figure 18: Migration due to environmental and natural disasters in the South Caucasus, 1988-2011

The relationships between migration, climate change and the environment are complex not only in the South Caucasus, but also globally. Over the last 20 years, the international community has slowly begun to recognize the wider linkages and implications of a changing climate on the environment and human mobility. Although relatively advanced in terms of the development of legislative processes related to Internally Displaced People (IDPs), countries in the South Caucasus do not yet recognize the status of people and communities who relocate due to ecological deterioration or disasters. Consequently, analyses are based on a few selected documented cases. Some documents and reports refer to these people as “eco-migrants” (CENN, 2013a; CENN, 2013b; CENN, 2013c). In Armenia, migration due environmental and natural disasters are usually categorized under socioeconomic migration even though social and economic factors are often not the main drivers. The linkage between climate change and migration is also difficult to quantify considering the fact that South Caucasus countries have always been prone to natural disasters and therefore attributing the extent of climate change is problematic.

In Georgia, the first documented cases of migration due to environmental and natural disasters were in the 1980s when two large-scale landslides in the region of Svaneti and Adjara forced approximately 40 000 people to relocate (CENN, 2013a). Since then, casualties from floods, flash floods, landslides and mudflows have been recorded regularly. The Ministry of Environment and Natural Resources in Georgia estimates that there are 37 000 households affected by natural disasters, of which 11 000 need urgent resettlement (CENN, 2013a). The regions most vulnerable to landslides in Georgia are Adjara, Samegrelo-Zemo Svaneti, Racha-Lechkhumi and Mtskheta-Mtianeti; and in Armenia are Lori and Tavush marz (CENN 2013a; CENN and Green Lane, 2013).

Migration due to environmental issues in Adjara, Georgia

In Georgia, in the northern Adjara region, people are moving away from the region as a result of the degradation of agricultural land. These people are often referred to as “soil migrants”. In 2011, Adjara had a population of 390 600, which represents roughly 8.6 per cent of Georgia’s population. Agricultural land comprises 25 per cent of the territory, of which 58 per cent suffers from various types of erosion. Important contributing factors include rapid and intensive precipitation, which is particularly damaging to slopes lacking vegetation. Illegal logging and unsustainable agricultural practices (overgrazing and intensive land cultivation) have accelerated the land degradation processes (UNDP, 2013a).

For centuries, natural disasters have forced people to migrate in Azerbaijan. As there is no official distinction between IDPs and migration due to environmental and natural disasters, it is difficult to determine the extent of the problem. However, recent flooding events worth noting occurred in 1995, 1997, 2003, 2009 and 2010. The worst flood in the region occurred on the Kura-Ara(k)s River in May-June 2010 affecting 40 surrounding districts (IFRC, 2010); 20 000 homes in the districts of Sabirabad, Salyan and Imishli were severely affected; 50 000 ha of land were flooded, destroying dams and roads, and about 32 000 people were evacuated (IFRC 2010).

Legislation does not provide any protection to migrants who have been forced to resettle as a result of environmental problems or natural hazards. Nonetheless, this situation appears to be changing: the State Ministry for Reconciliation and Civic Equality in Georgia, for example, is developing legislation on the management of eco-migration processes. There are some pilot transboundary initiatives in the following regions: Adjara Autonomous Republic, Mtskheta-Mtianeti region, Kakheti region, Kvemo (lower) Kartli region in Georgia; Lori and Tavush marzes in Armenia; and Saatli, Imishli and Sabirabadrayons in Azerbaijan (CENN, 2013a; CENN, 2013b; CENN and Green Lane 2013)

5.2. Adaptive capacity

Adaptive capacity typically includes social and economic measures such as education, poverty levels and diversity of income, along with institutional capacities related to governance and management of natural resources. Technology exchange and external assistance play major roles, as not all countries have the financial capacity to engage in economic reforms to combat climate change. Ecosystems, regions, countries and economic sectors with resilience and a high capacity for adaptation are less vulnerable to climate change, and strong well-balanced economies and effective governance improve adaptive capacity, while healthy ecosystems ensure higher resilience.

The efficiency of adaptive capacity at the national level depends on a number of factors such as available funding, institutional capacities and the level of political support. Regional climate change adaptation measures are largely dependent on inter-State dialogue and co-operation, which are currently limited by political challenges. Climate change considerations should also be seen as an opportunity for enabling sectors to take advantage of possible new developments such as new technologies and practices, but this requires a robust strategic vision. National climate change adaptation strategies are still lacking in the South Caucasus countries while there are a number of initiatives that have emerged at the provincial level.

5.2.1. Financial capacity

In response to commitments to tackling climate change, the South Caucasus countries are putting notable efforts into new research, and into adaptation and mitigation measures. The number of concrete initiatives that have been implemented over the last five years can be seen as a measure of progress in responding to climate change concerns. It is difficult to determine accurate budgetary allocations in each country, as there is both direct and indirect funding of climate change initiatives at different levels. Attention has been given to establishing new institutional structures, raising awareness and building knowledge, but with international assistance – foreign aid and loans – the countries are starting to implement large-scale projects such as irrigation rehabilitation and flood prevention.

The South Caucasus countries have achieved progress in economic development and the implementation of structural governance reforms – a critical step to addressing climate change commitments. However, considering the multitude of other national priorities and the implications of climate change across the social, economic and environmental sectors, current financial allocations are largely insufficient. An analysis of financial allocations in Georgia (Figure 19) shows that the majority of funding is allocated to projects dealing with climate change mitigation. Within climate change adaptation, priority is given to disaster risk management, biodiversity, forestry, agriculture and strengthening local capacities. Climate change adaptation concerns are clearly regarded as an environmental protection issue.

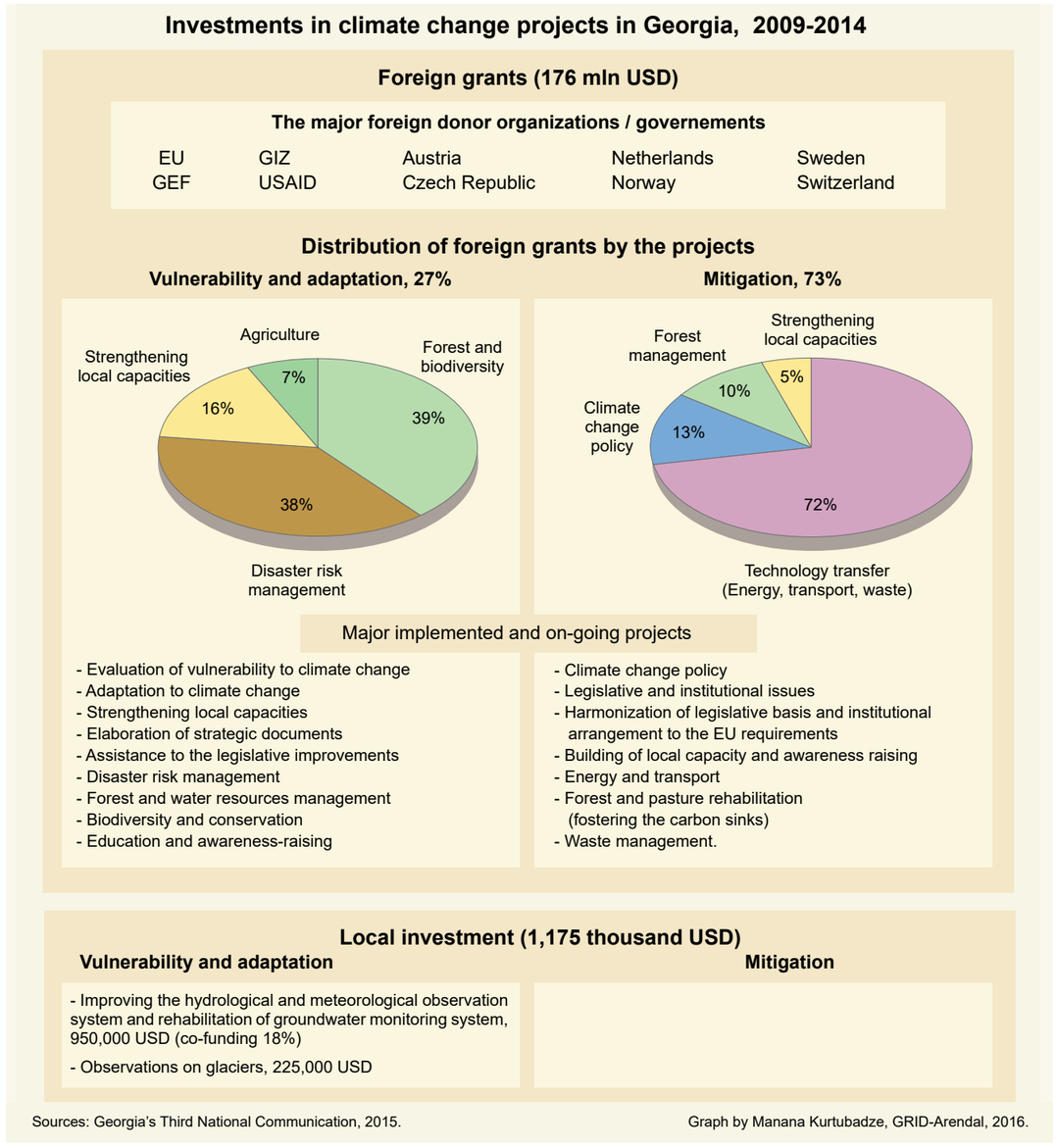


Figure 19: Investments in climate change projects in Georgia, 2009-2014

To date, financial assistance to address climate change adaptation measures is primarily provided by development banks, international agencies such as UNDP, the EU and a variety of bilateral initiatives. This has made it possible to follow up on recommendations deriving primarily from National Communications to the UNFCCC. Large-scale development projects within the sectors where climate change and security risks have been identified are being implemented in all three countries. These projects are funded through loans from development banks with matching funds from national budgets. However, it remains to be seen to what extent future climate change is considered in these projects.

Through the Global Environmental Facility (GEF), UNDP has helped the South Caucasus countries gain a better knowledge of local and regional climate change through modelling such as the Regional Climate Change Impact Study and the UNFCCC National Communications. These mechanisms have also enabled the countries to develop concrete climate change strategies – both overarching and sector specific. Georgia, for example, has developed climate change strategies for the provinces of Adjara, Kakheti, and Upper Svaneti; the climate change strategy for Kakheti is primarily targeted at the agricultural sector.

In Armenia, climate change adaptation measures in recent years were implemented in the water, agriculture, biodiversity and health care sectors; and measures were introduced to identify and reduce impacts from climate-induced natural hazards. The Government's role is mainly limited to policy development, establishing institutional structures and securing finance from different donors to implement a variety of studies and technical projects. Armenia relies on international support for adaptation related activities and developing an adaptation programme (MoNR 2015).[54]

Various donor-funded projects support agricultural development in Armenia, some of which also address climate change and security concerns. The projects cover agriculture management;[55] productivity and sustainability of grasslands and pastures; prevention of crop and animal diseases, and pest control; selection and cultivation of drought-resistant hybrids; and irrigation rehabilitation.[56] Armenia´s priority on energy security and energy efficiency has led to energy projects for securing electricity supply[57] and developing renewable energy with the aim of increasing the reliability and capacity of transmission networks.

Moreover, in 2009-2010 the State financed over 70 scientific projects relating to environmental issues, the majority of which are linked to biodiversity and desertification – topics relevant to climate change in Armenia. The Ministry of Territorial Administration and Emergency Situations prioritizes emergency mitigation, preparedness and response initiatives, and has implemented concrete risk reduction measures such as anti-hail stations. In Armenia, there are 370 anti-hail stations of which 240 are state-owned.[58]

Azerbaijan has a higher financial capacity for supporting climate change adaptation measures In addition, Azerbaijan also relies on foreign aid and loans. For example, Azerbaijan allocated about 60 million Manats for reconstruction after the flooding of the Kura and Aras Rivers in 2010 (Reliefweb, 2011). Important investments have been allocated for remediation of former industrial zones around Baku to reduce exposure to possible climate-induced events. Energy is the main priority, with projects aimed at developing renewable energy sources.[59] Less assistance goes to the agriculture sector. However, since 2001, there have been 17 projects in this sector that are funded by donor groups like the United States Agency for International Development (USAID), the World Bank, GEF, the EU Technical Assistance to the Commonwealth of Independent States (TACIS), the International Fund for Agricultural Development (IFAD) and the EU. Assistance in the agricultural sector relates mainly to improving yields and augmenting profitability. While none of these initiatives are primarily focused on improving security or reducing disaster risk many contain elements conducive to protecting against the impacts of climate change. The Regional Environmental Centre for the Caucasus (REC Caucasus) supports the development of biodiversity conservation policies and practices in the mountain regions of South Caucasus. This project spans all three countries and aims to raise awareness and improve the capacity of local communities and authorities to address biodiversity loss in forest ecosystems. Although this might not be directly linked to human security, the protection of biodiversity and ecosystems will provide Azerbaijan with sustainable natural resources, prevent soil degradation and, in some cases, improve the canopy cover. Additional assistance is given to sustainable land use and forest management initiatives in the Greater Caucasus through the GEF project. Ambitious targets have been set to increase the vegetation cover of 12 500 ha of pasture and maintain about 20 000 ha of forest.

As in neighbouring countries, climate change related projects in Georgia are implemented mainly through funding provided by international donors. Over the past five years, Georgia has received funding for 14 ongoing projects in the areas of climate change mitigation, adaptation, energy efficiency and disaster risk reduction. Considerable financial support for the realization of these projects has been secured and some have already demonstrated positive benefits for local communities. At times, these projects focus on the security aspects of climate change. In 2010, USAID-Caucasus launched a US $6.5 million programme entitled "Integrated Natural Resources Management in Watersheds of Georgia" (GLOWS, 2016). The project has carried out pilot activities in four representative watershed areas: Alazani-Iori and Rioni river basins in Upper and Lower Alazani and Upper and Lower Rioni. The project focused on the safety of local communities by identifying risk zones. The Adaptation Fund has also provided financial assistance to Georgia and allocated US $5.3 million to the Ministry of Environment and Natural Resources to tackle flooding in the Rioni River basin between 2014 and 2016. The aim of the project is to help the Government and the population of

54 Protocol Decision no. 47, adopted on 14 November 2013, Armenia.
55 Agricultural Resource Management and Competitiveness Project (US $21.33 million), IDA Credit and the Government of Armenia.
56 Irrigation System Enhancement Project (US $37.5 million), IBRD loan and the Government of Armenia.
57 Electricity Supply Reliability Project (US $52.00 million); IBRD loan and the Government of Armenia.
58 http://www.tert.am/en/news/2014/07/11/hakakarktayin-kayan/.
59 Pirakushkul Wind Park (€165 million), KFW Bank and the Government of Azerbaijan; Absheron Solar Park (€87.5 million), JLCA and the Government of Azerbaijan.

the Rioni River basin to develop its adaptive capacity and embark on climate-resilient economic development. The project is also looking into establishing vegetation buffers for flood prevention and an early warning system.

5.2.2. Institutional capacity

As Parties to the UNFCCC, the three South Caucasus countries have established institutional units to comply with their international obligations and facilitate national processes to deliver on national commitments. The institutional arrangements, decision-making processes and intergovernmental communication mechanisms are specific to each country.

The Government of Armenia launched the Inter-Agency Coordinating Council on Climate Change composed of high-level officials from different sectors. The inauguration, chaired by the Ministry of Nature Protection, was held in spring 2013. Due to the complexity of climate change issues and their impacts, a range of line ministries, such as the Ministries of Nature Protection, Agriculture, Territorial Administration and Emergency Situations, the Ministry of Urban Development, and the Ministry of Energy and Natural Resources, were engaged by the Council. The Ministry of Territorial Administration and Emergency Situations, which is one of the lead governmental bodies dealing with climate change issues and their impacts, solely focuses on emergency response rather than on prevention and preparedness activities. On a more operational level, the Climate Change Information Centre serves as the main gateway to climate change-related activities and manages an extensive network of partners within the country.

In 2013, Armenia established a new institutional unit, the National Centre for Disease Prevention and Control subordinated to the Ministry of Health, with the aim of implementing more coordinated and effective measures for ensuring the sanitary-epidemiological security of the Armenian population. However, even though Armenia is moving in the right direction, institutional capacities are insufficient for tackling climate change concerns. The Government itself recognizes that it lacks the capacity to deal with challenges in the agricultural sector (MoNP, 2015). Armenia is struggling with a lack of data and research (including modelling capacities) and a lack of practical experience in tackling climate-induced problems at the local level.

In Azerbaijan, the Ministry of Ecology and Natural Resources is defined as the coordinating body on climate change-related issues and is responsible for preparing the National Communications for the UNFCCC. The Climate Change and Ozone Centre (which has a staff of about 20 people) within the Ministry is the designated national authority for climate change-related issues. The Ministry of Emergency Situations, established in 2006, is the executive authority responsible for civic defence, protection against, and elimination of, the impacts of natural and man-made disasters. It is also responsible for the enforcement of safety standards for water infrastructure, the construction sector, industry, mining operations and the operation of small vessels, as well as policymaking, regulation, monitoring and co-ordination. Other government bodies that play an important, albeit indirect, role in addressing climate change issues include the Ministries of Agriculture, Economy and Industry, Education, Energy, Health, the Interior and Transport. In Azerbaijan the powers and responsibilities remain under the control of central authorities. Local municipalities have not yet been able to play an active role in local climate change mitigation and adaptation measures.

The Ministry of Environment and Natural Resources Protection in Georgia – which consists of the Climate Change Unit, the National Environmental Agency and the National Forestry Agency - lead and coordinate all activities related to climate change. Georgia sees other ministries such as the Ministry of Economy, Energy, Agriculture, Health Care, Finance, Foreign Affairs, Culture and Education and Science as supporting institutions to climate change-related issues. The Emergency Situations and Civil Safety Service, an important institutional structure in regard to hazardous events, is under the supervision of the Ministry of Internal Affairs. Although the expertise and financial capacities of these institutions are improving, they still remain inadequate. In the broader context, Georgia´s engagement in the Association Agreement with the EU, which includes climate change issues, will require additional expertise and financial help at all levels.

Georgia has been paying particular attention to climate change issues at the local level. It recognizes the lack of local government capacity, and has therefore instigated ongoing initiatives to strengthen the knowledge base for climate change adaptation and mitigation at the local level through training and dialogue. Georgia has been actively engaged in the Covenant of Mayors Initiative since 2008. In addition, the Georgian Government has also prepared a low-emission development strategy, which aims to create a long-term development plan that supports the country's economic growth on the one hand, and reductions of greenhouse gas emissions on the other. Adaptation strategies were prepared for the Adjara, Zemo Svaneti and Kakheti regions, which are the most vulnerable areas to climate change with serious security implications.

5.2.3. Regional processes

The geopolitical climate in the South Caucasus is still very fragile and regional co-operation on climate change adaptation activities has been limited. Projects targeting all three Caucasus countries do exist, but they remain fragmented and specific to individual sectors. These are supported by different donors including the World Bank and the European Union, and are implemented by regional NGOs and national stakeholders. Policies aimed at regional environmental management and climate change adaptation strategies have yet to be developed and initiatives remain localized.

In the South Caucasus, transboundary waterways are regional climate change and security hotspots. When successfully managed, they serve as examples of goodwill and friendly relations between neighbouring states. When they become the subject of rivalry and competition transboundary waterways may challenge national and regional security. The Kura-Ara(k)s river system is an example of an area where a lack of dialogue and co-operation contributes to existing tensions. Over the coming decades, the adverse effects of climate change, especially those linked to water availability, are likely to exacerbate these tensions.

On the other hand, there are several examples of successful joint management of transboundary waterways in the South Caucasus. In 2010, Azerbaijan and Russia signed a border delimitation and water-sharing agreement for the Samur river. The agreement states that each country will have an equal allocation of water.[60] Armenia has international water use agreements with Turkey for the Ara(k)s and Akhuryan Rivers, and with Iran for the Ara(k)s River. Before the break-up of the former Soviet Union, water issues were dealt with through decisions adopted among ministers of the Soviet states. Consequently, decisions and agreements were made between Armenia and Georgia on the use of the Debed River and between Armenia and Azerbaijan on the use of the Arpa, Vorotan, Agstev and Tavush Rivers. These decisions and agreements have generally been accepted and honoured by the former Soviet states. Currently Georgia and Azerbaijan are discussing a bilateral agreement on shared water resources in the Kura River basin, supported by OSCE and UNECE, within the framework of the Environment and Security Initiative. Several agreements between Georgia and Turkey regulate their co-operation on the Chorokhi (Coruh) River (UNECE, 2011). Since 2006, Armenia and Iran have jointly monitored surface water quality in the River Ara(k)s along the border.

The benefits of regional co-operation, particularly in the area of water resource management, are recognized through a variety of studies. A recent World Bank report, "Building Resilience to Climate Change in South Caucasus Agriculture", quantifies the impacts and identifies the key priorities for policies, programmes and investments to reduce the vulnerability of agricultural systems. Clear opportunities for co-operation in the agricultural sector were identified, which include coordinated management of water resources, collaboration on agricultural research and the joint development of a regional network for advanced weather forecasting (Ahouissoussi 2014). The EU-funded project, "Enhancing local capacity and regional co-operation for climate change adaptation and biodiversity conservation in Georgia and South Caucasus", aims to enhance regional co-operation among the three countries in an effort to identify transboundary climate change issues and mitigation efforts.

The Eastern Partnership is an initiative of EU member states that aims at improving the EU's external relations with Eastern European and South Caucasus countries by broadening political co-operation and economic integration. This partnership provides four thematic platforms for co-operation. Platform 2 – Economic Integration and Convergence with EU Policies – sets out the environment and climate change as core themes to be addressed within the framework of the initiative. Programmes under the Eastern Partnership Territorial Co-operation have been given priority as joint cross-border projects aiming at promoting synergies in agriculture and related economic sectors, finding joint solutions for common environmental problems and enhancing emergency preparedness. Joint co-operation initiatives are under way between Georgia and Azerbaijan and between Georgia and Armenia.

The Regional Environmental Centre for the Caucasus, a non-governmental organization, is the only instrument with a regional mandate in which all three countries share responsibilities. It provides support to countries in strengthening sustainable management of natural resources and protection of ecosystem integrity through biodiversity conservation and the sustainable use of agro-biodiversity.

The University of Geneva and UN Environment have also shown interest in establishing an open regional scientific network for the benefit of all three South Caucasus countries. The scientists have called for enhanced efforts towards the sustainable development and environmental protection of the Caucasus mountain ranges and their inhabitants. These and other initiatives are laying the foundations for much needed regional dialogue over natural resources.

5.2.4. National climate change policies and plans

Over the last decade, the South Caucasus countries have developed a number of national strategies and action plans for different national priority areas: sustainable development, poverty reduction, energy, agriculture, and environmental protection - all of which will be affected by future climate change. These efforts clearly show that the countries regard adaptation to climate change implications and risks at national level as important. However, it should be noted that a shift of focus on climate change adaptation is a fairly new requirement, therefore none of the countries

60 The Regional Network of Water (Basin) Organizations from Eastern Europe, Caucasus and Central Asia - NWO EECCA, 19.04.2010: Azerbaijan and Russia have agreed on the delimitation of the border and water allocation in the Caspian Sea http://www.eecca-water.net/content/view/479/51/lang,russian/.

has established a specific national climate change policy. Nevertheless, all three countries have declared the need for developing national adaptation plans.

Armenia's Sustainable Development Programme, aproved in 2008, considers climate change and security within the water sector, and recognizes the need for equitable water distribution in the agriculture and energy sectors. According to this programme a strategy should be developed to protect national water resources, regulate river flows and ensure the availability and rational use of water to prevent possible conflicts between water users.

In the environment sector in Armenia, concrete action plans have been developed on biodiversity, forest land desertification and degradation with some adaptation measures. There are also some intersectoral dialogues that address climate change. Currently they are predominantly focused on the implementation of mitigation activities, such as utilizing more renewable energy sources, improving energy efficiency and promoting energy saving. Security matters relating to climate change have not yet been addressed in sectoral strategies such as energy (Government of the Republic of Armenia, 2005), and agriculture (MoA, 2010). The strategy on agriculture makes references to measures to mitigate the impact of natural disasters (such as a regulating insurance system, the implementation of anti-flood and anti-hail measures and water conservation), but these need to be developed further. The recently launched National Disaster Risk Management Programme in Armenia may advance disaster resilience in the future. The Armenian government also recognizes the need to develop a national strategy on climate change adaptation to address cross-cutting issues (Government of the Republic of Armenia, 2015).

In 2009, Azerbaijan's MoENR significantly expanded the number of activities that focused on providing solutions to ecological issues. The concrete climate change adaptation policies and strategies, however, have yet to be developed (Shatberashvili, 2015). The State Programme on the Reliable Food Supply to the Population in the Azerbaijan Republic (2008-2015) is probably the most comprehensive sectoral policy document to address the impacts of climate change. The State Programme on Poverty Reduction and Sustainable Development includes some aspects of energy security and climate change challenges but these are limited.

Azerbaijan, which is party to the Convention on Biological Diversity, recognized climate change as one of the key pressures on biodiversity in its last national report to the Convention (MoENR, 2014a). Climate change adaptation is also underlined in the national forest programme and action plan to combat desertification. Malaria was eliminated in the late 1950s, but appropriate measures have to be taken in light of climate change and Azerbaijan has developed a national strategy to combat malaria epidemics. Moreover, a separate chapter on climate change is included in the draft Action Plan on Improvement of the Ecological Situation and Efficient Use of Natural Resources in the Republic of Azerbaijan (2015–2020), which is currently undergoing final inter-agency approval (Shatberashvili, 2015).

Over the last two years, Georgia has carried out several studies on climate change and developed overall strategic documents including an agriculture strategy, social-economic development strategy among others. In doing so, it has significantly enhanced institutional capacities and expertise, as well as placed climate change high on the political agenda. According to the National Environmental Action Programme, the country's long-term goal is to ensure "the security of the Georgian population by implementation of measures for adaptation to climate change" (MoEP, 2012), underlining the potential impact and proposing a comprehensive list of climate change adaptation measures. The environmental sector has been the most active in addressing climate change issues. Intersectoral efforts are slowly appearing. In the recent Georgian strategy for agriculture development, interministerial work is envisaged on designing and implementing adaptive measures to address potentially harmful impacts by global climate change. Some local level strategies have also emerged. In 2013, Georgia developed a climate change strategy for the Adjara region. In 2014, such an adaptation strategy was developed for Kvemo Svaneti. A thorough study of climate change and agriculture in Kakheti, has been undertaken by UNDP, proposing practical recommendations in each municipality. In addition, the national Council for State Security and Crises Management, which was established in 2013, is working on a national strategy that will also include environmental risks and hazards. On an overall political level, Georgia has to adhere to its commitments to the EU Association agreement and develop a National Adaptation Programme of Actions (NAPA).

6. CLIMATE CHANGE AND SECURITY HOTSPOTS

Climate change and security hotspots are areas with ongoing tensions or environmental concerns where climate change is expected to undermine social or economic stability, threaten infrastructure or livelihoods, or compromise security by exacerbating political or social tensions, conflicts or instability.

Defining climate change and security hotspots

This project identifies and assesses climate change and security hotspots across Eastern Europe, Central Asia and the South Caucasus. These hotspots are identifiable in geographic terms, and are characterized by ongoing tensions, environmental concerns or both. In each of these hotspots, climate change through one or more pathways is expected to undermine social or economic patterns, threaten infrastructure or livelihoods, or compromise security by exacerbating political or social tensions, conflicts or instability. Areas with weak institutions or lacking the effective mechanisms for transboundary environmental and security co-operation are especially vulnerable.

The analysis of hotspots, which has been discussed with stakeholders in the countries during several consultations, recognizes the value of natural resources both economically and in terms of security, and considers the tensions associated with the value of resources. Such tensions may arise from criminal activity conflicting with legitimate uses or from questions of who can use a resource, and how. How climate change may affect these situations is of particular interest.

The hotspots included here reflect the judgement of the project analysts and stakeholders as well as the outcomes of the national and regional consultations conducted in 2014 and 2016. The analysis considered the following:

- Existing or prospective vulnerability to climate change
- Existing instability or security risks
- Analytical conclusions regarding the connections between climate change and security
- Other existing political, socioeconomic and environmental factors

6.1. Regional/transboundary hotspots

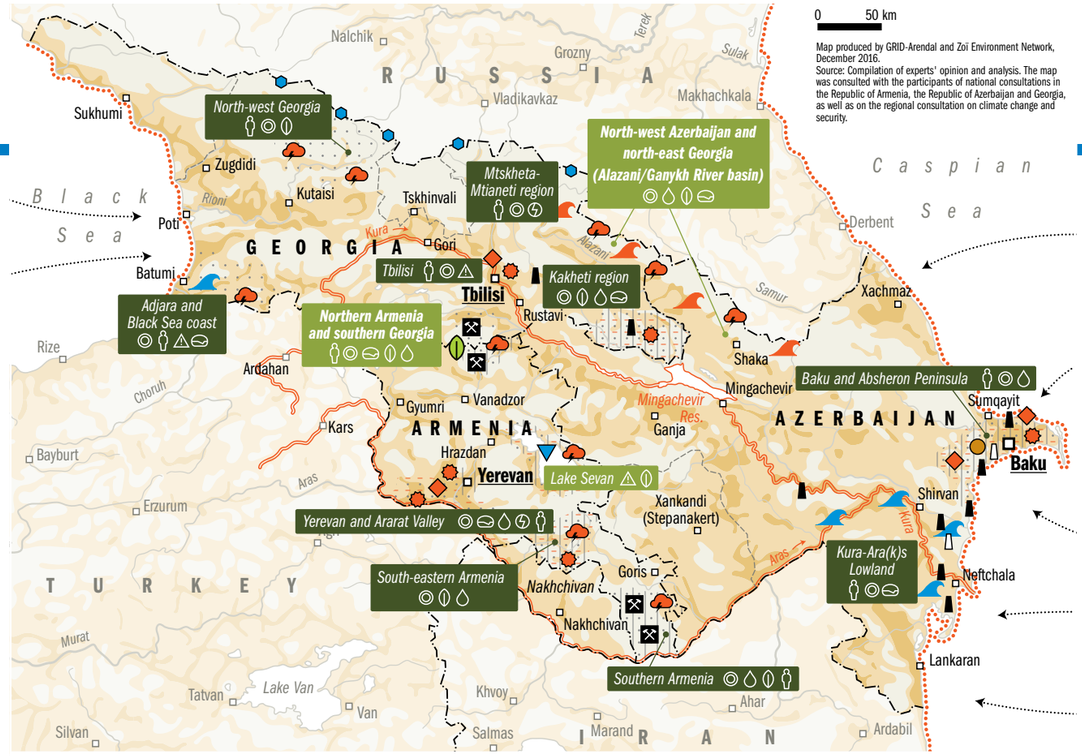
Regional hotspots have regional security implications, and may extend across ecosystems in more than one country. The South Caucasus regional hotspots include the border regions spanning Northern Armenia and Southern Georgia and north-west Azerbaijan and west Georgia. Figure 20 provides an overview.

6.1.1. Northern Armenia and southern Georgia

In the northern Armenia and southern Georgia border region, the countries share transboundary river and forest ecosystems. The implications of climate change on security in these important ecosystems are likely to increase. The ethnic population of the area is relatively diverse, particularly on the Georgian side, where Azerbaijanis are in the majority in the Kvemo Kartli district.

In northern Armenia industrial activities, such as mining, play an important role for the national economy. Despite this, about 39 per cent of the population in Lori marz is classified as poor (WB, 2015a). The area is closely connected to Georgia through the Debed Basin and cross-border infrastructure networks. Transboundary river pollution in this area is persistent, with a growing risk of pollution from industrial accidents, particularly in old and dormant mining sites. The current level of pollution is likely to increase with projected water shortages and reductions in water flows. As in other regions, mining infrastructure (at both existing and former production sites) in northern Armenia is located in natural hazard-prone zones with important implications for security. Releases of mining contaminants could exacerbate existing tensions over water quality in this transboundary context. The region is instrumental for the energy sector and serves as an energy bridge for power trade between Georgia and Armenia. There are also prospects for establishing new connections within the North-South energy corridor.

Only 11 per cent of Armenia is covered with forest, of which about 62 per cent is located in northern and eastern Armenia (MoNR, 2010; MoNP, 2015). The forest ecosystem in



Climate change and security hot-spots in the South Caucasus
Republic of Armenia, Republic of Azerbaijan and Georgia

Areas with climate change and security risks by 2030

- High
- Medium
- Urban areas and cities facing heatwaves, infection outbreaks, air and water pollution, fresh water scarcity, vulnerability of urban green zones
- A b c — Regional/transboundary hotspots
- A b c — National hotspots

Category of security implication

- Economic and livelihood insecurity, damage to infrastructure
- Food insecurity
- Human health insecurity
- Energy insecurity
- Land degradation, biodiversity, cultural and natural heritage
- Social insecurity
- Water insecurity, water resources scarcity

Population density (inhabitants per km²)
5 50

Predicted change in annual river flow for 2071-2100 compared to 1961-1990

- decline (-5 to -10%)
- no change/no information

- Water deficit (drinking water, and water for industry and irrigation)
- Soil erosion and degradation of soil productivity
- Desertification
- Risk of floods
- Flash flood

- Mudslide
- Heatwave
- Impacts on fauna and flora
- Storms
- Extreme weather events (strong rains, flash floods, etc.) followed by infrastructure damage, economic and human losses
- Infrastructure damage, economic and human losses
- Sea and coastal area: increase of sea level, salinization of coastal areas, changes of the coastline, soil salinization, deficit of safe drinking water, reduction of quality and diversity of fisheries
- Lake level decrease
- Melting of glaciers
- Mining
- Oil/gas production
- areas with no data

Figure 20: South Caucasus climate change and security hotspots

this region is threatened by human activities such as deforestation as well as climate change through an expected decrease in precipitation and an increase in annual temperature. Forest ecosystems will be more vulnerable to wildfires and diseases that may result in the loss of forest areas. The natural regeneration of forest is also predicted to be slow. In the Khrami-Debed River sub-basin the projected decline in precipitation and increase in temperature by the end of the century will lead to a decline in stream flow by between 45 and 65 per cent (UNDP, 2011). The reduction of water flow will also result in an increased concentration of pollutants in downstream areas. Lori marz is a high-risk zone for landslides and mudflows. About 65 per cent of the area is identified as prone to mudflows, which may threaten important infrastructure such as the interstate motorway (MoNP 2015). As in other provinces, early warning and response mechanisms are inadequate.

The northern part of Armenia is connected to its neighbours through important transboundary ecosystems and transboundary co-operation is being promoted through various mechanisms, including those supported by the EU. Although security aspects are excluded from co-operation priorities, the co-operation activities support efforts to minimize the region's social vulnerability (EU, 2014a).

In terms of exposure, vulnerability and probability, the short-term security risks for the northern part of Armenia and southern Georgia are medium, but the risks are likely to be high for longer-term climate scenarios.

6.1.2. North-west Azerbaijan and north-east Georgia (Alazani/Ganykh River basin)

In the north-west Azerbaijan and north-east Georgia border region, the countries share transboundary river and forest ecosystems. The implications of climate change on security in these important ecosystems are likely to increase.

Both sides of the border are relatively densely populated. Economic activities carried out in these areas are of national significance. The north-western part of Azerbaijan accounts for about 6 per cent of the country´s population, whereas Kakheti region in Georgia accounts for about 9 per cent of the country's population (EU, 2014b). Household living standards have increased over the last few years in Azerbaijan, but these changes have been slower in the Shaki-Zaqatala region where the population is heavily dependent on natural resources. In Kakheti, most of the population is self-employed with limited incomes. Agriculture plays a dominant role with cattle farming, silk farming, and fruit and tobacco cultivation being important activities in Azerbaijan. Kakheti is widely known for growing grapes and producing wine. In both countries animal husbandry is an important activity, and overgrazing has led to pasture degradation in the region. Ecosystem management in this region is vitally important (EU, 2014b).

The region shares important transboundary ecosystems through the Alazani-Ganykh River sub-basin and alpine ecosystems, which are protected within the framework of the Zaqatala State Nature Reserve. The natural and cultural heritage, together with improvements in infrastructure, mean the area could be a potential tourist destination. The southern slopes of the Great Caucasus are exposed to flash floods, mudflows and landslides, which affect vulnerable mountain communities where adaptation measures are limited. Due to the projected decline in precipitation and the increase in temperature, stream flow is predicted to decline by 25 to 36 per cent in the Alazani-Ganykh River sub-basin by the end of the century (UNDP, 2011). At the same time, the development of the energy and agriculture sectors may be hindered by reductions in water availability. Hydropower development is being promoted by the Government of Georgia, and agricultural practices are being modernized with an emphasis on agro-industry. These two main sectors are likely to put additional pressure on water flows and increase competition for water resources, if sustainability and climate change considerations are not taken into account. In addition to national priorities and goals, the joint transboundary management of ecosystem resources would benefit from a consideration of climate change scenarios.

The risk management tools such as early warning systems or meteorological stations are out-of-date and are unable to warn of critical water levels. Institutional capacities, as well as the capacities of local communities, need improved knowledge to respond to natural disasters. The transboundary co-operation on management of natural resources is critical. To this end, the Eastern Partnership Territorial Co-operation programme aims at fostering collaboration between the border regions in Georgia and Azerbaijan (EU, 2014b).

Considering all these factors, this transboundary region can be classified, in the short term, as a medium-risk climate change and security hotspot.

6.2. National hotspots

Each of the South Caucasus countries has climate and security hotspots, presented here on a country-by-country basis.

6.2.1. Armenia

Armenia's climate change and security hotspots include the Ararat Valley, Lake Sevan, southern Armenia and south-eastern Armenia. Figure 21 provides an overview.

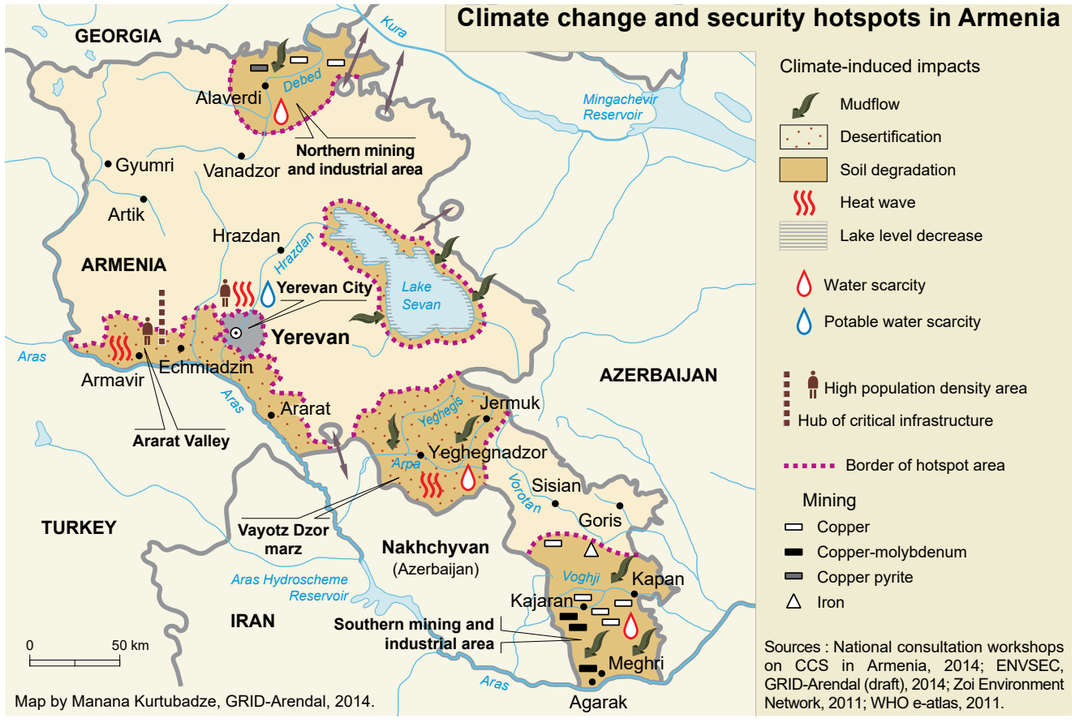


Figure 21: Climate change and security hotspots of Armenia

6.2.1.1. Yerevan and Ararat Valley

The central and western part of Armenia, which includes the densely-populated capital and adjacent Armavir and Ararat marzes, is a hub of diverse economic activity, with a high concentration of critical infrastructure. It is an important area for agriculture and aquaculture, urban infrastructure and development, industry, and energy infrastructure. The Ararat Valley contains productive agricultural land used for growing vegetables and fruits, and relies heavily on irrigation. Approximately 80 per cent of the value of agricultural products in the Ararat Valley is obtained from irrigated land (WB, 2014). Predicted increases in aridity and shortages of water resources are likely to have a substantial impact on crop yields in the future. An analysis of the agro-biodiversity in arid and semi-arid ecosystems by the Regional Environmental Centre for the Caucasus identifies Ararat as one of the most vulnerable areas to climate change (REC 2012).

Water shortages are expected to become more acute with reductions in water availability from both surface and recharged groundwater [61] and increases in water demand across the economic sectors. The demand for water is also expected to increase with improved sanitation services. In addition, existing water management practices are poor, resulting in a significant loss of irrigation water and the overuse of water. Significant water shortages predicted in the Upper Ara(k)s basin could lead to a negative water balance. Water stress is already being experienced by different water users, particularly in the agriculture, aquaculture and energy sectors. The recent increase in aquaculture activities, which use groundwater from the central part of the Ararat Artesian Basin, is resulting in a general depletion of water resources – the rate of input from precipitation and under-

61 Groundwater availability is judged on the present situation.

ground condensation is slower than the rate of withdrawal (USAID, 2014a). The combination of existing management practices, the forecast for reduced water availability and limited adaptation capacity, mean that increased competition for water for economic activities is likely to have serious security implications.

The energy sector also relies on water resources from the Upper Ara(k)s basin for existing energy infrastructure – for cooling the Metsamor Nuclear Power Plant and for the safety of thermal power plants.

The mean annual temperature in the Ararat Valley is forecast to increase, particularly in the summer months. The number of recorded heatwaves in Yerevan has increased over the last few decades and this trend is likely to continue. Heatwaves and elevated temperatures will have direct and indirect implications for human health security. Cardiovascular and chronic diseases are likely to be exacerbated. Indirect implications for health will be felt through changes in water availability and food security. Higher temperatures over a longer time, with reductions in precipitation, will lead to more droughts affecting food security for years to come. Other extreme events such as late spring or early autumn frosts are also likely to impact on agricultural productivity. Extreme events will continue to affect land and soil quality in Armenia. The Ararat Valley is also highly exposed to climate change hazards associated with extreme weather events leading to flooding and mud slides. For instance, infrastructure of Yerevan periodically is disturbed by mud slides. Considering the level of exposure, and the probability and magnitude of natural hazards in the Ararat Valley, the climate change implications for the economy and human health are serious.

The climate change and security implications extend to the economy and the environment, and may cross national boundaries through shared natural resources such as groundwater, in which case cross-border tensions may arise. The area's importance to the national economy, the competition for water resources, the high population density, the rapidly increasing shortages in water resources and the high exposure to climate-induced hazards all combine to increase the risks for security. For this reason, the central and western part of Armenia is identified as a climate change and security hotspot that should be targeted by a climate change adaptation strategy. The short-term security risks are medium but conditions are likely to deteriorate with longer-term climate change scenarios.

6.2.1.2. Lake Sevan

Lake Sevan, located in the Lesser Caucasus, is the largest mountain lake in the Kura-Ara(k)s Basin. It is an important ecosystem and plays a major role in the national water management system for irrigation and hydropower generation. It is considered a key resource for Armenia´s economic and strategic development (UNDP, 2013b). However, the lake is severely threatened by predicted reductions in water leveWWls and changes to its ecology. The water level has decreased by 19 metres as a result of human activities since the 1950s, but government efforts coupled with favourable climatic conditions have resulted in a positive change in the water balance and a gradual increase in water levels (Leummens and Matthews, 2013). However, there is major concern over the predicted decrease in water in the Lake Sevan Basin. Forecasts suggest that by 2030 inflows into the lake are likely to decrease by 53 million m^3 compared with inflows between 1961 and 1990.[62] The water level is projected to decrease by about 16 cm a year (MoNP, 2015). Consequently, the scarcity of water resources will have important implications for the agriculture and energy sectors.

The Lake Sevan area is also highly exposed to natural hazards such as hailstorms, landslides and mudflows, which pose an immediate threat to local communities and infrastructure located primarily on the south-west shores of Lake Sevan. The population density is similar to other rural areas in Armenia but poverty rates are higher than in other areas. Pockets of high poverty are found in Gegharkunik marz, and poverty is particularly acute in Sevan and Gavar subdistricts. Poor communities are more vulnerable to external factors such as natural hazards and, if no adaptation measures are taken, the risks posed to these communities are likely to increase, leading to further marginalization. The north-eastern shore of Lake Sevan, around Ijevan city, is a potential hazard zone – landslides, triggered by heavy precipitation, were recently reported (MoNP, 2015).

Changes in the aquatic ecosystem of Lake Sevan are taking place and are expected to continue in the future. Increasing temperatures will affect spawning grounds, feeding areas and migration patterns for cold-water fish. Aquatic plants that grow in and near the water will also be vulnerable to these changes, but the overall change in species is unpredictable.

Lake Sevan is regarded as a national treasure and there is strong political support for its preservation. This support increases adaptive capacity at the institutional level, but conservation efforts, particularly the urgent need to stabilize water levels in the lake, require significant financial resources that Armenia is lacking.

Lake Sevan is not only critical to the national water management system and strategic development but also serves as a national symbol. Yet climate change scenarios project significant water shortages, increasing the vulnerability of the agriculture and energy sectors, and affecting the entire ecosystem – all of which has security implications. The short-term security risks are medium but longer-term climate change scenarios classify Lake Sevan as a high-risk area.

62 According to A2 scenarios.

6.2.1.3. Southern Armenia

Economic activities in Syunik marz in southern Armenia include mining, energy production and agriculture. Development is heavily dependent on the mining industry, which brings with it a number of security risks. Its remote geographic position and the lack of transport links has left the province less economically developed than other parts of the country (National Statistical Service of the Republic of Armenia). The current state of the mining industry, coupled with possible climate-induced hazards, carries potential risks for existing excavation facilities and new projects if sound environmental and construction management practices are not applied. Old mining facilities require additional technical security controls for tailing dams and waste ponds as some sites have reached tipping points in terms of load capacity, particularly poorly constructed tailing ponds. Heavy precipitation could trigger leaks from these storage facilities and expose both nearby communities and downstream water users to high levels of pollution. In addition, construction standards and regulations do not include any climate change considerations such as rises in temperatures and episodic heavy precipitation. The southern region of Armenia also has transboundary ecosystems and the risks from possible industrial accidents and pollution may add to cross-border tensions.

Energy is the second largest economic sector in Syunik, delivering hydropower generated at small and medium-sized hydroelectric stations.[63] Following the Government support to renewable energy sources, small hydropower plants on the Meghri, Vorotan, and Sisian Rivers are under construction. In some cases, the development of small hydropower plants has led to water shortages, which affect local communities (ECOLUR New Agency website). Although the river basins in Syunik province may receive more water through increased precipitation in the future (MoNR, 2010), sustainable local development should be encouraged.

In addition, the adaptive capacity of the region is weak due to its geographic remoteness. Local infrastructure is less developed and early warning systems and response mechanisms to hazardous climate events are either non-existent or outdated, and should be given high priority. Raising awareness and strengthening local governance would enhance the preparedness and response mechanisms to natural disasters as well as climate change impacts and would reduce the potential risks.

Southern Armenia – a mountainous landscape with important forest ecosystems – is highly exposed to climate-induced hazards such as mudflows, seasonal floods, landslides and hailstorms. The risk of mudflows and landslides is higher in Syunik than in other areas. About 70 per cent of the Syunik marz has been identified as susceptible to mudflows (MoNP, 2015). A high incidence of hailstorms is also reported in southern Armenia. Extreme events, such as heavy precipitation, coupled with land degradation (as a result of deforestation), may put people and economic activities at risk – which in turn has important security implications.

The short-term and long-term security risks from climate-induced hazards in southern Armenia are high. Economic activities like mining are critical and require careful management in hazard-prone zones. The performance and safety of mining activities depend on design factors, construction methods and a careful consideration of the impacts of natural hazards such as heavy rains, flooding and landslides – all of which could be affected by climate change. Social tensions have been reported because of the development of various construction projects. These tensions could be reduced if more rigorous and transparent measures including stakeholder consultations were carried out. Climate change will also have security impacts on the wider region since the southern part of Armenia is an important transboundary ecosystem.

6.2.1.4. South-eastern Armenia

Although Vayots Dzor marz is the least populated region, economic activities are diverse and dynamic. Agriculture is the most important economic sector with a focus on cattle and goat farming, and vegetable and grape cultivation. The region is also known for hydropower generation, mainly in the Apra River basin. As of early 2014, 24 small hydropower plants have been operating in Vayots Dzor marz (MoNP, 2015). The agriculture and energy sectors, along with tourism (which is a rapidly growing industry), are threatened by climate change. Vayots Dzor marz serves as a major transportation corridor connecting the capital with the remote Syunik marz, and further on with Iran. Because of the area's diverse economic activities, important ecosystems and exposure to climate change, the Ministry of Natural Resources has selected Vayots Dzor marz as a pilot region for a vulnerability assessment and an adaptation action plan (MoNP, 2015).

Vayots Dzor marz is affected by extreme weather events and changes in annual temperature and precipitation, and is the Armenian marz most susceptible to temperature variations. Severe hailstorms, strong winds, sandstorms, flooding, heavy rain, frosts and droughts have been recorded over the last decade (MoNP, 2015). The province is also prone to mudflows. By 2030, agriculture will be severely affected by rising annual temperatures and consequent salinization (as a result of an increase in evaporation), an increase in extreme events and a decrease in overall precipitation, all of which will lead to losses in agricultural crop yields, the degradation of pastures and a decrease in grasslands. There is a projected decline in the water resources required for irrigation, energy and domestic use

63 Vorotan, Meghri and Shaki HPP stations.

(MoNP, 2015). Vayots Dzor marz is also recognized by the Regional Environmental Centre for the Caucasus as one of the most vulnerable areas to climate change in Armenia (EU, 2012).

The area's diversity of activities, which are important for both the national economy and the livelihoods in local communities, will be threatened by climate change and the increase in severe weather events. The arid and semi-arid ecosystems are highly vulnerable to rising temperatures and precipitation changes that are likely to contribute to further land degradation. Their direct links to agriculture and tourism activities, among others, have important security implications. The risk of irreversible degradation of ecosystems, vital for communities and the national economy, is also growing. Adaptation measures have been developed by the Government, but these are yet to be implemented. In terms of exposure, vulnerability and probability, the short and long-term security risks for the northern part of south-east of Armenia are medium.

6.2.2. Azerbaijan

Azerbaijan's hotspots include the Absheron peninsula and northern Absheron, and the Kura-Ara(k)s lowlands. Figure 22 provides an overview.

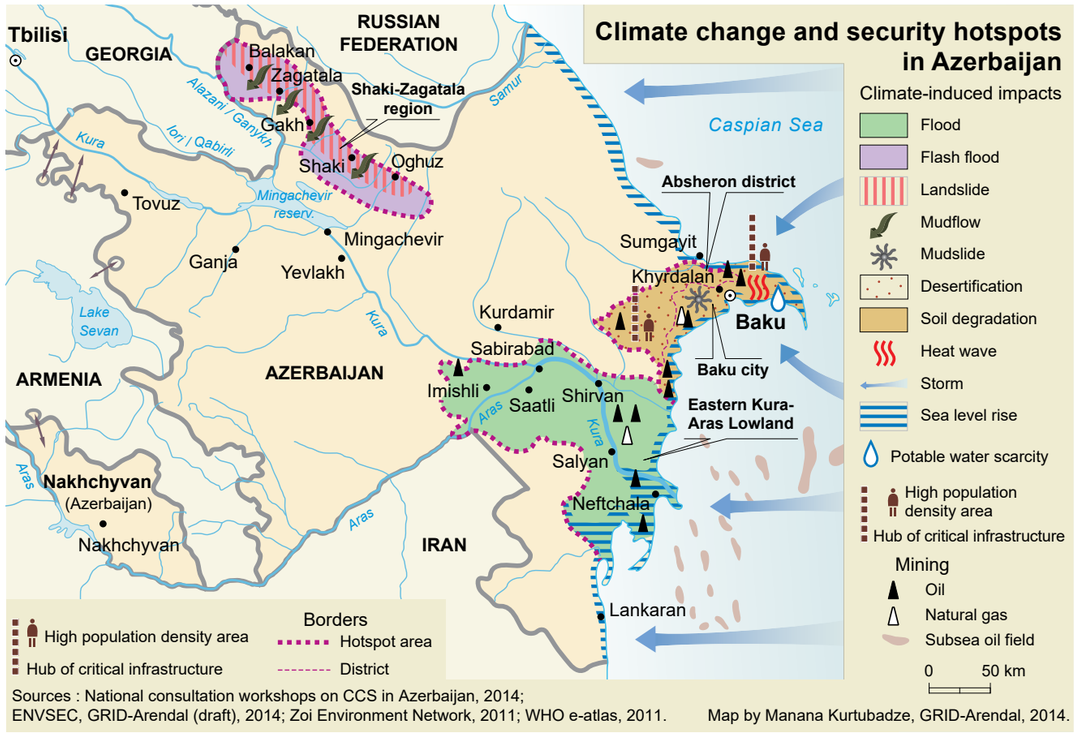


Figure 22: Climate change and security hotspots of Azerbaijan

6.2.2.1. Baku and Absheron Peninsula

The Absheron Peninsula, the most populated part of Azerbaijan, is a hub for economic activity, urbanization and infrastructure, both at the regional and national levels. It accommodates about 40 per cent of the country's population and 70 per cent of the country´s industrial production. For this reason the area is considered to be highly vulnerable to potential climate-induced hazards (MoENR website). The economy of the peninsula is driven by oil and gas production, chemical and petrochemical industries, metallurgy, textiles and food industry. Absheron has also been massively exposed to industrial activities in the past, which has left pollution behind. The peninsula suffers from land contamination from oil extraction works, the persistent contamination of small water bodies, inadequate sewage treatment systems and discharges of untreated wastewater from industrial activities (MoENR website). Some of these heavily polluted areas have benefited from clean-up operations and remediation; others await attention.

Baku, which is growing exponentially, has been identified by the World Bank and the United Nations International Strategy for Disaster Reduction (2010) as one of the highest risk cities among selected cities in Central Asia and the Caucasus region. It is vulnerable to fluctuations in the Caspian Sea level, and with the predicted rise in sea level, flooding is likely to increase. Although sea level fluctuation is directly related to the climate parameters, its precise trends are unknown. There will, however, certainly be long-term implications as the fluctuation has regular patterns. Moreover, the outskirts of the city are expanding on to steep slopes exposed to landslides and mud slides. The city is also exposed to other extreme events such as strong winds and significant heatwaves, which are expected to have direct and indirect impacts on human health. In Baku, the number of dangerously hot days due to climate change is expected to dramatically increase to about 120 days a year from 2020 to 2049 (UNDP, 2011). Coupled with a rapidly growing population, this likely will result in serious implications for human security.

Azerbaijan is already exposed to water shortages and the situation will deteriorate in future climate change scenarios, exposing human health to further risk. Absheron Peninsula currently struggles with access to potable water sources. The situation is gradually improving, with Baku providing access to high-quality, potable water to about 80 per cent of the city's population from its newly constructed ultrafiltration plant. However, water is supplied from other regions of Azerbaijan. Samur, Kura and the glacier fed springs near Guba provide the main sources of potable water (transported through the Shallar pipeline). These are all threatened by climate change. The glacial areas have shrunk by approximately 45 per cent since 1890 and continued melting is likely to reduce water availability in the long term. Russia and Azerbaijan have a new agreement on the Samur River, securing an equal share of water resources between the two countries. The availability of potable water is a security issue in Azerbaijan, and is likely to become more important with a changing climate.

The adaptive capacity of Baku is higher than the remote parts of Azerbaijan. It benefits from the strong support of central government and higher rates of investment. However, climate change is not perceived as a major security concern. Considering the high exposure to the impacts of climate change and the probable implications that this has, the Absheron Peninsula is seen as a medium-risk area in the short-term, developing into a high-risk area in the long term.

6.2.2.2. The Kura-Ara(k)s lowlands

The Kura-Ara(k)s lowlands is an important agricultural area, relying heavily on irrigation. The area is affected by ongoing salinization and desertification, coastal flooding due to sea level rise in the areas along the Caspian Sea, and flooding in the Kura River basin. These threats may also endanger the national parks located along the coast. The eastern Lower Kura is likely to suffer from irrigation water shortages. Climate change will have particular implications for remote communities as access to potable water and sanitation services is limited in rural areas. Infectious and parasitic diseases, related to potable water and food quality, coupled with hazardous events such as flooding, will have serious human health security implications. Due to the limited financial and human resources of local governments, the districts of the Kura-Ara(k)s lowlands have a limited capacity to respond to climate-induced disasters or risks.

The Kura-Ara(k)s lowlands are highly vulnerable to floods and droughts, with serious implications for economic activities and livelihoods as well as human security. The frequency of flooding in the Kura-Ara(k)s lowlands is increasing, which to a large extent can be explained by flow regulations and river management over time (Hasanova and Imanov, 2010). Settlements, villages and agricultural areas as far as 200 km from the river bed were flooded (MoENR, 2010). Exposure levels are high as approximately 15 per cent of the population lives under the risk of flooding. Agricultural productivity is also affected by more severe and frequent droughts that have had a nationwide impact. There is lack of risk management mechanisms such as early warnings systems and agricultural insurance schemes that could help farmers or households respond to natural hazards.

The Kura-Ara(k)s lowlands is classified as a high climate change and security risk area at the national level both in the short and long-term.

6.2.3. Georgia

The Georgia climate and security hotspots include Tbilisi, the Mtskheta-Mtianeti region, the Kakheti region, and north-west Georgia. Figure 23 provides an overview.

6.2.3.1. Tbilisi

As early as 2004, the Environment and Security Initiative highlighted Tbilisi as an environmental and security priority area due to its rapidly growing population and uncontrolled urbanization (ENVSEC, 2004). During the national participatory consultations in May 2014, organized within the framework of this project, Tbilisi was identified by the majority of participants as a climate change and security hotspot.

Officially, Tbilisi serves as the home for approximately 1.2 million people and is growing rapidly, driven by in-migration caused by the lack of economic opportunities in the countryside. Unregulated urbanization is the core challenge for the city´s development. The expansion of residential areas and the development of infrastructure take place at the expense of adjacent forests, agricultural areas and nearby hillsides. Changes in the amount and intensity of annual precipitation have already been noted. In 2015, for example, heavy rains triggered a major landslide causing casualties and enormous economic losses – and this at a time when the national budget is limited. Tbilisi is exposed to natural hazards such as landslides and mudflows and with the forecast increase in climate extremes, such events will continue to undermine human security in the capital.

The city will face more challenging conditions in the future as the number of hot days and air temperatures increase and precipitation decreases. It is expected that the number of dangerously hot days due to climate change will dramatically increase by the middle of the century reaching 95 days annually between 2020 and 2049 (UNDP, 2011). These unfavourable conditions will lead to an increase in cardiovascular diseases, along with a variety of other direct and indirect health risks. Future climatic conditions will undoubtedly exacerbate human security risks in Tbilisi. Therefore, changing climate conditions should be seriously considered in the overall health care system, particularly given the current numerous shortcomings.

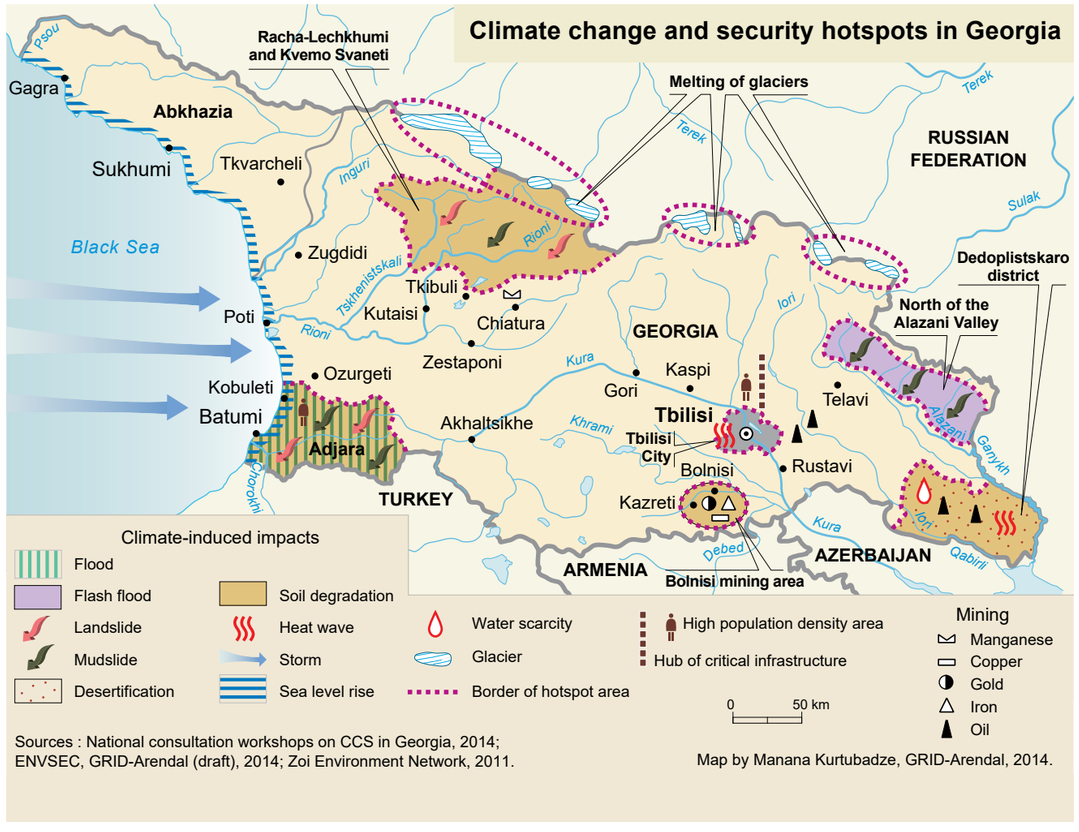


Figure 23: Climate change and security hotspots of Georgia

Tbilisi is one of nine Georgian cities that have signed the Covenant of Mayors, expressing a clear commitment to fight climate change at the local level. Planned activities are linked to sustainable energy use and mitigation of greenhouse gases and, in addition, the municipality is seeking opportunities for designing a road map for climate change adaptation. Considering the security implications of high exposure and the probability of climate change, Tbilisi's medium and long-term risks are high.

6.2.3.2. The Mtskheta-Mtianeti region

The Mtskheta-Mtianeti region in northern Georgia borders on Russia, and is an important transnational infrastructure hub for transportation and energy, and an increasingly important tourist destination. The Georgian military road, running from Tbilisi to Vladikavkaz, serves as a major artery for trade and mobility for the entire Caucasus region and between the former Soviet republics. The region is instrumental in the north-south electricity transmission network connecting Georgia and Russia, and in the gas pipeline supplying Armenia with gas from Russia. It serves not only as a significant energy infrastructure hub but also generates the hydropower and is promoted for new hydropower sites. This vitally important infrastructure at the regional and national levels is seriously threatened by elevated risks of landslides, mudflows and avalanches.

The region is not densely populated and overall well-being is high in comparison with other districts of Georgia (USAID, NALAG, 2016). The region is endowed with a beautiful mountain landscape with Mt. Kazbek among other natural and cultural heritage sites. It is part of Kazbegi National Park. Alpine skiing, climbing, hiking and other mountain sports attract both Georgian and foreign tourists across the seasons. The potential for developing the tourism sector is large, but the sector needs adequate health services, emergency response capacity and infrastructure to assure tourists of theirsafety and security.

The sensitivity of the tourism sector to climate change in Kazbegi municipality is among the highest in Georgia (USAID, NALAG, 2016). The risks of natural hazards such as landslides, mudflows and avalanches in Mtskheta-Mtianeti region are high, as is the region's sensitivity. These geological threats will only increase with persistent climate change. Considering its high sensitivity and vulnerability, the Mtsheta-Mtianeti region is seen as a high-risk area in the short and long terms.

6.2.3.3. The Kakheti region

The Kakheti region in eastern Georgia comprises eight municipalities,[64] some bordering Azerbaijan and the Russian Federation. It is located in the eastern lowlands and eastern mountainous agricultural regions, and is characterized by a diversity of climate zones. During the Soviet period, the Kakheti region was the main area in Georgia for agricultural production, with a well-established agricultural infrastructure, which included windbreaks and an extensive irrigation system. Today, the region remains an important contributor to economic development but it experiences important infrastructure shortcomings and challenges brought on by a changing climate.

According to the latest models, the climate will be dryer and hotter in Kakheti region for the decades to come (UNDP, 2014). Average annual temperatures are predicted to increase by 1.1°C by 2050 and by 3.5°C by 2100. At the same time, changes in precipitation are expected; these may be insignificant at first (within a range of ±5 per cent) but could decrease by as much as 10-20 per cent by the end of the century (UNDP, 2014). Climate change will directly impact crop yields. While for certain crops the change in climate may be beneficial, the majority of crops yields are predicted to decline (Ahouissoussi et al. 2014a). Pasture yields are predicted to increase by 87 per cent in eastern mountainous territories,[65] but yields of other agricultural crops such as wheat, corn, potatoes and grapes are forecast to decrease (Ahouissoussi et al. 2014a). It is also expected that water availability will not be sufficient to meet the growing demand for irrigation in the future. (UNDP, 2014; UNDP, 2011). In addition, irrigation systems in poor condition or insufficient irrigation networks will in some cases hinder water access and may also slow down possible adaptation measures, such as the substitution of climate resilient crops (UNDP, 2014).

Land degradation, erosion, forest degradation and extreme weather conditions have hampered economic activities. Land degradation is continuing as a result of worsening climate conditions – extreme weather events, such as hailstorms, strong winds and droughts – and unsustainable management practices. In some municipalities the situation is grave. In Dedoplistskaro municipality, for example, which is exposed to strong winds, windbreaks are needed to protect agricultural and pastoral lands. During the energy crises in the early 1990s, about 99 per cent of the windbreaks were destroyed exposing the land to wind erosion. Currently, about 89 000 ha of land in Dedoplistskaro is degraded with signs of desertification in some places (UNDP, 2014).

Agricultural land can also be washed away by rivers. Such incidents have been reported on the banks of the Alazani, Ilto, and Orvila Rivers (UNDP, 2014). The Alazani River washed away about 100 ha of arable and pasture lands close to the Azerbaijani border (UNDP, 2014). Awareness of climate change issues is growing. Recently, Kakheti conducted climate change and agriculture analyses outlining strategic steps for adaptation activities. These, however, have yet to be implemented.

64 Akhmeta, Gurjaani, Dedoplistskaro, Telavi, Lagodekhi, Sagarejo, Sighngi and Kvareli.
65 Under the scenario with no adaptation and no irrigation water constraints.

The majority of the population in Kakheti is rural with poor living conditions and low incomes that further contribute to the vulnerability of the population, particularly in relation to health risks. A significant increase in cardiovascular diseases was observed between 2010 and 2011. The Third National Communication identified Kakheti as one of the regions where the effects of climate change on human health is of particular concern (MoENRP, 2015).

Water and alpine ecosystems connect the area with Azerbaijan and transboundary co-operation through the Eastern Partnership Territorial Co-operation is expected to contribute to regional development (EU, 2014b).

Given the importance of this region for food production in Georgia and the critical role of its water resources for the agriculture sector, as well as the high level of poverty in rural areas, climate change impacts will significantly affect the livelihoods of the local population and may even jeopardize the food security of the entire country. Considering the high exposure, vulnerability and probability of climate change implications, the Kakheti is seen as a high-risk area in the short and long term.

6.2.3.4. North-west Georgia

The important cultural and natural heritage in the Racha-Lechkhumi and Svaneti regions in north-west Georgia are at risk from climate change. The annual temperature of north-west Georgia is forecast to increase by 4°C, inevitably leading to a substantial reduction in the size of the glaciers – the most sensitive ecosystems in Georgia. Already, the total area covered by glaciers in Kvemo Svaneti may have decreased by as much as 25 per cent and volume may have decreased from between 1.2 km^3 to 0.8 km^3 during the past half-century (MoEPNR, 2009). The glaciers located in the Racha-Lechkhumi and Svaneti regions serve as the main source for the Enguri and Rioni Rivers, which flow to the Black Sea. These vast water reserves maintain energy production – a leading economic sector. Georgia´s renewable energy programme includes new hydro projects that are dependent on water resources that are certain to decline in the long term. Tourism is another important sector vulnerable to the climate change, and its future is threatened by climate-induced natural hazards that will have negative consequences on local livelihoods as well as human security. The disappearance of the glaciers – a major tourist attraction – will have a significant impact on the industry.

The risk of natural disasters is high in this region, threatening local communities, infrastructure and economic activities. Natural disasters in the 1980s forced several hundreds of households to migrate and left the region under-populated; those who remained now struggle under difficult conditions. Poverty rates are high in the remote mountain areas and the local communities are particularly vulnerable to climate-induced hazards as opportunities for adapting to climatic changes or responding to natural disasters are limited. The most marginalized population are women, who live with higher levels of poverty than men. There has also been an observed increase in the incidence of diseases that may be related to natural disasters. The region is exposed to natural hazards such as landslides, mud slides and seasonal floods, which are likely to continue threatening human and economic security. Due to its remoteness, the region is less developed in terms of infrastructure and services, severely limiting disaster response capacities.

The adaptation capacities of the region are comparable with other remote regions of the country. Recently, Kvemo Svaneti developed a climate change adaptation strategy that provides direction for further recommendations. These, however, have yet to be implemented. The slow onset of glacial retreat will only increase with time, and will have major implications for the water-energy-tourism nexus. Local communities are exposed to serious risks with little means of protection and adaptation. The Racha-Lechkhumi and Svaneti regions are likely to be exposed to high risks in the short and long term.

6.2.3.5 Adjara and the Black Sea coast

In 2004, the Environment and Security Initiative identified the Black Sea coastal zone as a hotspot where environmental degradation had the potential to exacerbate economic and human insecurity. Similarly, the Georgian Second National Communications to the UNFCCC identified the Black Sea coastal zone as one of the three priority regions in terms of climate change vulnerability (MoEPNR, 2009). The Black Sea coastal zone was also identified as the most vulnerable geographic area by the National Consultations conducted in 2014 within the framework of the Climate Change and Security project. Hence, it remains a hotspot at the national and regional level.

The Black Sea coastal zone is of strategic importance: a regional transportation corridor and an important area of national economic activities such as agriculture, energy, tourism and industry. The east-west transportation corridor comprises strategic infrastructure delivering commodities and fuel by railway and road, as well as through pipelines, to and from the Black Sea ports in Batumi, Poti, Kulevi and Supsa. This high level of traffic places stress on the infrastructure. Most of the transport networks are old and require substantial investment, and despite the investments made in the past, the infrastructure often is of low quality (ADB, 2014b). Construction standards and materials are another area of concern, and do not take into account the potential impacts of climate change, which has implications for the sustainability of the transport sector (ADB, 2014b). Moreover, the coastal zone is vulnerable to risks induced by climate change, including rises in sea level and harsh weather conditions. These need to be taken into account in maintenance and development plans. The coastal zone and its adjacent areas are instrumental to the energy sector at regional and national scales, as important electricity transmission networks connect with neighbouring states, especially with Turkey.

Territories adjacent to the coastal zone in the western lowlands and western mountainous areas are widely used for agricultural and livestock production but these areas are considered fragile for a variety of reasons. Poor land management (agricultural practices, land reform, irrigation systems), coupled with land degradation, floods and weather variability make the agricultural sector vulnerable to climate change (UNDP, 2013; Ahouissoussi et al, 2014a).

The Black Sea coastal zone, particularly Adjara, has been identified as an area highly vulnerable to climate-induced diseases (UNDP, 2013a; MoENRP, 2015). According to the Third National Communication, the health care sector in Batumi municipality is the most vulnerable to current and projected climate change (MoENRP, 2015). The Adjara region also has high levels of poverty, which increases the vulnerability of its inhabitants. Poverty levels are higher in the mountainous regions and, in particular, among women. As land degradation becomes more widespread in the mountains of Adjara, it is becoming more difficult to rely on natural resources for subsistence, which could potentially increase levels of outmigration.

Sea level rise and harsh weather conditions including storm surges, intensive sedimentation processes, and coastal erosion associated with complex geophysical processes, are all exacerbated by climate change and are immediate threats to the coastal zone. The Black Sea coastal zone is exposed to tectonic movements and, together with intense storms, has significantly changed the coastline (MoEPNR 2009; UNDP, 2013a). Powerful storms have increased over the last decade threatening the area's infrastructure. In 2013, a category-six storm destroyed power lines, caused accidents at several locations along a gas pipeline, and damaged homes and public buildings. (UNDP, 2013a). The greatest impacts were observed in the Kolkheti Lowlands – an area that lies below sea level and stretches along the coast, in particular around the city of Poti on the Rioni River delta.

Increasingly, the risks from climate change are gaining more attention at the political level and among local stakeholders, such as municipalities, which are gradually investing in disaster risk reduction measures or infrastructure projects (Shatberashvili et al., 2015). Other sectors, such as health care, lack adequate response mechanisms to climate-induced impacts. The fact that the Black Sea coastal zone is located far from the capital means that capacities for climate change adaptation are more limited and the region as a whole is more vulnerable (Shatberashvili et al., 2015).

Considering the strategic position and economic importance of the Black Sea coast and Adjara, coupled with the increasing frequency of natural slow-onset events and extreme hazards induced by climate change, the area has been designated as a climate change and security hotspot. In terms of adaptive capacity, Adjara has been pioneering the development of a climate change strategy, but implementation may require additional time and effort. The region is therefore a high-risk climate change and security hotspot, both in the short and long-term, and at the national level.

The following table summarizes the climate and security hotspots described in this chapter.

Table 4: Summary of climate change and security hotspots

Hotspot	Political, socioeconomic and environmental conditions and trends	Climate change hazard	Security implications	Security risk: 2030/ 2050-2100	Adaptive capacity
Regional/transboundary hotspots					
Northern Armenia and southern Georgia	Water-agriculture-energy nexus with potentially large implications for energy Economically important region for Armenia (e.g., mining) Important agriculture activities in the bordering regions High poverty levels Weak economic tools for development of small communities Important and vulnerable transboundary ecosystems (e.g., reduction of water flows, forest ecosystems) Persistent water pollution	Flood-ing, hail, landslides, avalanches Wildfires	Economic insecurity Food insecurity Damage to infrastructure Safety of industrial activities (e.g., risks of abandoned industrial activities and ongoing activities) Human health insecurity Loss and/or degradation of ecosystems (e.g, water, forest) Water insecurity	Medium/ High	Medium Weak early warning or response mechanisms in hotspot area Remoteness Existing transboundary watershed projects Existing co-operation programmes between Georgia and Armenia (EaPTC) Lack of climate change consideration in exiting co-operation pro-grammes Lack of awareness and knowledge
North-west Azerbaijan and north-east Georgia (Alazani/ Ganykh River basin)	Water-agriculture-energy nexus Important agriculture activities in both countries Natural and cultural heritage and vulnerable transboundary ecosystems (e.g., reduction of water flows, forest ecosystems) Low quality of public services	High risks of floods, mudflows and landslides Soil degradation	Economic insecurity and livelihood insecurity Food insecurity Water insecurity due to decline of water resources Land degradation, biodiversity loss including damage to forest ecosystems Loss of natural and cultural heritage	Medium/ High	Medium Weak legislative base, risk management tools Existing environmental protection measures (e.g., Zaqatala Nature Reserve and Lagodekhi Nature Reserve) Existing co-operation programmes between Georgia and Azerbaijan (EaPTC) Weak consideration of climate change implications across activities. Lack of awareness and knowledge on climate change implica-tions at local level
National hotspots					
Yerevan and Ararat Valley	High population density Infrastructure hub Vibrant agriculture and fisheries sectors Competition for water between en-ergy and agriculture Water shortages Low level of co-ordination between agencies	Extreme events: droughts, heatwaves, frosts, hail, mudflows and floods	Economic insecurity Water insecurity Energy insecurity Human health insecurity Food insecurity	Medium/ High	Medium Geographically central location with high education levels and potential for growth in public awareness Lack of adaptation measures Integrated Water Resources Management plans
Lake Sevan	Highly important in the national water management system, and for irrigation and hydro-power generation High poverty levels Cultural value Priority area for tourism development	Mudflows, avalanches, landslides, hail, and droughts Increase in water temperature by 2100	Social insecurity Loss of natural heritage Biodiversity changes	Medium/ High	Medium National priority with political backing and environmental protection status Lack of financial capacity and lack of governmental awareness of climate change implications
Southern Armenia	Economically important trans-boundary region Heavy reliance on mining sector with ageing infrastructure Economic opportunities through border crossing with Iran Energy-water nexus Social tensions related to development projects Important forest ecosystems	Mudflows, landslides, flooding, droughts, frosts Extreme events Water scarcity	Water insecurity Land degradation, biodiversity loss including damage to forest ecosystems Human health insecurity Economic and livelihood insecurity and damage to insecurity	High/High	Medium/Low Lack of policy support Remoteness Lack of technical safety standards for industrial activities Lack of early warning and response systems in case of natural disasters Lack of climate change consideration in ongoing projects Lack of awareness and knowledge on climate change implications at local level

Hotspot	Political, socioeconomic and environmental conditions and trends	Climate change hazard	Security implications	Security risk: 2030/ 2050-2100	Adaptive capacity
National hotspots					
South-eastern Armenia	Reliance on agriculture, tourism and energy New mining development Focus on small hydropower Semi-arid ecosystems vulnerable to accelerated land degradation	Hailstorms, strong winds, sandstorms, flooding, frosts and droughts	Economic insecurity, e.g., agriculture, tourism, energy sectors Water insecurity Land degradation, biodiversity	High/High	Medium Adaptation policy framework in place Lack of adaptation measures Lack of implementation capacity Lack of awareness and knowledge on climate change implications at local level
Baku and Absheron peninsula	Economic,social and political importance Hub for logistics and infrastructure Urbanization, uncontrolled growth High population density	Sea level rise Landslides and mud slides	Economic insecurity, damage to infrastructure Livelihood insecurity Human health insecurity Water insecurity	High/High	Medium Central location, strong financial support Low consideration of climate change
The Kura-Ara(k)s lowland	Intensive agriculture Water-agriculture nexus Potable water quality and quantity concerns Vulnerability to land degradation, salinization	High risks of floods and droughts Sea level rise	Livelihood insecurity Human health insecurity Food insecurity Damage to infrastructure	High/High	Low Remote areas Weak local governance Lack of adaptation measures
Tbilisi	Infrastructure hub High population density In-migration Uncontrolled urbanization	Landslides and mud slides Increase in temperature Heatwaves Abnormal precipitation	Economic and livelihood insecurity, damage to infrastructure Human health insecurity Social insecurity	High/High	Medium Low adaptive capacity in public sector Existing climate change awareness and political will

Hotspot	Political, socioeconomic and environmental conditions and trends	Climate change hazard	Security implications	Security risk: 2030/ 2050-2100	Adaptive capacity
National hotspots					
The Mtskheta-Mtianeti region	Important energy, trade and tourism sectors Important transportation hub Important energy network	Landslides, mud slides and avalanches Abnormal precipitation Glacial melt	Economic and livelihood insecurity, damage to infrastructure Human health insecurity Human insecurity due to high disaster risks Energy insecurity	High/High	Medium Weak adaptive capacity Good progress in establishing early warning systems Poor meteorological service Poor emergency response (particularly for economic sectors such as tourism)
The Kakheti region	Transboundary region with important agriculture sector Shortcomings in infrastructure Rural population with high poverty rates Land, forest and pasture degradation	Extreme weather Significant temperature and precipitation changes	Food insecurity Water insecurity, water resource scarcity Livelihood insecurity Land degradation including agriculture land	High/High	Climate change and agriculture strategy in place, but not yet implemented Weak adaptation capacities
North-west Georgia	Important tourism and energy sectors Remote region with limited development Poor infrastructure Significant poverty, and low quality public services with limited access Sensitive glaciers Likely changes in entire ecosystem	Increase in temperature Landslides, mud slides and seasonal floods	Human insecurity due to high disaster risks Economic insecurity Losses in biodiversity, cultural and natural heritage Livelihood insecurity Human health insecurity	High/High	Regional strategy for climate change adaptation developed, but not yet implemented Existing ecosystem protection measures Overall low adaptive capacity Low emergency response capacity

Hotspot	Political, socioeconomic and environmental conditions and trends	Climate change hazard	Security implications	Security risk: 2030/ 2050-2100	Adaptive capacity
National hotspots					
Adjara and the Black Sea coast	Strategically important area for national and regional infrastructure and logistics Economic nexus of agriculture, tourism and industry sectors. Development of infrastructure High level of poverty and outmigration Migration due to environmental and natural disasters Unpreparedness to climate change conditions (e.g., in health sector) Degraded environment (e.g., land resources)	Extreme events Sea level rise Risk of further land degradation High risks of floods, landslides and mud slides	Economic and livelihood insecurity (e.g., loss of incomes, monetary losses due natural disasters) Threats to economic sectors (such as tourism) Human health insecurity Social insecurity (e.g., loss of properties) Food insecurity	High/High	Medium Policy support (Climate Change Strategy of Adjara) Investments in infrastructure Low adaptive capacity in economic and public sectors Weak health care sector

7. CONCLUSIONS AND RECOMMENDATIONS

Climate change is evident in the South Caucasus, with increases in annual air temperatures and changes in precipitation patterns. These changes will most likely have implications for human, economic and environmental security, particularly linked to water availability, agriculture, energy activities, infrastructure safety and human health. Climate change will also affect the national economies in the South Caucasus mainly by increasing the number of natural disasters.

Water resources, both in terms of quantity and quality, are foreseen as the major transboundary security concern in the South Caucasus. As a direct consequence of rising temperatures and decreasing precipitaion levels, water resources are projected to decrease in river basins by the end of the century. Coupled with increased demands for water for economic sectors and households, scarcity of water resources will likely lead to cumulative cross-sector and cross-border concerns. The complexities of the water-agriculture-energy nexus will undermine multisectoral security and may have implications for national stability.

Unilateral national plans in areas where transboundary water resources are critical may create disputes between countries in the region. The patterns of too little and too much water over seasons across the region, coupled with an increase in the frequency and magnitude of extreme events such as devastating floods and slow onset events such as land degradation, will most likely have implications on a regional scale. These risks may also have knock-on effects, such as implications for infrastructure networks and dormant industrial sites. Transboundary connectivity through river networks is the most fragile domain in the climate change and security context.

Users of many shared ecosystem resources can benefit from transboundary co-operation. A legal framework towards a more sustainable development will not only ensure the security of upstream and downstream stakeholders, but will also establish strong working relationships and improve economic growth and ties. Coordinated regional management of water resources can alleviate potential conflicts over scarce resources and should involve all the countries.

Agriculture will be the sector most affected by climate change. The complex interrelationships between land, water and climate will have important implications for overall agricultural productivity. While the production of some commodities may benefit from changing climatic conditions, these positive impacts will be overshadowed by the major implications for current agricultural activities. Large territories presently used for agriculture are already affected and will continue to suffer from degradation unless adaptive measures are developed and implemented. Cross-border connectivity will have implications for the availability of water resources. The spread of diseases and pests will affect the sector.

Energy security is a primary goal for all three countries, with a focus on securing national energy production and diversifying energy sources. Renewable energy, particularly from hydrological sources, is one of the priority areas. However, a changing climate coupled with existing water management practices may have implications for the sector and create tension between different water users and communities. The energy-water nexus plays a central role in the security discussion; thus a more holistic approach is required to secure safe energy in the future.

Ecosystems in the South Caucasus countries are facing challenges due to losses in biodiversity, altering systems' vulnerability to external factors. Forest ecosystems, which provide a range of valuable ecosystem services, are under threat from climate change, which is often linked to droughts and forest fires. With warmer annual temperatures, flora and fauna will move to higher altitudes, creating more favourable conditions for some human activities. Important aquatic systems will change but, as yet, there is little understanding of the real impacts.

Safe infrastructure is a prerequisite for providing basic services. Climate change may have important security implications for urban areas, strategic infrastructure, and communication and transport networks as a result of extreme climate events and extreme climatic conditions such as longer heatwaves.

Industrial sites and former Soviet legacies will pose risks to communities and surrounding ecosystems unless climate change adaptation measures are developed and implemented.

Human security is undermined by climate-related disasters including mud slides and landslides, and an increase in extreme climatic events such as heatwaves which are likely to exacerbate the conditions of vulnerable groups of society, particularly in densely-populated areas.

Adaptive capacity depends on social and economic conditions alongside governmental and geopolitical stability. In general, all three countries have shown signs of economic development over recent decades, but they are still largely dependent on external financial support to address climate change adaptation needs as well as institutional and human capacity-building. Table 5 summarizes the recommendations by hotspots.

Table 5: Climate change and security issues and recommendations in the South Caucasus

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
Regional/transboundary hotspots			
Northern Armenia and Southern Georgia	Economic insecurity Food insecurity Damage to infrastructure Safety of industrial activities e.g., risks of abandoned industrial activities and ongoing activities) Human health insecurity Loss and/or degradation of ecosystems (e.g, water, forest) Water insecurity	**General** • Adapt leading sectors to climate change to avoid economic losses and increase resilience • Consider ecosystem approach in developing new activities and further managing existing human activities • Establish early warning systems for extreme climate events and natural disasters; enhance preparedness for emergency situations • Review and update technical documents, regulations and permits for buildings and construction in light of climate change • Promote and provide state and private insurance scheme for climate-related risks • Raise awareness among the general public about climate change and increase community resilience capacities • Develop and implement public awareness campaigns • Build capacities of local governments on adaptation to climate change and security risks • Develop joint initiatives in both countries to address gender issues to narrow or reduce the gender gap • Enhance and strengthen women´s role by ensuring access to / ownership of resources (e.g., land resources) and development resources (such as credit, information, training) **Water resource management** • Establish transboundary co-ordination mechanisms for management of water resources (e.g., joint monitoring and management of water resources) in light of climate change • Co-ordinate national goals with the major economic sectors in light of climate change to avoid unnecessary overuse of water resources • Provide access to safe water supply systems and safe sewer systems to adapt to climate change and security risks • Eliminate or minimize water pollution • Improve monitoring systems to allow further modelling of climate change implications for major economic activities • Implement disaster risk prevention and preparedness measures including for flooding	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy, industry, health care systems, and forest service Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
Regional/transboundary hotspots			
Northern Armenia and Southern Georgia	Economic insecurity Food insecurity Damage to infrastructure Safety of industrial activities e.g., risks of abandoned industrial activities and ongoing activities) Human health insecurity Loss and/or degradation of ecosystems (e.g, water, forest) Water insecurity	**Industrial sector** • Develop/ update construction guidelines and other relevant technical documents considering climate change conditions • Increase safety of existing industrial facilities and provide safety of abandoned mines • Monitor and assess tipping points of former and active tailing ponds and waste sites **Urban areas** • Take climate change implications into consideration in urban development plans. • Establish functional response protocols to climate-induced health emergencies **Agriculture sector** • Develop subregional climate change strategies that provide agriculture adaptation measures • Develop and apply climate change adaptation practices in the agriculture sector • Establish financial mechanisms to support sustainable development of the agricultural sector • Improve efficiency of agriculture infrastructure • Develop and apply state insurance for climate-related risks, including crop and livestock insurance • Establish early warning systems for extreme climate events • Raise awareness among farmers on climate change implications and adaptation practices **Forest ecosystems** • Improve forest fire management including emergency services • Design and implement early warning systems as a response to forest fires • Improve transboundary co-operation in forest fire management • Develop joint ecosystem restoration	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy, industry, health care systems, and forest service Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
Regional/transboundary hotspots			
North-west Azerbaijan and north-east Georgia (Alazani/ Ganykh river basin)	Economic insecurity and livelihood insecurity Food insecurity Water insecurity due to decline of water resources Land degradation, biodiversity loss including damage to forest ecosystems Loss of natural and cultural heritage	**General** • Adapt leading sectors to climate change issues to avoid economic losses and to increase the resilience to climate change • Consider an ecosystem approach in developing new activities and further managing existing human activities • Establish early warning systems for extreme climate events and natural disasters, and enhance preparedness for emergency situations • Develop/ update construction guidelines and other relevant technical documents considering climate change conditions • Promote and provide state and private insurance schemes for climate-related risks • Raise awareness among the general public about climate change to increase the resilience to climate change • Develop and implement public awareness campaigns • Build capacities of local governments on adaptation to climate change and security risks • Develop joint initiatives in both countries to address gender issues to narrow or reduce gender gap • Enhance and strengthen women´s role by ensuring access to ownership resources (e.g., land resources) and development resources (such as credit, information, training) **Water resources management** • Establish transboundary co-ordination mechanisms for management of water resources (e.g., joint monitoring and management of water resources) • Co-ordinate national goals with the major economic sectors to avoid unnecessary overuse of water resources • Improve monitoring systems to allow further modelling of climate change implications for major economic activities • Improve efficiency of irrigation infrastructure • Establish early warning systems for extreme climate events • Implement disaster risk prevention measures including for flooding **Agriculture sector** • Develop and apply climate change adaptation practices in the agriculture sector • Establish financial mechanisms to support the agricultural sector • Improve efficiency of agriculture infrastructure • Develop and apply state insurance for climate-related risks, including crop and livestock insurance • Establish early warning systems for extreme climate events • Raise awareness among farmers on climate change implications and adaptation practices	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy, and health Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
Regional/transboundary hotspots			
North-west Azerbaijan and north-east Georgia (Alazani/ Ganykh river basin)	Economic insecurity and livelihood insecurity Food insecurity Water insecurity due to decline of water resources Land degradation, biodiversity loss including damage to forest ecosystems Loss of natural and cultural heritage	**Energy sector** • Co-ordinate national goals with the major economic sectors to avoid unnecessary overuse of water resources • Improve water and, where relevant glacier, monitoring systems to allow further modelling of climate change implications for the major economic activities • Consider climate change implications for proposed energy projects • Diversify renewable energy sources • Design and implement energy efficiency measures • Build capacity and raise awareness on climate change concerns in the energy sector and integrate climate change considerations into planned hydropower projects **Urban areas** • Develop and apply state insurance schemes for climate-related risks **Forest ecosystems** • Establish joint monitoring of forest ecosystems and joint programs on forest management to avoid futher destruction of forest resources. • Establish joint ecosystems restoration	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy, and health Non-governmental organizations, civil society
National hotspots			
Yerevan and Ararat Valley	Economic insecurity Water insecurity Energy insecurity Human health insecurity Food insecurity	**General** • Develop/ incorporate climate change adaptation activities into existing action plans • Perform in-depth assessments of possible climate change risks to be considered in the development of national socioeconomic development strategies and action plans • Raise awareness among the general public about climate change to increase the resilience to climate change. Develop and implement public awareness campaigns • Build capacities of local governments on adaptation to climate change and security risks **Water resources management** • Co-ordinate national goals with the major economic sectors to avoid unnecessary overuse of water resources • Eliminate existing groundwater pollution sources • Monitor and model groundwater resources **Agriculture sector** • Develop and apply climate change adaptation practices in the agriculture sector • Establish financial mechanisms to support the agricultural sector	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy and health Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
National hotspots			
Yerevan and Ararat Valley	Economic insecurity Water insecurity Energy insecurity Human health insecurity Food insecurity	**Agriculture sector** • Improve efficiency of agriculture infrastructure • Develop and apply state insurance for climate-related risks, including crop and livestock insurance • Establish early warning systems for extreme climate events • Raise awareness among farmers on climate change implications and adaptation practices **Urban areas** • Develop urban plans that consider climate change implications • Develop climate change adaptation strategies or incorporate climate change adaptation activities into existing action plans • Integrate climate change considerations into the health care system and enhance emergency readiness and response • Improve emergency readiness and response • Establish early warning systems for extreme climate events • Develop/ update construction guidelines and other relevant technical documents considering climate change conditions **Energy Sector** • Co-ordinate national goals with the major economic sectors to avoid unnecessary overuse of water resources • Improve water and, where relevant glacier, monitoring systems to allow further modelling of climate change implications for the major economic activities • Consider climate change implications for suggested energy projects • Diversify renewable energy sources • Design and implement energy efficiency measures • Build capacity and raise awareness on climate change concerns in the energy sector and integrate climate change considerations into hydropower projects **Health sector** • Integrate climate change aspects into the health care system, and improve emergency readiness and response	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy and health Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
National hotspots			
Lake Sevan	Social insecurity Loss of natural heritage Biodiversity changes	**General** • Enhance monitoring systems to allow further modelling of climate change implications for major economic activities • Consider an ecosystem approach in developing new activities and further managing existing human activities **Ecosystem / Water resources management** • Conserve the Lake Sevan ecosystem • Implement measures to increase the water level in the lake Sevan • Conserve the main tributaries • Co-ordinate sectoral policies to ensure sustainable use of water resources **Agriculture sector** • Raise awareness among farmers on climate change implications and adaptation practices • Develop and apply climate change adaptation practices in the agriculture sector • Restore pastures **Energy sector** • Co-ordinate national goals with the major economic sectors to avoid unnecessary overuse of water resources • Improve monitoring systems to allow further modelling of climate change implications for major economic activities • Consider climate change implications for suggested energy projects • Consider environmental and socioeconomic impact assessments in new energy project development • Diversify renewable energy sources • Design and implement energy efficiency measures • Build capacity and raise awareness on climate change concerns in the energy sector and integrate climate change considerations into planned hydropower projects	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture and energy Non-governmental organizations, civil society
Southern Armenia	Water insecurity Land degradation, biodiversity loss including damage to forest ecosystems Human health insecurity Economic and livelihood insecurity damage to infrastructure	**General** • Consider an ecosystem approach in developing new activities and further managing existing human activities • Establish early warning systems for extreme climate events • Raise awareness among the general public about climate change to increase the resilience to climate change • Develop and implement public awareness campaigns • Build capacities of local governments on adaptation to climate change and security • Enhance and strengthen women's role by ensuring access to / ownership of resources (e.g., land resources) and development resources (such as credit, information, training)	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy, industry and health care systems Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
National hotspots			
Southern Armenia	Water insecurity Land degradation, biodiversity loss including damage to forest ecosystems Human health insecurity Economic and livelihood insecurity damage to infrastructure	**Water resources management** • Co-ordinate sectoral policies to ensure sustainable use of water resources • Improve monitoring systems to allow further modelling of climate change implications for major economic activities • Implement disaster prevention, preparedness and response measures including for flooding **Health sector** • Integrate climate change considerations into the health care system • Improve emergency readiness and response • Raise awareness among the general public about climate change **Industrial sector** • Develop/ update construction guidelines and other relevant technical documents considering climate change conditions • Increase safety of existing industrial facilities, including mining tailings and waste sites • Monitor and assess tipping points of tailing ponds and waste sites • Establish early warning systems for extreme climate events	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy, industry and health care systems Non-governmental organizations, civil society
South-eastern Armenia	Economic insecurity, e.g., agriculture, tourism, energy sectors Water insecurity Land degradation, biodiversity	**General** • Consider an ecosystem approach in developing new activities and further managing existing human activities • Establish early warning systems for extreme climate events • Raise awareness among the general public about climate change and increase resilience capacities • Develop and implement public awareness campaigns • Build capacities of local governments on adaptation to climate change and security risks • Enhance and strengthen women´s role by ensuring access to ownership resources (e.g., land resources) and development resources (such as credit, information, training) **Agriculture sector** • Develop national climate change adaptation strategies that include agriculture • Develop and apply climate change adaptation practices in the agriculture sector • Establish financial mechanisms to support the agricultural sector • Improve efficiency of agriculture infrastructure • Develop and apply private and state insurance schemes for climate-related risks, including crop and livestock insurance	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture and energy Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
National hotspots			
South-eastern Armenia	Economic insecurity, e.g., agriculture, tourism, energy sectors Water insecurity Land degradation, biodiversity	**Agriculture sector** • Establish early warning systems for extreme climate events • Raise awareness among farmers on climate change implications and adaptation practices **Energy sector** • Co-ordinate sectoral policies to ensure sustainable use of water resources • Improve water and, where relevant glacier, monitoring systems to allow further modelling of climate change implications for the major economic activities • Consider climate change implications for suggested energy projects • Diversify renewable energy sources • Design and implement energy efficiency measures • Build capacity and raise awareness on climate change concerns in the energy sector and integrate climate change considerations into planned hydropower projects	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture and energy Non-governmental organizations, civil society
Baku and Absheron peninsula	Economic insecurity, damange to infrastructure Livelihood insecurity Human health insecurity Water insecurity	**Urban areas** • Develop urban plans that consider climate change implications • Develop climate change adaptation strategies or incorporate climate change adaptation activities into existing action plans • Integrate climate change considerations into the health care system • Improve emergency readiness and response • Establish early warning systems for extreme climate events • Establish monitoring systems to keep observations up-to-date • Develop/ update construction guidelines and other relevant technical documents considering climate change conditions • Raise awareness among the general public about climate change **Coastal zones** • Develop / incorporate climate change adaptation activities into existing action plans, including for coastal zones • Integrate climate change considerations into the health care system • Improve emergency readiness, early warning and response against extreme climate events and natural hazards • Establish monitoring systems to keep observations up-to-date • Develop legal frameworks such as construction guidelines, permits and other relevant technical documents considering climate change conditions • Raise awareness among the general public about climate change	Governmental institutions, local authorities, environmental agencies Particularly, ministry of health Baku municipality Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
National hotspots			
Baku and Absheron peninsula	Economic insecurity, damange to infrastructure Livelihood insecurity Human health insecurity Water insecurity	**Health sector** • Integrate climate change considerations into the health care system • Improve emergency readiness and response and strengthen disaster preparedness and prevention • Raise awareness among the general public about climate change	Governmental institutions, local authorities, environmental agencies Particularly, ministry of health Baku municipality Non-governmental organizations, civil society
The Kura-Ara(k)s lowland	Livelihood insecurity Human health insecurity Food insecurity Damage to infrastructure	**Water resource management** • Co-ordinate national goals with the major economic sectors to avoid unnecessary overuse of water resources • Consider an ecosystem approach in developing new activities and further managing existing human activities • Strengthen monitoring systems to allow further modelling of climate change implications for major economic activities • Improve efficiency of irrigation infrastructure • Integrate climate change considerations into the health care system • Enhance emergency response against extreme climate events and natural hazards and strengthen disaster preparedness and prevention • Establish early warning systems for extreme climate events • Implement disaster risk prevention measures • Raise awareness among the general public about climate change **Agriculture sector** • Co-ordinate national goals with the major economic sectors to avoid unnecessary overuse of water resources • Develop and apply climate change adaptation practices in the agriculture sector • Establish financial mechanisms to support the agricultural sector • Improve efficiency of agriculture infrastructure • Develop and apply state insurance for climate-related risks, including crop and livestock insurance • Establish early warning systems for extreme climate events • Raise awareness among farmers on climate change implications and adaptation practices and develop and apply adaptation practices in the agriculture sector	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture and health care systems Local authorities Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
National hotspots			
The Kura-Ara(k)s lowland	Livelihood insecurity Human health insecurity Food insecurity Damage to infrastructure	**Urban areas** • Promote and provide state and private insurance schemes for climate-related risks **Health sector** • Integrate climate change considerations into the health care system • Improve emergency readiness and response • Raise awareness among the general public about climate change	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture and health care systems Local authorities Non-governmental organizations, civil society
Tbilisi	Economic and livelihood insecurity, damage to infrastructure Human health insecurity Social insecurity	**Urban areas** • Develop urban plans that consider climate change implications • Develop climate change adaptation strategies or incorporate climate change adaptation activities into existing action plans • Improve emergency readiness and response • Develop/update construction guidelines and other relevant technical documents considering climate change conditions • Raise awareness among the general public about climate change • Enhance emergency response against extreme climate events and natural hazards and strengthen disaster preparedness and prevention **Health sector** • Integrate climate change considerations into the health care system • Improve emergency readiness and response • Raise awareness among the general public about climate change	Governmental institutions, local authorities, environmental agencies Particularly, ministry of health Tbilisi municipality Non-governmental organizations, civil society
Mtskheta-Mtianeti region	Economic and livelihood insecurity, damage to infrastructure Human health insecurity Human insecurity due to high disaster risks Energy insecurity	**Energy sector** • Enhance emergency response against extreme climate events and natural hazards and strengthen disaster preparedness and prevention • Co-ordinate sectoral policies to ensure sustainable use of water resources • Consider an ecosystem approach in developing new activities and further managing existing human activities • Strengthen water and relevant glacier monitoring systems to allow further modelling of climate change implications for the major economic activities • Consider climate change implications for suggested energy projects • Diversify renewable energy sources • Design and implement energy efficiency measures	

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
National hotspots			
Mtskheta-Mtianeti region	Economic and livelihood insecurity, damage to infrastructure Human health insecurity Human insecurity due to high disaster risks Energy insecurity	**Energy sector** • Build capacity and raise awareness on climate change concerns in the energy sector and integrate climate change considerations into planned hydropower projects **Tourism sector** • Integrate climate change considerations into development plans for the tourism sector • Provide accessible financial instruments to develop tourism industry • Raise climate change awareness in the sector	
Kakheti region	Food insecurity Water insecurity, water resource scarcity Livelihood insecurity Land degradation including agriculture land	**Agriculture sector** • Co-ordinate national goals with the major economic sectors to avoid unnecessary overuse of water resources • Consider an ecosystem approach in developing new activities and further managing existing human activities • Develop and apply climate change adaptation practices in the agriculture sector • Establish financial mechanisms to support the agricultural sector • Improve efficiency of agriculture infrastructure • Promote and provide state and private insurance schemes for climate related risks, including crop and livestock insurance • Establish early warning systems for extreme climate events • Strengthen forest fire management and regulate agricultural burning • Restore windbreaks • Raise awareness among farmers on climate change implications and adaptation practices and develop and apply adaptation practices in the agriculture sector	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture Non-governmental organizations, civil society
North-west Georgia	Human insecurity due to high disaster risks Economic insecurity Losses in biodiversity, cultural and natural heritage Livelihood insecurity Human health insecurity	**General** • Enhance emergency response against extreme climate events and natural hazards and strengthen disaster preparedness and prevention **Energy sector** • Co-ordinate sectoral policies to ensure sustainable use of water resources • Consider ecosystem approach in developing new activities and further managing existing human activities • Improve water and, where relevant glacier, monitoring systems to allow further modelling of climate change implications for the major economic activities • Consider climate change implications for suggested energy projects	Governmental institutions, local authorities, environmental agencies Particularly, ministry of energy and health and tourism Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
National hotspots			
North-west Georgia	Human insecurity due to high disaster risks Economic insecurity Losses in biodiversity, cultural and natural heritage Livelihood insecurity Human health insecurity	**Energy sector** • Diversify renewable energy sources • Design and implement energy efficiency measures • Build capacity and raise awareness on climate change concerns in the energy sector and integrate climate change considerations into planned hydropower projects **Mountain areas/glaciers** • Design and implement protection and response measures • Develop and promote innovative projects in energy and agriculture to enhance adaptive capacity • Manage forest ecosystems in a sustainable manner • Strengthen water and, where relevant, glacier monitoring systems to allow further modelling of climate change implications for major economic activities • Support health care system • Raise climate change awareness **Tourism sector** • Integrate climate change considerations into development plans for the tourism sector • Provide accessible financial instruments to develop tourism industry • Raise climate change awareness in the sector **Health sector** • Improve emergency readiness and response • Raise awareness among the general public about climate change • Integrate climate change considerations into the health care system	Governmental institutions, local authorities, environmental agencies Particularly, ministry of energy and health and tourism Non-governmental organizations, civil society
Adjara and the Black Sea coast	Economic and livelihood insecurity (e.g., loss of incomes, monetary losses due to natural disasters) Threats to economic sectors (such as tourism) Human health insecurity Social insecurity (e.g., loss of properties) Food insecurity	**General** • Adapt the energy, transport, tourism and industry sectors to climate change to avoid economic losses and increase resilience • Consider an ecosystem approach in developing new activities and further managing existing human activities • Establish early warning systems for extreme climate events and natural disasters, and enhance preparedness for emergency situations • Review and update technical documents, regulations and permits for buildings and construction projects in light of climate change • Promote and provide state and private insurance for climate related risks • Raise awareness among the general public about climate change • Develop and implement public awareness campaigns	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy, and health Local municipalities Non-governmental organizations, civil society

Hotspot	Security implications and risks related to climate change	Recommendations	Target group
National hotspots			
Adjara and the Black Sea coast	Economic and livelihood insecurity (e.g., loss of incomes, monetary losses due to natural disasters) Threats to economic sectors (such as tourism) Human health insecurity Social insecurity (e.g., loss of properties) Food insecurity	**General** • Build capacities of local governments on adaptation to climate change and security risks • Enhance and strengthen women´s role by ensuring access to ownership resources (e.g., land resources) and development resources (such as credit, information, training) **Agriculture sector** • Develop and apply climate change adaptation practices in the agriculture sector • Strengthen emergency preparedness systems • Establish financial mechanisms to support the agricultural sector • Develop and apply state insurance schemes for climate-related risks, including crop and livestock insurance • Improve efficiency of agriculture infrastructure • Raise awareness among farmers on climate change implications and adaptation practices and develop and apply adaptation practices in the agriculture sector • Establish early warning systems for extreme climate events and natural disasters, and strengthen disaster preparedness, prevention and response **Coastal zones** • Develop climate change adaptation action plans for the coastal zone and implement them • Develop and implement coast protection measures in the most vulnerable and sensitive coastal area • Improve early warning, emergency readiness and response against climate change events and natural disasters • Establish monitoring systems to keep observations up-to-date • Develop legal frameworks such as construction guidelines, permits and other relevant technical documents considering climate change conditions • Raise awareness among the general public about climate change **Health sector** • Integrate climate change considerations into the health care system • Improve emergency readiness and response • Raise awareness among the general public about climate change	Governmental institutions, local authorities, environmental agencies Particularly, ministry of agriculture, energy, and health Local municipalities Non-governmental organizations, civil society

Note: Some priorities in the table (formulations for some were shortened) reflect ENVSEC regional priorities and were selected from the Outcome Statement of Priority areas of the ENVSEC work programme 2015-2020 in the South Caucasus region in the field of CC and DRR and awareness-raising.

RESOURCES

ON-LINE DATABASES:

NATIONAL AUTHORITIES

Climate Change Information Centre of Armenia(CCIC): http://www.nature.am

Government of the Republic of Armenia: http://www.gov.am

Government of Georgia: http://gov.ge

Ministry of Agriculture of the Republic of Armenia: http://minagro.am

Ministry of Ecology and Natural Resources of the Republic of Azerbaijan: http://www.eco.gov.az

Ministry of Environment and Natural Resources Protection of Georgia: http://www.moe.gov.ge

Ministry of Energy of Georgia: http://www.energy.gov.ge

Ministry of Emergency Situations of the Republic of Armenia: http://www.mes.am

Ministry of Emergency Situations of the Republic of Azerbaijan: http://www.fhn.gov.az

Ministry of Nature Protection of the Republic of Armenia: http://www.mnp.am

Ministry of Regional Development and Infrastructure of Georgia: http://www.mrdi.gov.ge

National Statistical Service of the Republic of Armenia: http://www.armstat.am

National Statistic Office of Georgia: http://www.geostat.ge

The State Statistical Committee of the Republic of Azerbaijan: http://www.stat.gov.az

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