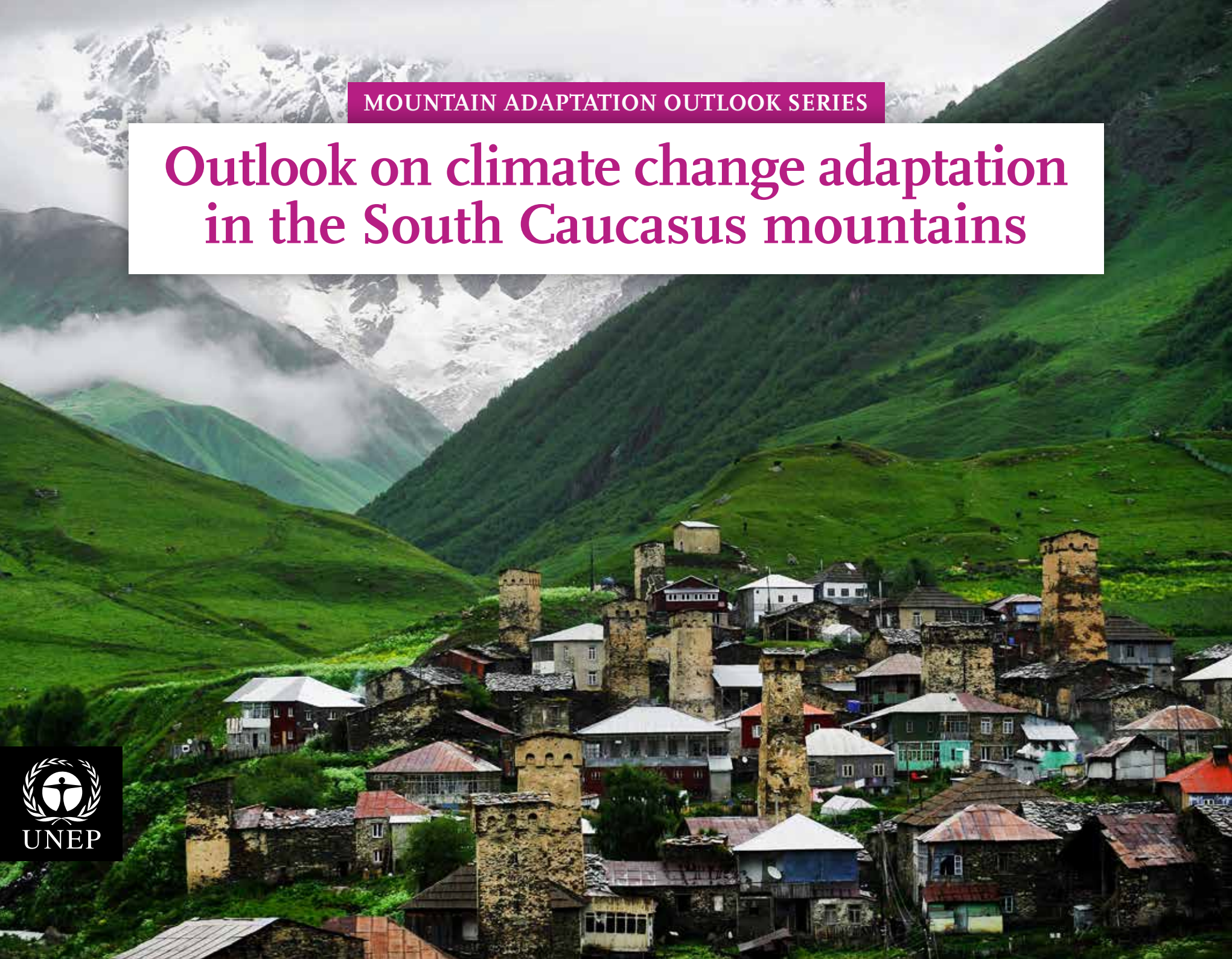

MOUNTAIN ADAPTATION OUTLOOK SERIES

Outlook on climate change adaptation in the South Caucasus mountains

UNEP

DISCLAIMER

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MOUNTAIN ADAPTATION OUTLOOK SERIES

Outlook on climate change adaptation in the South Caucasus mountains

Alpine meadows, Georgia

Foreword

Mountain ecosystems enrich the lives of over half of the world's population as a source of water, energy, agriculture and other essential goods and services. Unfortunately, while the impact of climate change is accentuated at high altitude, such regions are often on the edge of decision-making, partly due to their isolation, inaccessibility and relative poverty.

That is why the United Nations Environment Programme and GRID-Arendal have partnered on a series of outlook reports about the need for urgent action to protect mountain ecosystems and to mitigate human risk from extreme events. Covering the Western Balkans, Southern Caucasus, Central Asia, (tropical) Andes and Eastern Africa, the reports assess the effectiveness of existing adaptation policy measures and the extent to which they apply to mountain landscapes, going on to identify critical gaps that must be addressed to meet current and future risks from climate change.

The result of a broad assessment process involving national governments and regional and international experts, the reports offer concrete recommendations for adaptation. This includes sharing regional good practices with the potential for wider replication to improve cost efficiency and adaptation capacity.

While each of the regions is covered in a dedicated report, they all face similar issues. On one hand, rising temperatures and changing precipitation patterns affect a range of mountain ecosystems, including forests, grasslands and lakes. On the other, drivers such as pollution from mining and unsustainable agriculture erode their ability to cope with these changes. The combined impact is increasing vulnerability among the local and downstream populations who depend on mountain ecosystems – especially when they are isolated from markets, services.

Armenia, Azerbaijan and Georgia, the three countries of the South Caucasus sub-region, are already exposed to changes in climate with steadily increasing annual air temperature and declining annual precipitation; both of which are predicted to reach unseen levels by the end of the century. Changes in diverse ecosystems that include snow-capped peaks, forests and freshwater habitats, are inevitable due to human activities and climate change. However, this increases the vulnerability of mountain populations, particularly women. This makes it key to build reliance by safeguarding natural values and diligent adaptation mechanisms. Increased regional dialogues on common ecosystems can only serve to strengthen such resilience, so we thank the respective governments of the South Caucasus region for their support.

We hope that this report will serve as a practical companion for local, regional and national policy makers seeking to protect fragile mountain ecosystems and the people who depend on them.

Achim Steiner
UNEP Executive Director and Under-Secretary-General of the United Nations

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Executive summary

Changes in climate patterns are already evident in the South Caucasus countries – Azerbaijan, Armenia and Georgia. Annual temperatures are increasing accompanied by severe heat waves and droughts. More extreme weather events, such as heavy rains and unusual hail storms, and changes in precipitation patterns are also linked to climate change. Human casualties, damage to infrastructure and economic losses are increasing due to intensifying natural disasters such as floods, landslides and mudslides. The latest large-scale natural disaster occurred in Tbilisi, Georgia in June 2015, when heavy rainfall triggered landsides and disgorged debris in the capital of Georgia. This disaster resulted in 19 human casualties and economic losses of about US$ 100 million.

In the region, the majority of natural disasters occur in the mountains, which cover the largest territory of the South Caucasus. These disasters threaten not only mountain inhabitants and critical infrastructure but also people living in the lowlands. Moreover, poverty rates are higher and gender inequality more profound in mountain regions than in lowland and urban centres, where access to basic resources such as energy and water is secured. The national trends towards a warmer and drier climate (with some exceptions) will continue leading to serious consequences such as water shortages and desertification in all three countries.

At the policy level, the South Caucasus countries recognize the adverse effects posing severe threats to both ecosystems and national economic sectors and the necessity of prioritizing climate change adaptation. However, this outlook reveals that even though the importance of climate change gains recognition among some decision-makers, adaptation activities, particularly in the mountain regions, are still at an early stage of development. For instance, specific climate change adaptation activities are few, and consistent coordination and a long-term strategic approaches are missing. This report also highlights which ecosystems (e.g. forests) and economic sectors (e.g. energy, agriculture, mining, tourism) are most vulnerable to climate change, as well as the impacts of climate change on human health and well-being.

Recently submitted Intended Nationally Determined Contributions (INDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) from the South Caucasus countries highlight the countries' commitment towards an agreed outcome with legal force under the Convention. INDCs further outline concrete emission reduction plans and highlight some adaptation approaches. The respective National Communications to the UNFCCC are the main reference documents where climate change adaptation plans and interventions are laid out. These documents are widely used as source of key references especially by international development agencies and non-governmental organizations and serve as tools for progress measuring.

Political commitments and legal mechanisms are the basis for implementing concrete actions on climate mitigation and adaptation processes.

Walking near the mountains of Armenia

While some south Caucasus countries are starting to enact such commitments, other countries are taking a more cautious approach towards political engagement. Climate change is mentioned, even though not sufficiently, in a number of legally binding policies, especially high profile documents such as development strategies. Some countries are on the path to adopt an ecosystem based adaptation approach. It is hoped, for example, that Georgia's biodiversity strategy and Armenia's climate adaptation vision will lead to concrete adaptation measures. Regardless of some positive developments, there are few laws or subordinated regulations that include provisions on climate change or promote climate change adaptation. The existing legal framework remains fragmented and insufficient for full-scale deployment of climate adaptation action.

With some exceptions, climate change remains profoundly linked to environmental policy. Safeguarding environmental integrity and building resilience to climate change is elaborated in detail in documents relating to environmental protection (e.g. national environmental action plans, documents on biodiversity protection and combatting desertification, national forest programs). Some countries, such as Azerbaijan, are responding to impacts of climate change, such as the projected water shortages, long drought periods, and outbreaks in pests and diseases, through a strategic food supply programme. However, adequate climate change considerations are lacking in the planning documents for other important economic sectors that will face threats from climate change. The impacts of climate change on energy provision, health, and water supply,[1] for example, are not adequately covered by policy measures.

Certain aspects of climate change impacts are not addressed at all by any government assessment or policy document. These include the impact on specific vulnerable groups such as women (who are disproportionately affected by climate change) and people living under the poverty line, particularly in mountains energy security and safety of industry sector. At the national level, countries would benefit from a coherent policy approach towards climate change adaptation, which could be a framework and strategic guide for mainstreaming climate change adaptation considerations into sectoral development plans and strategies.

The increase in frequency and severity of natural disasters has led the countries of the South Caucasus to invest more in disaster risk reduction measures, such as prevention of floods or sea storms, afforestation measures, and sustainable water and land management. Municipalities and local stakeholders are essential stakeholders in the climate change discussions and design of appropriate responses to address impacts of climate change. Some municipalities already invest, in or co-finance infrastructure projects that are "climate proofed" (e.g. projects addressing flooding or sea level rise). However, these activities are not classified or reported as "adaptation projects". This means there may be more adaptation activities than what is

being reported. Nevertheless, adaptation to climate change at local levels is facing some barriers, such as a lack of relevant knowledge and capacity, as well as significant lack of financial and human resources and absence of adequate overall supporting policy instruments. In addition, the current system of self-governance decentralisation and statutory functions limitations does not allow much opportunity to take strengthened action on climate change at the local, municipal level.

As general awareness of climate change issues continues to grow and climate change impacts are recognized as a threat by the general public, the opportunity for adaptation increases. There is more information available than ever on climate change projections. However, sound knowledge-based decisions, access to information and public participation are still lacking in the region. Since the collapse of the Soviet Union, monitoring activities have been hindered in the countries of the South Caucasus due to cutting down of the observation network. This creates challenges of acquiring accurate and reliable data for projections of climate change and its impacts on economic sectors and ecosystems. Investment in applied research and collection of data, such as about glacier mass balance, water runoff, vulnerability of economic sectors and impacts on ecosystems services would also increase understanding of future challenges and allow evidence based decision-making. Therefore, certain measures should be undertaken to improve data access and management, e.g. establishing comprehensive climate exposure and sensitivity indicators. Moreover, building the foundation for an information exchange platform at the sub-regional level would support enhancement of national capacity in data management, particularly in cases of shared ecosystems, such as the Caucasus mountain ecoregion.

Ministries of environment in all three countries are the designated authorities on climate change matters. They host UNFCCC focal points as well as the focal points for climate change financial instruments such as the Green Climate Fund (GCF). The insufficient designated national coordination mechanisms for involving other relevant institutions, however, makes it challenging for countries to design a coherent approach to climate change adaptation. Also, human and technical capacities are limited to cover needs for action. In addition, climate change can compete financially or thematically with other national priorities, such as social concerns or diversifying the national economies. To overcome these limitations, use of certain mechanisms for technical and financial assistance that are provided through the global mechanisms, e.g. the Climate Technology Centre & Network (CTCN), GCF and the Global Environment Facility (GEF), would allow for enhanced action towards climate change adaptation.

A final challenge for all three countries is to prioritize mountain regions in national policy and strategies and to design targeted actions to increase resilience of mountain ecosystems and mountain communities to climate change. Enhanced monitoring and evaluation of various measures and activities undertaken would greatly serve as a strengthened approach towards climate change and adaptation.

Recommendations[2]

National level

Information and awareness

- Increase awareness about climate change and its impacts, especially in mountain regions and ecosystems, among governments, including at the highest political level, and other stakeholders, particularly outside of the environment sector
- Identify vulnerable economic sectors (e.g. energy, tourism) depending on mountain ecosystem goods and services (such as water resources) using existing data and future projections to provide a strong incentive for action to enhance support for climate change adaptation measures

Policy and law

- Strengthen the governance system and overall strategic approaches including policies and laws related to climate change and adaptation to generate high-level political support for climate change and adaptation issues
- Where necessary, establish long-term policies and strategies, as well as necessary funding mechanisms to support the sustainability of actions undertaken
- Incorporate mountain-specific considerations and related adaptation approaches into relevant policies and laws
- Develop pro-active actions and mechanisms at the policy level (e.g. "Loss and Damage") aimed at mitigating the damage caused by climate change

Financial mechanisms

- Establish innovative funding mechanisms for enhanced climate change adaptation, particularly in mountain regions
- Mobilize resources and allocate adequate governmental budget to support the implementation of adaptation programmes and actions
- Enhance the use of existing climate change financial mechanisms and instruments such as the Green Climate Fund

Coordination mechanisms and cooperation

- Create relevant coordination mechanisms including inter-sectoral working groups and councils, to identify and address country needs and priorities as well as to provide a more coordinated approach towards action. Enhanced communications between the various actors involved in climate change activities would promote synergies between the different actions
- Create a mechanism and incentives for cooperation between the public and private sector

Capacity building

- Strengthen the in-house capacity of relevant government ministries (e.g. Ministry of Environment) to support the continuity of actions undertaken
- Establish self-sustaining climate change knowledge centres or hubs that are linked with government authorities for engaging in systematic research and technology transfer (e.g. provided through Climate Technology Centre & Network), to provide expertise for governments and other stakeholders, as well as to ensure knowledge transfer and uptake of results at the policy level

Implementation and monitoring

- Create a paradigm shift towards adaptation actions, instead of only focusing on mitigation, and integrate environmental concerns into existing socio-economic programmes
- Establish an information exchange system, which allows to monitor the implementation of climate change adaptation programmes and projects (including budget allocation) and to assess their impacts
- Formulate strategies and action plans, including measurable indicators, to better guide the implementation, monitoring, reporting and verification (MRV) of accompanying actions, in particular at the local level

Cross-cutting

- Establish comprehensive data-sharing mechanism allowing to link and build synergy between relevant adaptation programmes and projects, as well as between policy and action, which will work both ways: policy based action and action results reflection into policy documents
- Design programmes and projects that are user-driven (civil society, targeted vulnerable groups, etc.), not just donor-driven

Regional level[3]

- Promote a regional approach to climate change adaptation, including exchange of data and information, methodologies of research assessments, monitoring of climate change, and coordination of relevant actions on the ground among the countries of the South Caucasus
- Promote ecosystem-based approaches to climate change adaptation including building on the results and success of other relevant initiatives such as the Caucasus Biodiversity Council

Hada village, Georgia

Introduction

The Caucasus Ecoregion stretches across the Greater and Lesser Caucasus Mountains, running between the Black and Caspian Seas and encompassing part or all of six nations.[4] This unique region is diverse in its culture, landscape and biodiversity. It is recognized as one of the World Wide Fund for Nature's (WWF) top 35 "priority places". With some of the richest and most endangered biodiversity on Earth, Conservation International classifies it as one of the world's 34 Biodiversity Hotspots (Zazanashvili 2012). The South Caucasus represents the central part of this ecoregion, extending across Armenia, Azerbaijan, and Georgia.

Following the collapse of the Soviet Union in 1991, the economies of the three South Caucasus countries experienced dramatic economic declines. Previously, they were highly developed republics of the Soviet Union but after the collapse of the USSR, they found themselves with dilapidated industries and diminished administrative infrastructure. Now the region has grown in its importance, serving as a geopolitical bridge between East and West. It serves as a transit corridor for energy and benefits from the economic opportunities associated with that. All three countries have shown a significant macroeconomic recovery and in 2014, gross domestic product reached US$ 10.8 billion in Armenia, US$ 75.2 billion in Azerbaijan, and US$ 16.5 billion in Georgia (national statistics).

Despite encouraging economic signs in the region, these are still fragile states that continue to undergo administrative reforms, suffer from the unsustainable use of natural resources, and lack economic diversification. The natural heritage of the South Caucasus faces serious threats from increasing human activities. Geopolitical tensions are also hampering the regional cooperation necessary for environmental action and sustainable development. Exacerbating these threats are the growing impacts from climate change on the region.

Lake Sevan, Armenia

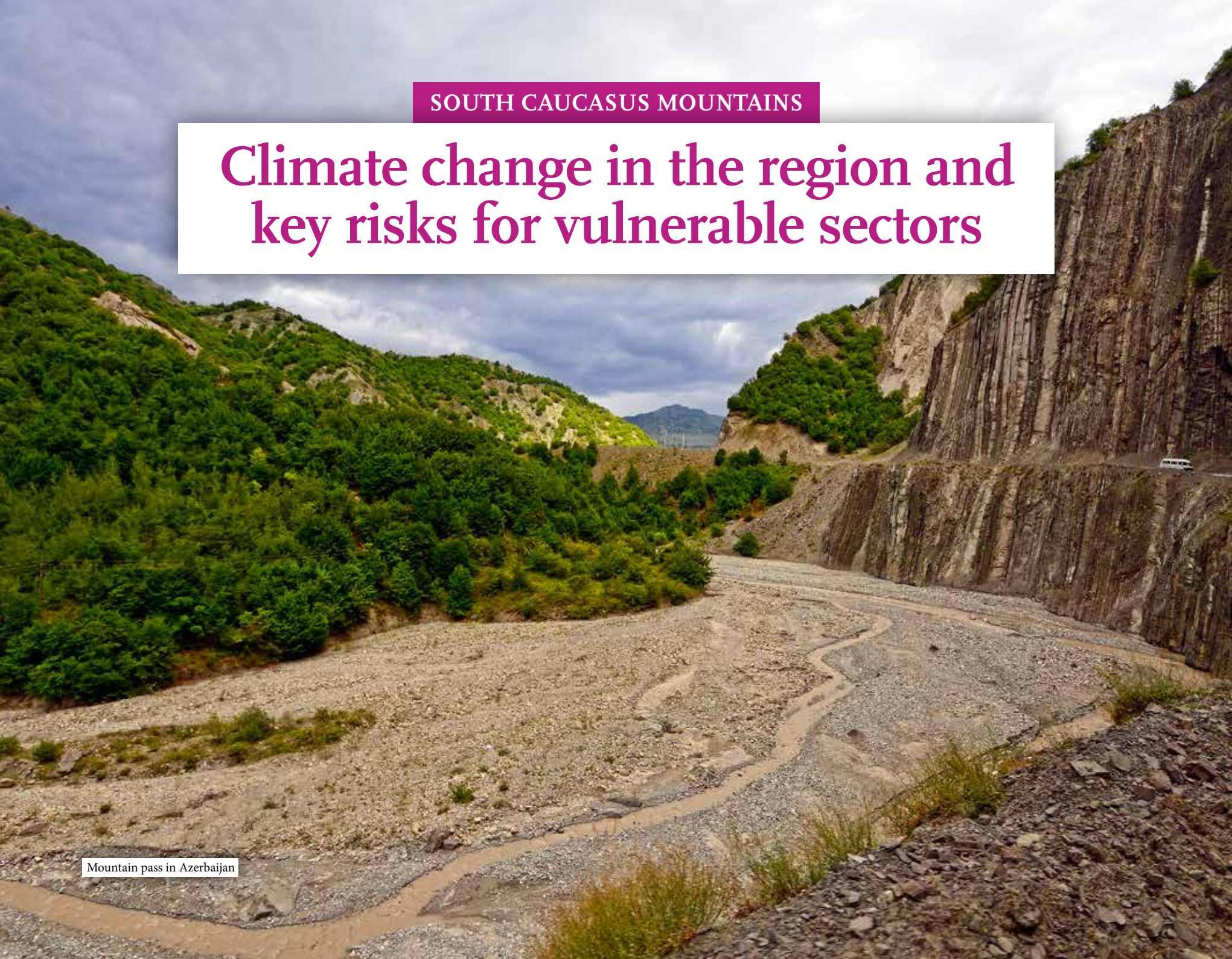
Lake Göygöl, Azerbaijan

The countries of the South Caucasus are all party to the United Nations Framework Convention on Climate Change (UNFCCC) as Non-Annex I countries.[5] The Convention serves as an important platform for international action on climate change mitigation and adaptation. All three countries are mostly dependent upon donor support for their climate actions, with majority of activities focused on climate mitigation measures, such as lowering greenhouse gas emissions, developing renewable energy sources, and increasing energy efficiency. The impacts of climate change, however, continue to grow. Rising temperatures and changing precipitation patterns are leading to more frequent and intense weather events clearly highlighting the need for immediate adaptation measures in addition to mitigation.

Against this background, this sub-regional outlook has been prepared to review and synthesize the existing climate change adaptation responses in the South Caucasus mountain region. This outlook was undertaken in the context of the South Caucasus component of the United Nations Environment Programme´s inter-regional project "Climate Change Action in Developing Countries with Fragile Mountainous Ecosystems from a Sub-regional Perspective."

SOUTH CAUCASUS MOUNTAINS

Climate change in the region and key risks for vulnerable sectors



Mountain pass in Azerbaijan

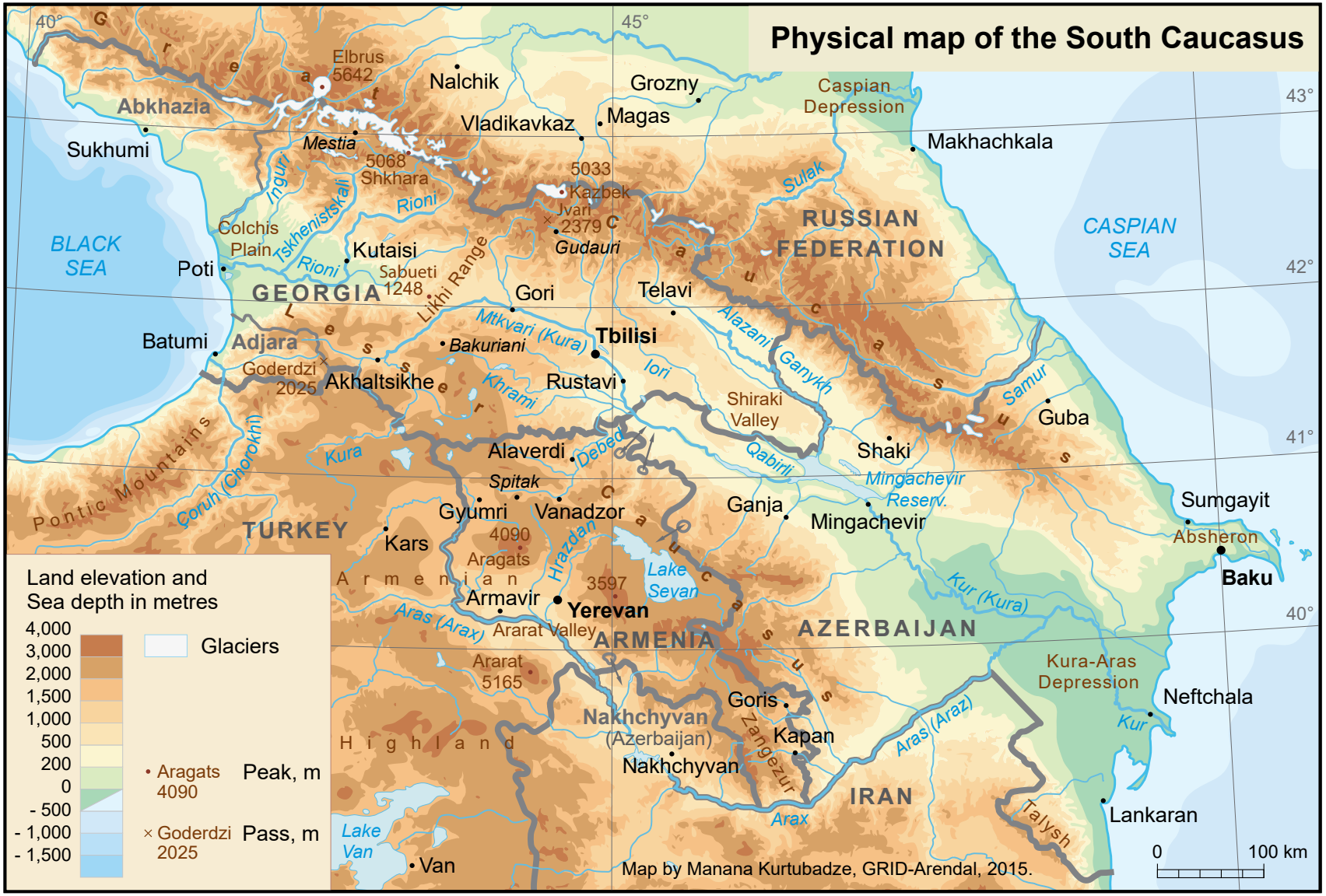
The latest climate change trends

The impacts of climate change may have severe consequences for the people and environment of the mountainous areas of the South Caucasus. The characteristics of these areas, including high risk of natural disasters, low resilience of local communities, and the severity of impacts from anthropogenic activities, make them particularly vulnerable. When combined, these vulnerabilities and the effects of the changing climate may lead to a deterioration of economic activities (e.g. those related to agriculture, energy and industry), loss of human life, and change in natural ecosystems. Temperatures are increasing over the entire region and are expected to continue to do so into the future, and while the trends and scenarios for average precipitation are more varied, they are tending to decrease. Extreme weather events are expected to increase, thus significantly increasing the various risks in the mountains, especially in relation to agriculture, ecosystems, and human health and security (MoNP 2015; MoENR 2010; MoENRP 2015).

Armenia – Warmer and drier

Armenia has undergone significant warming since the early 20th century. The highest rate of warming was observed during the last decade. While the annual temperature increased by 0.4°C between 1929 and 1996, when the data from 2007–2012 is included, the increase is between 0.85°C and 1.03°C (MoNP 2015). Summer temperatures have increased the most, by up to 1.1°C (MoNP 2015).

Agricultural landscape in Armenia


Physical map of the South Caucasus
40°
45°
43°
42°
41°
40°
Elbrus 5642
Nalchik
Grozny
Caspian Depression
Abkhazia
Vladikavkaz
Magas
Sukhumi
Mestia
Makhachkala
5068
Shkhara
5033
Kazbek
Jvari
2379
Gudauri
Inguri
Tskhenistskali
Rioni
Sulak
RUSSIAN FEDERATION
CASPIAN SEA
BLACK SEA
Colchis Plain
Kutaisi
Poti
Sabueti
1248
Likhi Range
Gori
Telavi
GEORGIA
Mtkvari (Kura)
Tbilisi
Batumi
Adjara
Bakuriani
Alazani
Ganykh
Samur
Guba
Goderdzi
2025
Akhaltsikhe
Khrami
Rustavi
Iori
Shiraki Valley
Kura
Alaverdi
Debed
Shaki
Qabirli
Mingachevir Reserv.
Pontic Mountains
Coruh (Chorokhi)
Spitak
Gyumri
Vanadzor
Ganja
Sumgayit
Mingachevir
TURKEY
Kars
4090
Aragats
Hrazdan
Absheron
Baku
Lake Sevan
3597
Armavir
Yerevan
Kur (Kura)
Aras (Arax)
Ararat Valley
AZERBAIJAN
ARMENIA
Ararat
5165
Kura-Aras Depression
Goris
Neftchala
Nakhchyvan (Azerbaijan)
Kapan
Kur
Zangezur
Aras (Araz)
Nakhchyvan
IRAN
Arax
Talysh
Lankaran
Lake Van
Van
Land elevation and Sea depth in metres
4,000
3,000
2,000
1,500
1,000
500
200
0
- 500
- 1,000
- 1,500
Glaciers
Aragats 4090 Peak, m
Goderdzi 2025 Pass, m
Map by Manana Kurtubadze, GRID-Arendal, 2015.
0
100 km

Blossoming peach orchard in Azerbaijan

The summers of 1998, 2000, 2006 and 2010 were extremely warm, indicating an increase in extremely warm temperatures since the 1990s (MoNP 2015). This is supported by precipitation data which shows that the climate in Armenia has generally become drier. Observations between 1935 and 1996 indicate a 6 per cent reduction in precipitation, and almost 10 per cent between 1935 and 2012. This reduction is not, however, evenly distributed throughout the country. While the northeastern and central regions (Ararat valley) have become more arid, precipitation in the southern, northwest and western part of the Lake Sevan Basin has increased over the observation period. The number of days with heavy precipitation and hailstorms has increased due to changes in global atmospheric circulations (MoNP 2015).

Azerbaijan – Warmer and drier

Between 1991 and 2001, the mean annual temperature in Azerbaijan increased by 0.4°C. Annually, this increase is three times as high as the temperature increase of 0.36°C that occurred between 1961 and 1990. Precipitation has decreased significantly throughout the country. On average, annual precipitation has decreased by 9 per cent over the past decade, although some areas have been more affected than others. Compared to the period 1961–1990, precipitation declined by 17.7 per cent in Ganja-Gazakh, 17.1 per cent in Nakhchivan, 14.3 per cent in the Kura-Ara(k)s lowland, 6.4 per cent in Shaki-Zagatala, 2.6 per cent in Guba-Kachmaz, and 1.2 per cent in the southern region (MoENR 2010).

Georgia – Warmer and wetter/drier

The Likhi Ridge that runs down the centre of Georgia has given the country two distinct climates – a humid climate in the west and a dry climate in the east. The observed changes to the climate, therefore, differ between east and west. Regardless of this, temperatures throughout Georgia have increased between 1961–1985 and 1986–2010. Temperatures in the west warmed by 0.3°C, while mean annual temperature increased by 0.4–0.5°C in the east. Precipitation, on the other hand, has generally increased in the west and decreased on the Likhi Ridge and areas to the east. In the west, the mountain zone of Svaneti and the mountain area of Adjara have both seen increases of about 14 per cent in precipitation (MoENRP 2015).

Data presented in the adaptation strategy for Upper Svaneti indicate that the average annual temperature at Mestia, located at an altitude of 1 441 metres above sea level (m.a.s.l), has increased by 0.3°C between the periods of 1961–1985 and 1986–2010. Summers have seen the highest increases in temperature (+0.7°C), compared to winters which have become slightly colder (–0.1°C). Mestia receives about 918 mm of precipitation annually. A comparison between the two periods indicates a 10 per cent increase in precipitation, with winters becoming substantially wetter (+30 per cent) and summers drier (–8 per cent) (UNDP 2014a).

Climate change scenarios

Armenia – Warmer and drier/wetter

The national trend of a warmer and drier climate that has been observed over the last 80 years is forecast to continue throughout the 21st century. Temperatures are predicted to increase 1.3–1.7°C by 2040, 2.6–3.2°C by 2070 and 3.3–4.7°C by 2100 (MoNP 2015). Summers will see the greatest increase in temperature, followed by winter. The understanding of how climate change will affect precipitation trends is less clear, but there is a general trend towards drier and hotter summers. Pre-montane and montane regions can, however, expect a slight increase of precipitation by the mid-21st century (MoNP 2015).

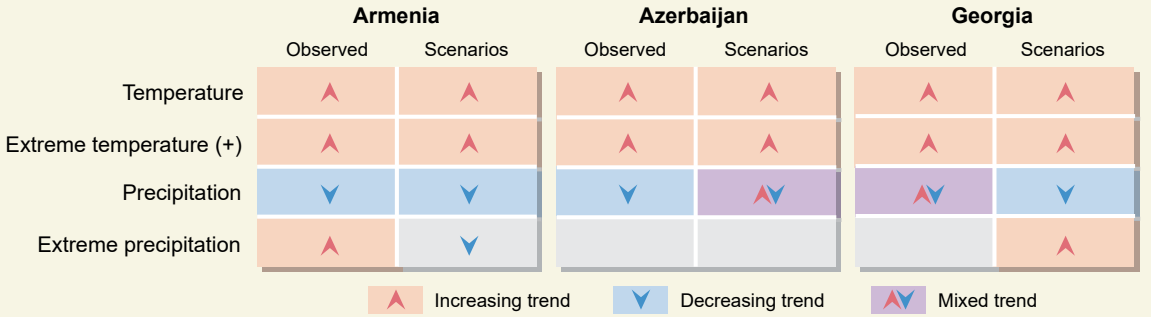
Azerbaijan – Warmer and wetter/drier

The current trend towards a warmer climate is projected to continue. Climate models indicate an average annual increase of 1.5–1.6°C by 2021–2050 and 3–6°C by 2070–2100 across the entire country. Maximum temperatures are also predicted to increase and may reach 47–53°C. There is less certainty about precipitation trends. According to Azerbaijan's Second National Communication to the UNFCCC, precipitation is projected to increase by 10–20 per cent towards 2050 compared to the period 1961–1990. Towards the end of the century, precipitation is expected to increase by 20 per cent in the west and 80 per cent in the east, while the Nakhchivan is expected to become drier with a 20 per cent reduction in precipitation in comparison to 1961–1990 (MoENR 2010). Other studies, however, predict that precipitation will decline by 5–23 per cent towards the end of the century (UNDP 2011).

Georgia – Warmer and drier

According to Georgia's Third National Communication to the UNFCCC (MoENRP 2015), the country will continue to experience warmer temperatures towards the mid- and late part of the century. Average annual temperatures are expected to increase by 0.8–1.4°C by 2050 and 2.2–3.8°C towards 2100 (MoENRP 2015). The temperatures in the mountainous areas of the northwest of Georgia, such as Mestia and Ambrolauri, are predicted to be among the areas with the greatest temperature increase by the end of the century. Data on precipitation is less certain than for temperatures. According to Georgia's Third National Communication to the UNFCCC, precipitation is expected to increase in nearly all of the territory up to 2050, but then drastically decline towards 2100. The exception is the central part of the Likhi Range (Mta-Sabueti) where precipitation is predicted to increase by 93 per cent. According to a UNDP study conducted in 2011 under the Environment and Security Initiative, the change in precipitation varies between 0–24 per cent decrease towards end of this century. Both frosty days and nights are expected to decrease in Georgia, and frosty days will only be characteristic for mountainous areas by the end of the century. Similarly, hot days are expected to increase, mainly in summer and autumn. The number of hot days may double in some of the mountain areas, such as Tsalka, Pasanauri, Ambrolauri, and Goderdzi Pass. Increases in heavy precipitation are expected with a concomitant risk of increasing floods, flash floods, mudflows and landslides in the mountain areas (MoENRP 2015).

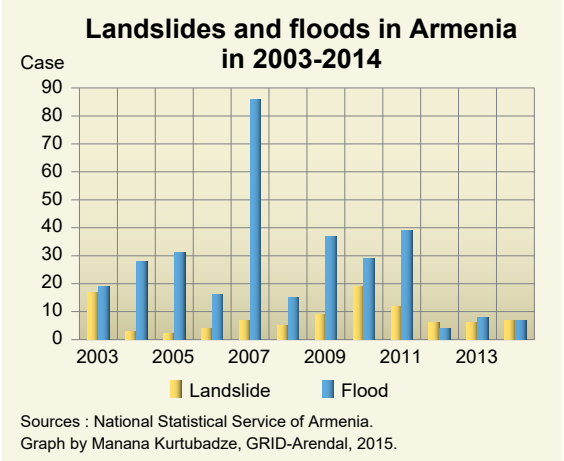
Observed climate change and scenarios for South Caucasus



Sources : Second National Communication of Azerbaijan, 2010; Third National Communication of Armenia, 2015; Third National Communication of Georgia, 2015; ENVSEC and UNDP, 2011.

Natural hazards

The South Caucasus region is highly exposed to natural disasters and its mountainous areas are particularly high-risk zones. Disasters prevalent in the region include landslides and mudslides, floods, flash floods, droughts, avalanches, hailstorms and earthquakes. The countries lie in a region with moderate to very high seismic activity and are thus especially exposed to earthquakes that may have devastating impacts on human life, buildings and infrastructure. This seismic activity may also trigger secondary events such as land- and mudslides, avalanches and flash floods in the mountainous areas (UNIDSR 2009). The 1988 earthquake in Spitak, Armenia exemplifies the vulnerability of the region to natural disasters and the social vulnerability of its people. This earthquake, and the secondary events it triggered, resulted in 25,000 casualties, affected a total of 1.6 million people and led to an estimated US$14.2 billion in economic losses (UNIDSR 2009).

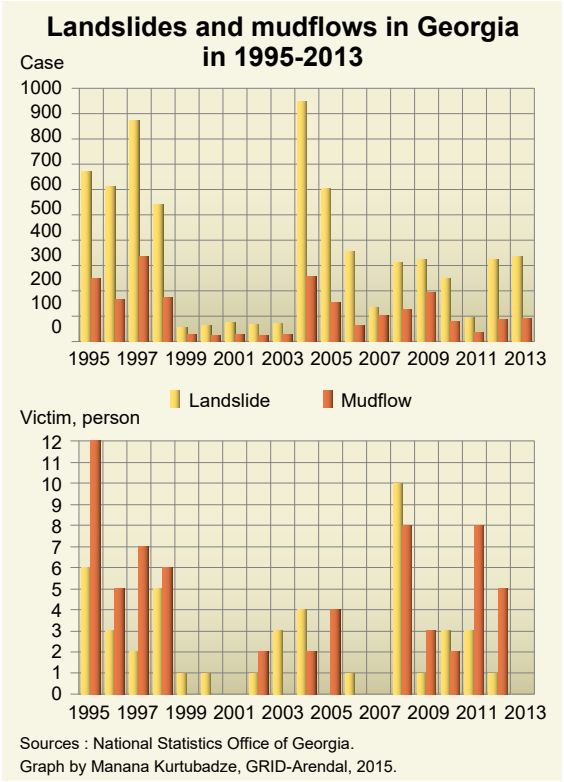


Sources : National Statistical Service of Armenia.
Graph by Manana Kurtubadze, GRID-Arendal, 2015.

Large areas of the country are under threat from natural hazards. In Georgia, almost 70 per cent of the territory, home to some 57 per cent of the population, is at risk from disasters, including mudflows (32 per cent of the total area), flooding and erosion (27 per cent), landslides (24 per cent), and avalanches (17 per cent) (MoENRP 2015). Armenia's main threats are from land- and mudslides, primarily on mountain slopes and hillsides. About one-fifth of all communities in Armenia have been affected by landslides. Areas with the highest risk of mudslides include Vayots Dzor (100 per cent of area at risk), Tavush (78 per cent), Syunik (70 per cent) and Lori (65 per cent) (MoNP (2015). Azerbaijan and Georgia also have a high exposure to floods. In fact, the Greater and Lesser Caucasus Mountains are some of the most flood-prone areas in the world. In Azerbaijan, floods are most prevalent on the southern slope of the Greater Caucasus and in the high mountain zone of Nakhchivan AP (MoENR 2010). Droughts occur less frequently than floods in Armenia, Georgia and Azerbaijan but the economic losses are generally higher than those associated with flooding (UNIDSR 2009).

While the region is naturally prone to many natural disasters, climate change is generally expected to exacerbate the frequency, intensity and severity of such events (Ahouissoussi *et al.* 2014). The three countries have already recorded an increase in natural disasters. The frequency of floods, for example, has already increased in Georgia and Azerbaijan (MoENR 2010; MoENRP 2015). Between 1995 and 2001, floods in Azerbaijan occurred 2-5 times per year but increased to 8-27 annual events between 2002 and 2008 (MoENR 2010). The melting of glaciers in the Great Caucasus Mountains also increases the risk of glacial lake outburst floods (GLOF). Between 1985 and 2000, the number of glacial lakes increased by 50 per cent, significantly increasing the risk of outburst floods that are devastating for downstream communities and infrastructure (MoENRP 2015). Since 1987, landslides have increased by 63 per cent


Damaged road in Georgia




Landslide, Georgia

(MoENRP 2015), while the frequency of droughts has increased almost threefold in recent years; mostly in Shida, Kvemo Kartli, Kakheti and upper Imereti (Ahouissoussi *et al.* 2014).

As documented in Georgia's Third National Communication to the UNFCCC (MoENRP 2015), the increase in landslides, floods and mudflows is caused by a combination of factors, including an increase in anthropogenic pressures (population growth, removal of vegetation on hillsides and mountain slopes, construction on unstable soils, development of artificial waterways), increase in tectonic activity, and climate change (warmer temperatures and increased frequency of heavy precipitation). The likelihood of these incidents occurring increases during heavy precipitation or abnormally high amounts of seasonal precipitation. As a result, areas projected to experience an increase in such events are also likely be affected by higher numbers of hydrological disasters. As temperatures are expected to increase across the region, it is also likely that the areas prone to drought will increase and that droughts will become more intense (World Bank 2006).

CASE STUDY

Turbulent Rioni River basin

The Rioni River basin is the second largest in Georgia and the largest in Western Georgia originating in the Greater Caucasus range and flowing into the Black Sea near the city of Poti. Georgia's National Communications to the UNFCCC and the National Environmental Action Plan recognizes the Rioni River Basin as the most sensitive area to climate change due high exposure to floods. Yet, the basin is an important area for agriculture activities, energy generation and mining. The majority of people, about 71 per cent, are employed in the agricultural sector engaged in cattle breeding and cereal, nuts, vegetable and fruit farming. Abundant water resources from glaciers and precipitation in the river basin also serves as an important source for energy production.

It's geological and hydrological complexity means that the Rioni River is prone to catastrophic floods in almost all seasons and with intensive sedimentation processes. Caused by heavy precipitation, intensive snow and glacial melting, means that water levels can increase by 3m and even up to 8m in some tributaries, such as the Tskhenistskali River. This high water flow triggers frequent landslides and mudflows in the upper river basin, and floods and flash floods in the middle and lower river basins.

The floodplains of the Rioni River basin support large areas of the basin's agricultural activities therefore floods can have a devastating impact on crop and livestock production. Severe floods can also destroy infrastructure and lead to loss of life. In 1987, for example, the Rioni River exceeded its earlier historical maximum water discharge when peak flows reached as high as 4,850 m^3/s. The extent of the inundated area on the Kolkheti Lowland reached 200 km^2. The losses were severe - 150 people died and material damage reached nearly US$ 700 million including destroyed infrastructure such as housing, railway, roads and power lines (Ewoldsen 2014). The challenging natural conditions are further exacerbated by anthropogenic factors. Unregulated land use and lack of spatial planning practices, allows the local population to expand farming plots and civil construction in the floodplain areas, thus increasing the size of the population at risk.

Climate change is another factor intensifying the situation. According to Georgia's Second National Communication to the UNFCCC, the Lower Svaneti, a region on the southern slopes of the Greater Caucasus has experienced an increase in annual precipitation of 10 per cent and an increase in annual mean temperatures of 0.6°C over the last decade (in comparison to the period 1955–1970). This resulted in glacier retreat and changes in river runoff and increased sediment loads carried by the rivers. The silting of the riverbed by glacial sediment has reduced the river discharge capacity, especially during floods, and the riverbed gradient along the affected length all the way to the coast.

To respond to the identified risks, the project "Developing Climate Resilient Flood and Flash Flood Management Practices to Protect Vulnerable Communities of Georgia" (2011–2016) was designed and submitted to the Adaptation Fund, an organization established under the Kyoto Protocol and funded by governments as well as private funders (Adaptation Fund 2015). The aim of this project is to establish long-term flood management practices enabling the Georgian government to manage flood risk in a more sustainable manner. The objective of the project is to improve the resilience of highly exposed regions of Georgia to hydro-meteorological threats that are increasing in frequency and intensity as a result of climate change. The project will help the government and population of the Rioni River basin to develop adaptive capacity and embark on climate-resilient economic development.

The project has three main components:

1. A floodplain development policy to incentivize long-term resilience to flood/flash flood risks
2. To develop and implement climate-resilient flood management practices to reduce the vulnerability of highly exposed communities
3. An early warning system to improve the preparedness and adaptive capacity of the population

Activities have been prioritized through consultation with local communities, including heads of municipalities, the National Environment Agency (NEA) at the Ministry of Environment and Natural Resources Protection and its local staff responsible for management of the hydro-meteorological network, and the relevant staff of the Ministry of Regional Development and Infrastructure (MRDI). The project takes an integrated and comprehensive approach by addressing critical gaps in land use policy and the regulatory framework fundamental to climate resilient flood management.

The project aims to help the government and the population of the Rioni River basin to develop adaptive capacity and embark on climate-resilient economic development. Through project implementation, 5 meteorological stations, 20 meteorological posts and 10

hydrological posts equipped with modern equipment were established and rehabilitated thus increasing the spatial coverage of the monitoring network.

Research and analysis revealed about 300 active landslide points with a total area of 11,470 ha. Ninety-eight mudflow rivers were identified, and cadastres for all detected points were drawn up. Meteorological and hydrological data from 26 hydrological stations/posts were digitized and uploaded to the project's server. Socio-economic data were collected by the project from six pilot municipalities and additionally from 12 municipalities of Rioni River basin. All collected digital data were used for landslide hazard assessment.

National and local staff of the NEA was trained in weather, hydrological, flood, flash flood, landslide and mudflow risk assessment, as well as in forecasting and early warning systems (Delft-FEWS training), GIS and data management software, and the operations and maintenance of observation stations. Local emergency response staff were also trained to ensure better local emergency preparedness planning and response coordination.

The project also provided a number of community-based adaptation solutions to be implemented at the local level. After intensive work with target municipalities and the local population, territories for agro-forestry were selected in six pilot municipalities. These territories mostly encompass downstream municipalities (Tskaltubo and Samtredia). In all, eight plots were selected with a total area of 10 ha. During the project, different species of trees (e.g. walnut, hazelnut, acacia) will be planted on afforested plots to protect the soil from riverbank erosion.

Rioni River, Georgia

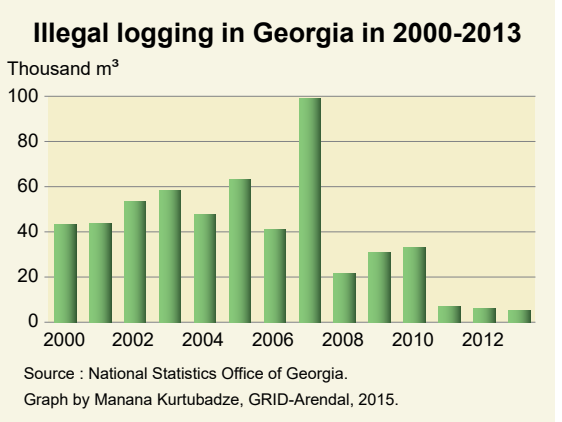
Vulnerability and impact assessment

Ecosystems

The mountainous areas of the South Caucasus have a wide variety of climate zones, ranging from cold moderate alpine peaks to temperate, humid and arid landscapes.[6] The variation in climate zones gives the region its unique and diverse biodiversity, including many rare and endemic species (CEPF 2003). Caucasus region has been recognized as holding an important reservoir of biodiversity, and is indeed considered a globally significant 'biodiversity hotspot' based on the richness of species, and level of endemism, recorded. As part of the Caucasus-Anatolian-Hyrcanian Temperate Forest, Armenia's forests are recognized as a global conservation priority under WWF's Global 200 Ecoregions (Ulander and Ter-Zakaryn 2012).

In the Southern Caucasus, the majority of forest ecosystems in the mountains are of great importance for mountain communities. Georgia has the highest percentage of forest cover in South Caucasus at almost 40 per cent, followed by Azerbaijan and Armenia both having forest cover of 11.8 per cent and 11.5 per cent respectively (MoENRP 2015, AZ Stat, MoNP 2015). In Georgia, over 60 per cent of its forests are situated on mountain slopes at an elevation of 1,000 m.a.s.l or higher (MoENRP 2015; MoENR 2010; Ulander and Ter-Zakaryn 2012). Forest ecosystems protect biodiversity, store carbon, and store and purify water. In addition, they provide benefits vital to human livelihoods and food security, including construction materials, fuel wood, food (mushrooms, nuts and berries), medicinal plants, and grazing areas for animals. The ability of trees to prevent soil erosion and landslides is essential in the hazard-exposed mountains. The forests, however, are under constant pressure from deforestation. Deforestation rates were especially high after the collapse of the Soviet Union when energy shortages were common. Wood became the main source of energy for heating and cooking, and in rural areas wood is still used to reduce costly electricity and gas bills. Illegal logging for commercial purposes also remains a serious problem in the region (Ulander and Ter-Zakaryn 2012).

Sources : National Statistical Service of Armenia; ICARE Foundation, 2011.
Graph by Manana Kurtubadze, GRID-Arendal, 2015.



Source : National Statistics Office of Georgia.
Graph by Manana Kurtubadze, GRID-Arendal, 2015.

In addition to human pressures, forest ecosystems are vulnerable to changes in temperature and precipitation. An assessment conducted for Georgia's Third National Communication to the UNFCCC found evidence of climate change impacts on forests in all three areas investigated – Adjara, Mestia and Borjomi Municipality – that may reduce the critical ecosystem services provided by them. The various climate change-related impacts included an increase in areas infested by pests and diseases, introduction of new diseases (Adjara and Borjomi), increased frequency of drought and wildfires (Borjomi), and displacement of species due to warmer temperatures, and prolonged vegetation period (Mestia).

Similar risks for forest ecosystems due to current and future changes in temperature and precipitation are underlined in Armenia's Third National Communication (MoNP 2015). This report also gives a comprehensive oversight into the predicted upward vertical shift of climatic zones and vegetation. In general, drier ecosystems will expand in the lower altitudes while the forest ecosystems are likely to migrate to higher altitudes. Forest coverage is expected to gradually decline as forestland gradually converts to open arid forests, and further to semi-desert and steppe ecosystems. The altered ecosystems will not only change in structure but also in the composition of species. The boundless and fluid

nature of ecosystems gives no consideration to human borders, and the shifting geography of ecosystems can, therefore, have a significant impact when assessing the changes within national parks and other territories defined by humans. One example is how the changing ecosystems will impact the Lake Arpi National Park in Armenia, situated at an altitude of around 2000 m. Here, the altered conditions could be beneficial for the Asia Minor ground squirrel (*Spermophilus xanthoprymnus*), Transcaucasian water shrew (*Neomys schelkovnikovi*), Eurasian otter (*Lutra lutra*), Dalmatian pelican (*Pelecanus crispus*), Corncrake (*Crex crex*), marbled polecat (*Vormela peregusna*) and Armenian sea-gull (*Larus armeniacus*). Other species, however, such as the Black stork (*Ciconia nigra*) and Common crane (*Grus grus*) are likely to decline due to the altered ecosystems. This scenario, however, gives no indication on how these species are changing outside the borders of the national park, and emphasizes the necessity of not limiting ecosystem and species assessments to only anthropogenic borders.


Adishi Glacier in Georgia

Species in mountain ecosystems are vulnerable to changes in climate, as they tend to thrive in fairly narrow climatic zones. While there is limited data available on the impact of climate change on species in the South Caucasus Mountains, Armenia's Third National Communication provides some information. According to the report, climate change will likely have a significant impact on 238 plant species out of the 452 species described in Armenia's 2011 Plant Red Data Book (MoNP 2015). Changes in habitats may result in population reductions and the threat of species extinction in Armenia. For another 140 plant species (thermophilic species), warmer temperatures will expand the area suitable for growth. Some vertebrate animals, such as the minor ground squirrel, grey pochard, corncrake, otter and water shrew, may also benefit from improved conditions for feeding and breeding, as well as a larger habitat.

Aquatic ecosystems in the South Caucasus, and especially mountainous, glacier ecosystems, are particularly vulnerable to the predicted continuation of warmer temperatures (Shahgedanova *et al.* 2009). Only the Greater Caucasus Mountains supports the formation of glaciers in the region (there are no glaciers in Armenia). Georgia has the largest glaciated area and the greatest number of glaciers. Research shows that between 1985 and 2000, the glaciated areas in the region decreased by 10 per cent. According to the study, glacier melting is driven primarily by temperatures that have been warming since the 1970s and especially since the mid-1990s (Stokes *et al.* 2006).[7] More specific examples include the decrease of glaciers in the Gusarchay Basin in Azerbaijan from 4.9 to 2.4 square km over the past 110 years (MoENR 2010). In Georgia, all glaciers on the southern slope have retreated due to climate change. The Chalaati glacier, for example, retreated by 436 m between

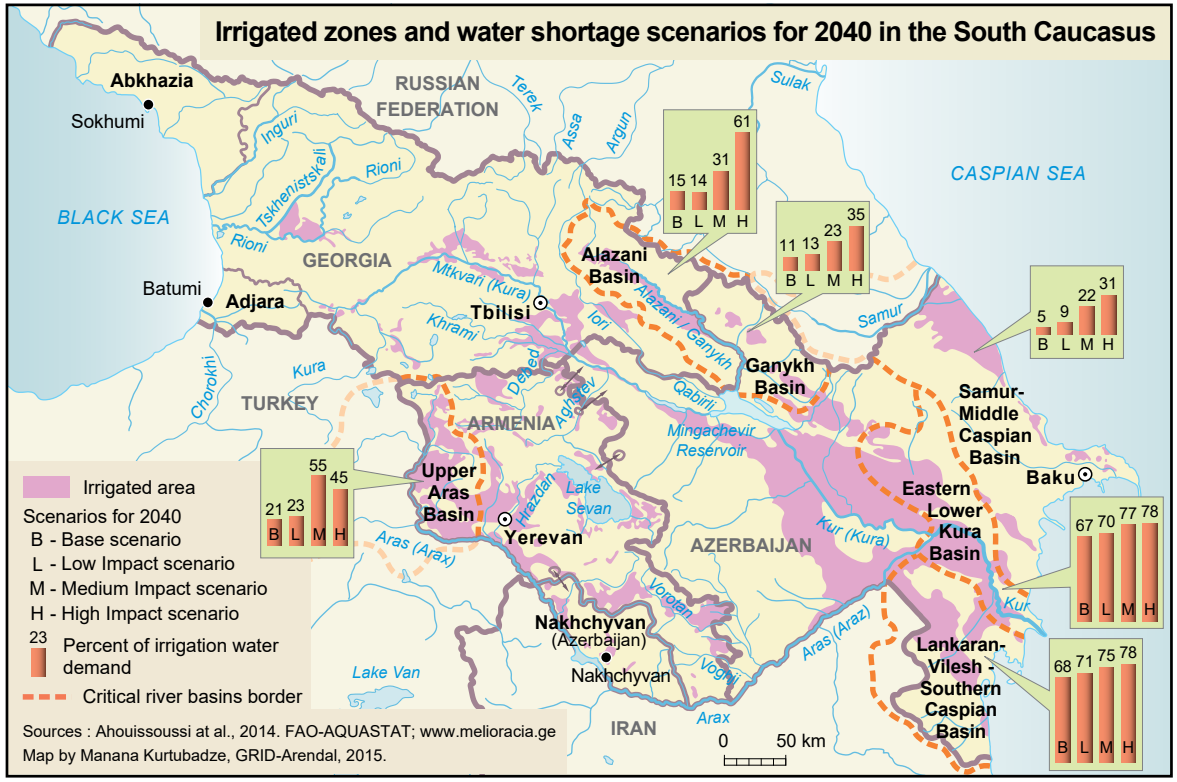
Sources: CEO-Caucasus-2002, UNEP; Geopolitical Atlas of the Caucasus, Autrement, 2010.
Map by Manana Kurtubadze, GRID-Arendal, 2015.


Agriculture in the Ararat valley, Armenia

1974 and 2011, while the Tviberi glacier, the largest in Georgia, has decreased from 43.1 square km to 23 square km. The glacial retreat has caused sections of the glaciers to disconnect from each other, such as the Kvitlodi glacier that is now 800–900 m away from the main Tviberi glacier (Gobejishvili *et al.* 2012).

Warmer temperatures, increasing evaporation and decreased precipitation will lead to decreased water availability, crucial to sustaining the health of aquatic ecosystems, as well as meeting the water needs for energy, agriculture, industries and domestic use (Stoke *et al.* 2006; MoENR 2010; MoENRP 2015). The glacial runoff from the Inguri River in Georgia, for example, is predicted to decrease by 40 per cent by the end of the century as compared to 2010. As a result, the annual river runoff will decrease by about 13 per cent (MoENRP 2015). A study conducted by UNDP in 2011 called "Regional Climate Change Impacts Study for the South Caucasus Region" found that water flow of three trans-boundary river basins fed by glacier runoff and/or snowmelt are likely to decrease due to declining precipitation and increased temperatures by the end of the century. The basins are the Alazani (Gamik) (expected reduced water flow of 26–30 per cent), Khrami-Debed (expected reduced water flow of 45–66 per cent) and Aghstev (expected reduced water flow of 59–72 per cent) (UNDP 2011).

While there are no glaciers in the Lesser Caucasus Mountains, higher temperatures and less precipitation will also reduce water flow in rivers and lakes (UNDP 2011; MoNP 2015). The water level of Lake Sevan, for example, Armenia's most important aquatic ecosystem, is expected to recede due to a 40 per cent reduction in the water flow from the 28 rivers and streams that flow into the lake (MoNP 2009). Warmer temperatures are also likely to affect species in aquatic ecosystems. The expected increase in water temperature of Lake Sevan is predicted to increase by 3.6–4°C by 2100, causing serious damage to the whitefish (Coregonus lavaretus) population, the most dominant fish species of the lake (MoNP 2015).



Reduced water availability is expected to play a role in water quality issues across the region. The countries are still struggling with pollution problems resulting from poor sanitation facilities and industrial activities, including mining pollution. It will affect local aquatic ecosystems and play a role in water sharing.

Agriculture

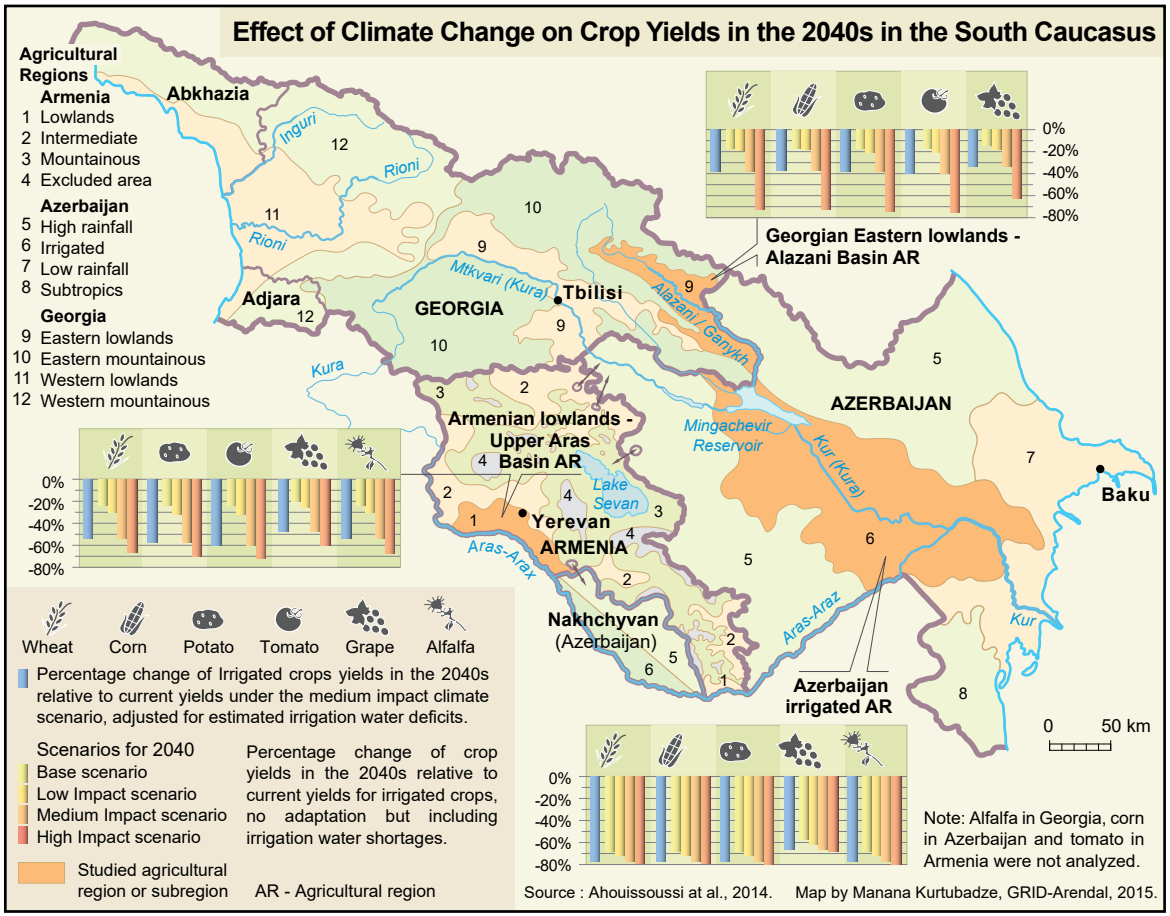
While the contribution of agriculture to the gross domestic product of the three countries has declined over the past decade, the countries are still largely dependent on this climate-sensitive sector. Employment in agriculture and subsistence farming are vital activities amongst rural mountain communities where the percentage of poverty is highest throughout the region. Due to limited arable land, many families combine crop production with animal husbandry. In addition, there are other stress factors such as high levels of land degradation, including soil erosion and salinization due to a mix of human activities (e.g. cultivation practices, overgrazing, and deforestation). Climate change further exacerbates the situation through increases in extreme weather events such as heavy precipitation, which causes soil instability, flooding, and land- and mudslides (MoENR 2010; MoNP 2015; MoENRP and UNDP 2015).

The capacity of farmers to adapt to the impacts of climate change is low due to poorly managed irrigation and drainage systems, limited financial resources restricting the use of new technologies, inadequate support from and access to agricultural extension services, and poor access to weather and climate information. Thus the impacts of climate change on agriculture in the South Caucasus region may be severe (Ahouissoussi *et al.* 2014).

Changes in crop yields are one of the most direct ways climate change is expected to impact agriculture. The World Bank study "Building Resilience to Climate Change in South Caucasus Agriculture" (Ahouissoussi *et al.* 2014) includes a comprehensive assessment of the

impact of climate change on crop yields towards 2040 for the region, including mountainous areas in Georgia and Armenia, as well as areas with high precipitation in Azerbaijan, which correlates with higher-altitude regions. The report concludes that the majority of the region is likely to be negatively affected by higher temperatures and evaporation, decreasing and more varied precipitation patterns, reduced river runoff, and increased frequency and severity of extreme natural disasters. The various expected impacts can result in reduced, and less certain crop quality of and livestock yields. One example is the mountainous region in the Upper Araks basin in Armenia. As presented in the figure below, the estimated changes in yield for this region show significant decreases when considering the changes in temperature, precipitation and the expected decrease in water available for irrigation.[8] It is, however, also evident that the expected decreases in yields are estimated to be more adverse at lower altitudes.

The changes in crop yields, however, vary between locations. For certain crops in the mountain regions the changes may, in some cases, be beneficial. When assessing the impact of changes in temperature and precipitation, Armenia's intermediate (1001–1700 m.a.s.l) and mountainous (1701–2500 m.a.s.l) areas are likely to benefit from increasing yields in tomato, watermelon and wheat crops. Wheat, which is the country's key crop, may experience an increase in yields of 38 per cent in the higher altitudes.[9] While crop yields will likely decrease throughout Azerbaijan, pasture yields are expected to increase by 5–11 per cent with the highest increases expected to take place in areas




Georgia


Armenia

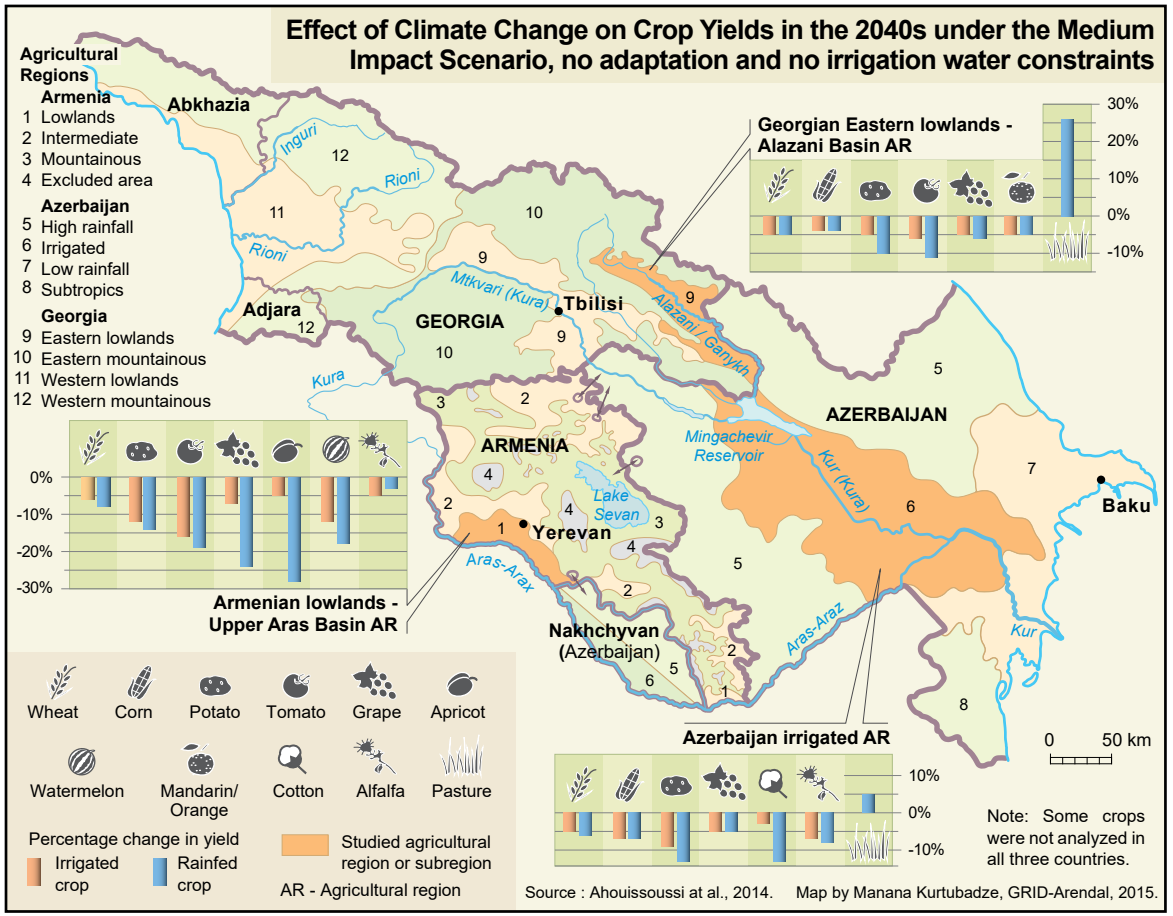
with high rainfall.[10] Pasture yields are also expected to increase in the western and eastern mountainous regions of Georgia by 44 and 87 per cent, respectively.[11] The region that is likely to benefit the most is the eastern mountain region in Georgia, which may experience substantial yield increases in crops such as corn, tomato and wheat of 3, 23, and 17 per cent respectively.[12] The rest of the Georgian territory, however, is expected to experience decreased yields (Ahouissoussi *et al.* 2014).

Future warmer temperatures and reduced water availability is further expected to increase aridity and intensify desertification processes, especially in Armenia. Here, 80 per cent of the territory shows notable signs of desertification due to a combination of human pressures and natural causes. Increased aridity is expected to reduce the fertility, and further degrade the quality, of arable land with adverse affects on people's livelihoods (MoNP 2015).

Water constraints are perceived as the most severe impact of climate change on the agricultural sector. Climate change will inevitably increase the number of areas needing irrigation, the water demand for crops, and consequently reduce water availability. Azerbaijan already struggles with a water deficit. In Armenia alone, the demand for irrigation water is expected to increase by about 202 million m^3 by 2030 due to reductions in river flow and summer precipitation. This increase in demand, however, is expected to take place mostly in the Ararat valley. In the region of Shirak (altitudes between 1400–2200 m), the demand is expected to increase by 13.2 million m^3. A reduction of 11 per cent in river flow is expected by 2030 as compared to average water flow for the period 1961–1990.[12] A 10–23 per cent reduction in summer precipitation is expected by 2040 (MoNP 2015).

Climate change is also predicted to shift the agro-climatic zones higher in elevation. This can create more beneficial conditions for agriculture in areas previously limited by low temperatures. At present, the areas located at around 2,500 m in the Upper Svaneti region in Georgia, for example, are on the borderline of permanent snow and glaciers and low temperatures restrict crop cultivation. The expectation is that by 2100, it will be possible to cultivate earlier: potatoes, oats, barley, vegetable and root crops due to a warmer climate (UNDP 2014a).

An additional stress factor for farmers in the mountain regions of the South Caucasus is the high and increasing exposure to extreme events, including heat waves, drought, hail storms, floods, late frosts, heavy rainfalls, heavy winds, as well as land- and mudslides that cause severe damage or loss of crops, livestock, and infrastructure. Many of these events have steadily increased over the years and have had severe impacts on crop yields, for example, due to impacts from heavy precipitation and hailstorms, as well as harvest failures in corn and bean production in Georgia (Ahouissoussi *et al.* 2014; MoNP 2015; Ministry of Environment and Natural Resources of Georgia 2015).



CASE STUDY

Dedoflistskaro – food pocket of Georgia

The Dedoflistskaro Municipality is located in the easternmost part of Georgia, within an arid and semi-arid climate zone. Annual precipitation in the region fluctuates between 300–648 mm and the area is under high risk of desertification. It is recognized as one of the most sensitive regions to climate change in Georgia (MoEPNR and UNDP 2009; MoEPNR 2012; MoEPNR 2014). Agriculture accounts for about 70 per cent of the gross domestic product of the Dedoflistskaro Municipality (REC 2012). The main agricultural activities include wine and cereal production, vegetable and livestock farming, both of which are affected by extreme weather events such as droughts and high winds.

Climate change scenarios developed in the last five years indicate that climate change will have clear and dramatic impacts on arid and semiarid ecosystems (Mavlyanova 2007). It is expected that precipitation will decrease and temperatures will rise and that this will be followed by an invasion of thermophilic species, which are more resistant to a lack of precipitation (Thuiller *et al.* 2008).

There has been an increase in annual mean temperature in the municipality of 0.6°C in the past half-century (MoEPNR and UNDP 2009). The main climate-related impacts affecting development of the agricultural sector in the Dedoflistskaro Municipality, however, are strong winds and a lack of rainfall. According to Ministry of Agriculture data, 164,488 ha of Dedoflistskaro Municipality now suffer from wind and water erosion (REC-Caucasus 2012). To mitigate these processes, windbreaks have been systematically planted in the region since the 1930s. In the 1980s, they occupied 906 ha (60 m state-owned windbreaks) and 865 ha (10 m "Kolmeurneoba"-owned windbreaks[14]) of land. Windbreaks played a significant role in moderating the micro climate of fields and vineyards, and protecting the soil from wind erosion. Unfortunately, during the 1990s, these windbreaks were almost completely cut down for fuel and as a result, the productivity of the land has decreased.

Studies show that the frequency of high winds (≥ 30 m/s) has increased five-fold since the beginning of 1980s (MoENRP 2009). The surveys also show an increase in the average duration of drought by 22 days (up to 60 days). More frequent and drawn-out periods of droughts in arid and semi-arid regions will inevitably degrade plant communities with reduced growth in vegetation cover. Along with anthropogenic loading (overgrazing, cutting down of windbreaks, salinization, fires, etc.), these factors result in soil erosion; starting a process of desertification which under most circumstances, is irreversible (GoG 2014).

All this indicates a high level of vulnerability of the primary economic sector of this municipality to climate change. It calls for urgent adaptation measures to reduce relevant risks in agricultural production, such as damage from frequent strong winds causing land erosion and, consequently, exacerbating the desertification process. Windbreaks were always seen as a measure for protecting farm lands, pastures and, fauna of protected areas in the municipality. The main purpose of these belts was to protect arable lands and pastures from wind erosion. Because most of them were destroyed during the energy crisis of the 1990s, the impact of strong winds on the productivity of crops is becoming more evident. This is more pronounced at the early stage of cultivation, in winter and spring. There is a now critical need for the municipality to restore these windbreaks.

Dedoflistskaro, Georgia

The best way to restore natural landscapes and protect arable lands from the growing threat of climate change in the Dedoflistskaro Municipality would be to rehabilitate its windbreaks, which along with the protection of soil from erosion also would

promote the preservation of local biodiversity. At the same time, where appropriate, natural landscapes should be enriched by shelterbelts that can promote both preservation of biodiversity and provision of firewood to the local population, thus protecting windbreaks from illegal logging. To mitigate the impacts of climate change and reduce the risks of drought and land degradation (erosion) processes, the "Rehabilitation of windbreaks in Dedoflistskaro region" project was proposed. The project focused on identifying areas where rehabilitating windbreaks could significantly contribute to the mitigation of climate change impacts. It also looked at rehabilitating selected windbreak areas that had deteriorated as a result of the energy crisis, as well as mobilizing local farmers to implement the project and take further steps to protect the rehabilitated windbreaks.

The project identified by the Second National Communication to the UNFCCC is currently being implemented by GIZ, the German government development agency, and the Austrian Development Cooperation as the "Support of climate-adapted agriculture and rehabilitation of windbreaks in East Georgia" project within the framework of the Sustainable Management of Biodiversity programme. More than 66 km of windbreaks have been rehabilitated in the above-mentioned territory during 2012–2015 and an additional 40 km will be rehabilitated in fall 2015.

In order to promote sustainable agricultural practices, the Sustainable Management of Biodiversity programme provided assistance to a group of farmers from the "Agrarian and Environmental Association" to gain knowledge about and application of modern environmental-friendly agricultural practices in Shiraki Valley, such as low/no till wheat cultivation in order to efficiently use the available moisture in the soil; planting of legumes (for example alfalfa or lespedeza) and/or rapeseed; and use of green manure to protect agrobiodiversity; etc.

Unfortunately, fires in July 2015 destroyed newly rehabilitated windbreaks. These were the result of shepherds using the traditional method of burning grass to encourage fast growth in common pastures. The impact of using these traditional methods is the complete exhaustion of the soil and severe damage to the newly planted windbreaks. The fires demonstrated that the knowledge of farmers in the area has not yet reached sufficient levels, and that their ownership over assets provided through donor support is also insufficient. Therefore, some economic or social incentives for increasing ownership of farmers and establishment of sustainable practices of windbreak rehabilitation and further promotion of sustainable agricultural practices should be established.

CASE STUDY

Better management of pastures and forests in Armenia

Pastural landscape, Armenia

The mountain, forest, and rangeland ecosystems are an important asset for the population of Armenia. 50 per cent of this population lives in rural communities and so are particularly dependent upon the ecosystem goods and services they provide. However, the high level of rural poverty, poor economic conditions, and a decline in infrastructure, along with weak institutional and management capacities in governing structures has resulted in many negative impacts on these vital ecosystems. These include the loss of vulnerable habitats and species, reduction of ecological functions, and the growing threats to ecosystem services, as well as a decrease in carbon storage in the soil and vegetation.

The current status of natural rangelands (pastures and meadows), which cover approximately 1,244 thousand ha of the country, is extremely unsatisfactory. Almost half of the pastures are exposed to degradation, and their biological productivity has decreased 1.5–2 times since the 1950s (UNDP 2013b). Forest-covered land is also increasingly scarce, now accounting for only 350 thousand ha (MoNP 2015). The continued degradation of forests has led to a reduction in the integrity and resilience of forest ecosystems.

The declines in these ecosystems are due to both anthropogenic and natural causes. Unsustainable forest management and land use, and poor agricultural practices accompanied by a hotter and drier climate are also resulting in the depletion of carbon sinks and storage. In response, the Government of Armenia adopted the decree "On approval of land monitoring procedure"[15] which requires state monitoring procedures to define the organic carbon content of 15 important indicators of soil and soil-layer protection. The Clima East Pilot Project entitled "Sustainable management of pastures and forest in Armenia to demonstrate climate change mitigation and adaptation benefits and dividends for local communities" supported by the European Union and UNDP is one of the tools to support the implementation and enforcement of the decree. The project aims to demonstrate sustainable natural resource management in degraded mountain pastures and forests of Armenia. In addition it aims to increase the capacity of ecosystems to sequester carbon under a changing climate while at the same time retaining biodiversity and economic values.

The project will introduce a pasture management system, including rehabilitation of 2,000 ha of meadows and forest belts (60 ha), in the selected region. The project will help prevent further deterioration of natural resources (biodiversity, land, water, forest), promote better understanding of the impacts of climate change, and the potential for adaptive management, including the enhancement of local capacity for sustaining livelihoods in the face of climate change. A replication strategy will support the extension of the project experience and best practices to other regions of the country.

The project implementation period is 2013–2016. To date, it has led to the creation of conceptual designs for

forest and pasture rehabilitation pilots with the wider stakeholder society. In December 2014, 58 target community residents of Gegharkunik Marz were trained in the sustainable management of mountain forest and pasture ecosystems under changing climate conditions. The initial methodology for carbon stock assessment and monitoring in soil and vegetation has been identified, followed by a practical survey for carbon stock assessment. Forest rehabilitation and restoration activities were launched in spring 2015 in three target communities and Sevan National Park covering 60 ha. Rotational grazing plans were developed and approved by the Community Elder Councils for five target communities. Training in rotational grazing plans were conducted in all five communities. Finally, regular monitoring missions to the project pilot sites were conducted to examine and verify in-field activities and continue collaboration with local communities and partners.

Results from the project will be disseminated within and beyond the project intervention zone through existing information sharing networks and forums. The project will identify and participate in relevant scientific, policy-based, and/or any other networks, which may benefit project implementation. The project will identify, analyze, and share lessons learned that might be beneficial for the design and implementation of similar future projects. Finally, there will be a two-way flow of information between this project and other similar projects.

A comprehensive analysis of policy frameworks will create the necessary information basis for further research and analysis at the regional and national levels. Selected ecosystem rehabilitation models can be easily used in other regions of Armenia. The methodology used for calculating GHG emissions within the framework of this project will be described and included in the package of documents presented to governments as one of the basic methods for replicating the experience generated within the project. The practical results of successful implementation of pilot adaptation measures in local communities will serve as a baseline and stimulate the interest of other communities of the region in developing and implementing such activities. A full range of information dissemination campaigns will be conducted (e.g. through distribution of knowledge material and reports, national conferences, media events, electronic networking, etc.) Updated and reliable information will be provided to national and local authorities, and recommendations for decision-makers will be provided to state entities and local self-governance authorities. The project team will also participate in relevant scientific, policy-based and other networks that can benefit project implementation via lessons learned and will share its own lessons with other similar projects.

Mixed coniferous forest, Armenia

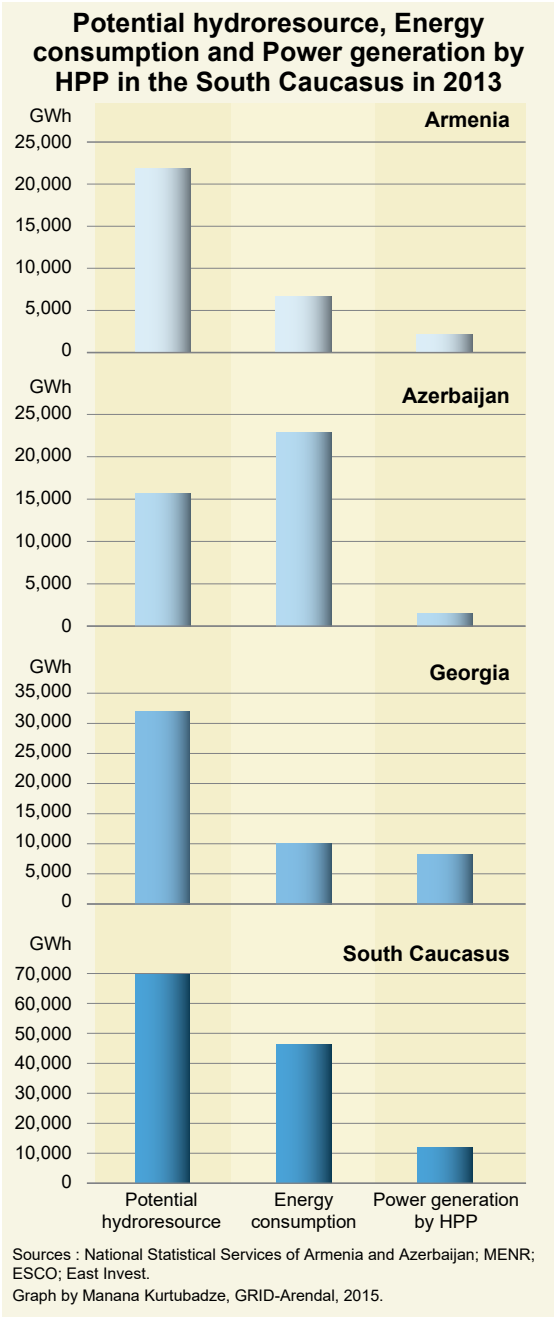
Energy

Primary energy supplies in the three countries vary according to their access to fossil fuels and water resources.[16] Georgia relies on imported gas and oil, but also have renewable energy such as hydropower for electricity and heating, while Azerbaijan[17] relies mainly on its gas and oil resources. Armenia[18] uses a mix of imported gas resources, nuclear energy and national water resources (IEA 2013). As such, the vulnerability of the energy sector to climate change varies depends on the main energy source in each country.

Hydropower is by far the most vulnerable energy source due to its dependency on stable water supplies that are likely to be affected by changes in precipitation patterns, reduced glacial water, and higher evaporation due to warmer temperatures. Water resources are predicted to decline across the region. Hydropower in Georgia is, for example, centred on glacier-fed rivers originating in the Greater Caucasus Mountains, such as the Inguri and Rioni River. Glacial runoff of these rivers is likely to be reduced by 13 per cent by 2100 due to increased melting consequently reducing the potential of hydropower (MoENRP 2015). The flow of three trans-boundary river basins also used for hydropower – Alazani (Gamik), Khrami-Debed and Aghstev basins – is likely to decline due to declining precipitation and increased temperatures by the end of the century (UNDP 2011). Reduced water availability and increasing temperatures may also have adverse effects on thermal and nuclear power that need water for cooling (WB 2009).

Additional stress factors in the energy sector are the expected increase in frequency and severity of

Inguri Dam, Georgia



Sources : National Statistical Services of Armenia and Azerbaijan; MENR; ESCO; East Invest.
Graph by Manana Kurtubadze, GRID-Arendal, 2015.

extreme events, such as floods, land- and mudslides. Such events reduce and disrupt production and can prevent delivery of energy. This was already witnessed when a landslide on the Georgia-Russia border caused major damage to the North-South gas pipeline transporting gas from Russia to Armenia in 2014 (Agenda 2014).

Due to the projected increase in temperatures, especially during summers, it is expected that energy demand for cooling will increase in summer months (WB 2009). Urban heat stress is likely to be the most serious climate change-related health issue in the region. In the city of Vanadzor, Armenia (1,424 m.a.s.l) dangerously hot days are expected to increase seven-fold by 2040 as compared to current figures (UNDP 2011).

Despite its vulnerability, all three countries are investing in new hydropower plants to increase their energy security and meet their growing energy demands and renewable energy targets. In Georgia, for example, forty new hydropower plants are to be developed to meet that country's ambitious goal of generating all of its electricity through renewable resources in the coming years, up from 92 per cent (Green Georgia 2015). Armenia had 115 small hydropower plants in 2010 and another 88 are under construction while an additional 108 have been approved (Government of Armenia Protocol Session Resolution No. 3 of January 22, 2009). Due to the sensitivity of hydropower plants to climate change, it is crucial that future water flow reductions are considered in new developments (Stanton *et al.* 2009).

Even though electricity is available throughout the South Caucasus region, energy poverty is widespread in remote villages due to the high costs of electricity and gas (WB 2015). Poor households commonly use traditional sources of energy for heating and cooking, such as burning firewood, shrubs and dung, as well as plastic and other waste, in combination with electricity and gas (SE4ALL 2012). In total, poor households in Georgia may use as much as 30 per cent of their income on energy (Gamisonia 2014). Poverty reduction is, therefore, an important strategy to increase energy security in rural mountain areas and in general to increase their adaptive capacity to climate change.

Industry

The industrial sectors of the three countries were developed during the Soviet era with a focus on rapid economic growth and little consideration for the potential environmental impacts. The main industrial activities taking place in the mountainous regions of South Caucasus are related to the extraction and processing of natural resources. These activities are important to all three countries but they have a high impact on nature. Mining activities alter the structure of the landscape, which in combination with climate change can have severe consequences. In addition, mining and processing activities often create toxic waste, which can have adverse impacts on the surrounding environment if not securely contained. With the increasing impacts from a changing climate, it becomes more important to consider these when planning for new mining activities (USGS 2010; USGS 2014; UNECE 2010).

The physical condition of industrial structures in general is another important issue. Old structures are generally less secure and more unstable and so are less resilient to extreme weather events already occurring in the South Caucasus and predicted to occur more often in the future. The combination of extreme events (e.g. landslides, mudflows, and floods) and unstable infrastructure can have severe and destructive consequences. In Azerbaijan alone,

Oil derricks on the shore near Baku, Azerbaijan

250 industrial plants have been subject to flooding since 1978. If these events increase in the future as a result of climate change, it becomes even more important to increase the resilience of industrial structures (MoENR 2010). It is currently unknown whether the planning of new industrial construction takes the impacts of climate change into consideration (UNECE 2010).

An example of the consequences of poorly managed toxic waste comes from the Tsana arsenic mining sites in Georgia. When the three mining sites were abandoned in 1992, approximately 50,000 tons of arsenic ore were left in surface and some amount of highly toxic materials were in unprotected containers. The three sites are close to the Tskhenistkali River, a tributary to Rioni River, and so the leaking arsenic waste posed a threat to both nearby villages and the whole of Western Georgia. There was a high risk that the waste would be released into the environment when the Tskhenistkali River flooded in 2013. Fortunately, no further contamination due to the flooding has been observed thus far. Due to a growing concern regarding the contamination threat from the three sites, a joint project of OSCE, UNEP/OCHA and UNDP Georgia in cooperation with the Ministry of Environment and Natural Resources Protection was initiated in 2013 partly with the goal of containing the waste more securely on-site (UNEP/ENVSEC 2014).

In spite of the increasing need to consider climate change when planning industrial activities, little research has been done on how industrial structures will respond to, or interact with, climate change. An overview of the current risk zones of, for example, old and unstable industrial sites, is lacking but clearly necessary if catastrophic consequences are to be avoided in the future (UNECE 2010).

The lack of research and available information may be a reflection of the current political focus. Since the three countries gained their independence, many issues have required the focus of politicians such as securing a stable economy, reducing poverty and preventing corruption. Contamination from industrial sites and the influence of climate change have not been a priority but attention on this issue is increasing (UNEP/ENVSEC 2014; UNECE 2010; USGS 2014).

Tourism

Climate change has already started to affect the tourism sector around the world. The World Tourism Organization recognizes mountain tourism as being especially vulnerable to the impacts of climate change. Tourism is affected directly through the potential degradation of infrastructure due to events such as floods and erosion. In addition to these are various indirect impacts of climate change, including the changes to the food and water supply (UNWTO 2015).

Tourism in the South Caucasus is a growing sector that is of increasing importance to the national economies of the three countries. Georgia has the most developed tourism sector, followed by Armenia and Azerbaijan. In 2015, tourism and travel contributed 20 per cent, 12.7 per cent and 8.4 per cent to the economies of Georgia, Armenia, and Azerbaijan, respectively (WTTC 2015 a,b). The mountain areas are popular destinations and comparable to other tourism destinations such as beaches and lakeside resorts.

At the mountain destinations, tourists are offered a wide variety of activities including mountain climbing, hiking, rafting, winter sports, national parks, bird watching, and cultural heritage sites. Eco-tourism and agro-tourism are also becoming more popular.

Shahdag Mountain Resort, Azerbaijan

Due to the vulnerability of mountain areas to climate change, mountain tourism is likely to be affected by the predicted increase in temperature, changes to precipitation patterns, and natural disasters. It will also lead to changes in ecosystems and biodiversity (e.g. changing patterns in bird migration, changes to the quantity and quality of snow) that can have adverse impacts on tourism (MoENRP 2015; Green Georgia 2015b; Azerbaijans.com 2015; Welcome Armenia 2015). The most popular alpine ski resorts in Bakuriani and Gudauri in Georgia are already affected by shorter winter seasons with less snow. The tourism industry is also affected by extreme events appearing more frequently in the mountain regions. In Upper Svaneti in West Georgia, for example, 95 per cent of the region is under threat of avalanches of varying degrees (MoENRP 2015), while Adjara, Georgia, is exposed to the risks of mudslides and landslides (MoENRP 2015).

The vulnerability of the tourism sector in South Caucasus was assessed in the Third National Communication to UNFCCC from Georgia (assessing the entire Georgian tourism sector) and Armenia (for the tourism industry in the Vayots district) (MoNP 2015; MoENRP 2015). Based on these assessments, some conclusions can be drawn from the impacts of climate change on tourism activities in the region of South Caucasus. The Armenian assessment of the Vayots district predicts

climate change will impact the tourism industry on several fronts. First, it can lead to increased costs for accommodation and catering businesses (e.g. if additional cooling is required due to increasing temperatures). It is also expected that the security of tourists may be at risk from the projected increase in natural hazards such as mudflows, floods and rock falls. Historical sites and monuments, as well as infrastructure may also be at risk (MoNP 2015).

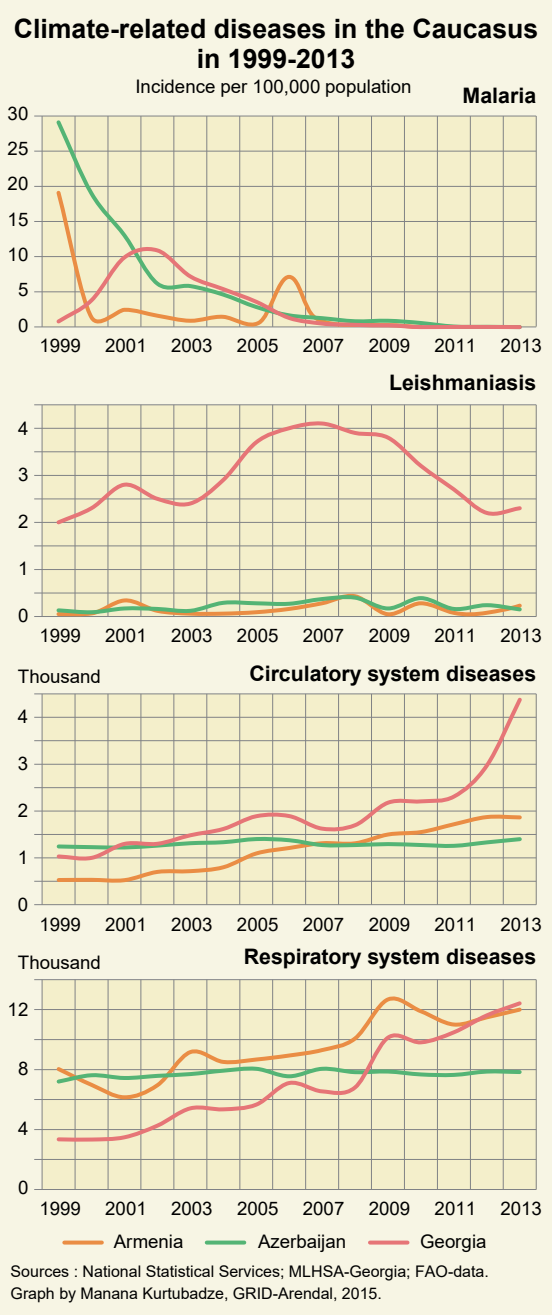
The Georgian assessment of the tourism sector focused on three regions in the country – Adjara, Upper Svaneti and Kakheti. It used the Tourism Climate Index (TCI) developed by Mieczkowski (1985) to determine the impact of climate change on the tourism sector. According to their analysis, the weather conditions in Adjara have become more favorable to the industry over the past fifty years. Predicted changes will continue this trend and prolong the spring/summer season in mountain areas, while the conditions will worsen in coastal areas by 2050. Upper Svaneti (Mestia), a region famous not only for mountain tourism but also for its cultural and architectural monuments will be negatively affected by increased temperatures. In contrast, better environmental conditions are expected in Kakheti from October to March. Indeed, as summer temperatures in the lowlands are predicted to reach uncomfortable levels, mountainous areas with their cooler climates can expect an increase in summer tourism (MoENRP 2015).

As mountain regions are one of the most exposed areas to natural disasters, increased development of mountain tourism must be supported by improved preparedness and monitoring of natural disasters as these are predicted to increase in frequency and magnitude. In Mestia, for example, the number of injuries is 3 to 4 times higher than the national average, a result of the high frequency of natural disasters and the high risks involved in some forms of mountain tourism. Damage to transportation networks, gas- and electricity systems and sanitation and water systems are also a concern for tourism (MoENRP 2015).

Another negative impact of climate change is the reduction in the size of glaciers in the Greater Caucasus Mountains, which are a popular attraction for tourists, as well as being important for water and energy security. Cultural monuments and historical buildings, important attractions in, for example, Upper Svaneti, may also be negatively impacted by increased precipitation and air humidity as it can cause the mortar that bonds the stone together to dissolve (MoENRP 2015).

Human health and safety

Climate change directly impacts human health and security. Natural disasters have the most obvious and immediate impact on people's health and security as they abruptly destroy property, livelihoods, infrastructure, can be fatal, and often force people to leave their homes and communities. The exposure to floods and land- and mudslides is especially high across the South Caucasus, and the mountainous areas and its communities are hardest hit (UNIDSR 2009). Heavy rainfall in June 2011, for example, resulted in floods and landslides in western and eastern Georgia that caused severe damage to farmland, roads and bridges, canals, water and gas pipelines, and communication networks. Seven people died and a total of 3,000 households were affected (Red Cross 2011). The following year, an extreme hailstorm, windstorm and flash flood affected 20,000 families in the Kakheti region of Georgia and damaged over 5,200 houses, as well as water, gas and electricity distribution systems. The total economic impact when considering the damages and losses came to US$ 123 million (Bergsma 2012).

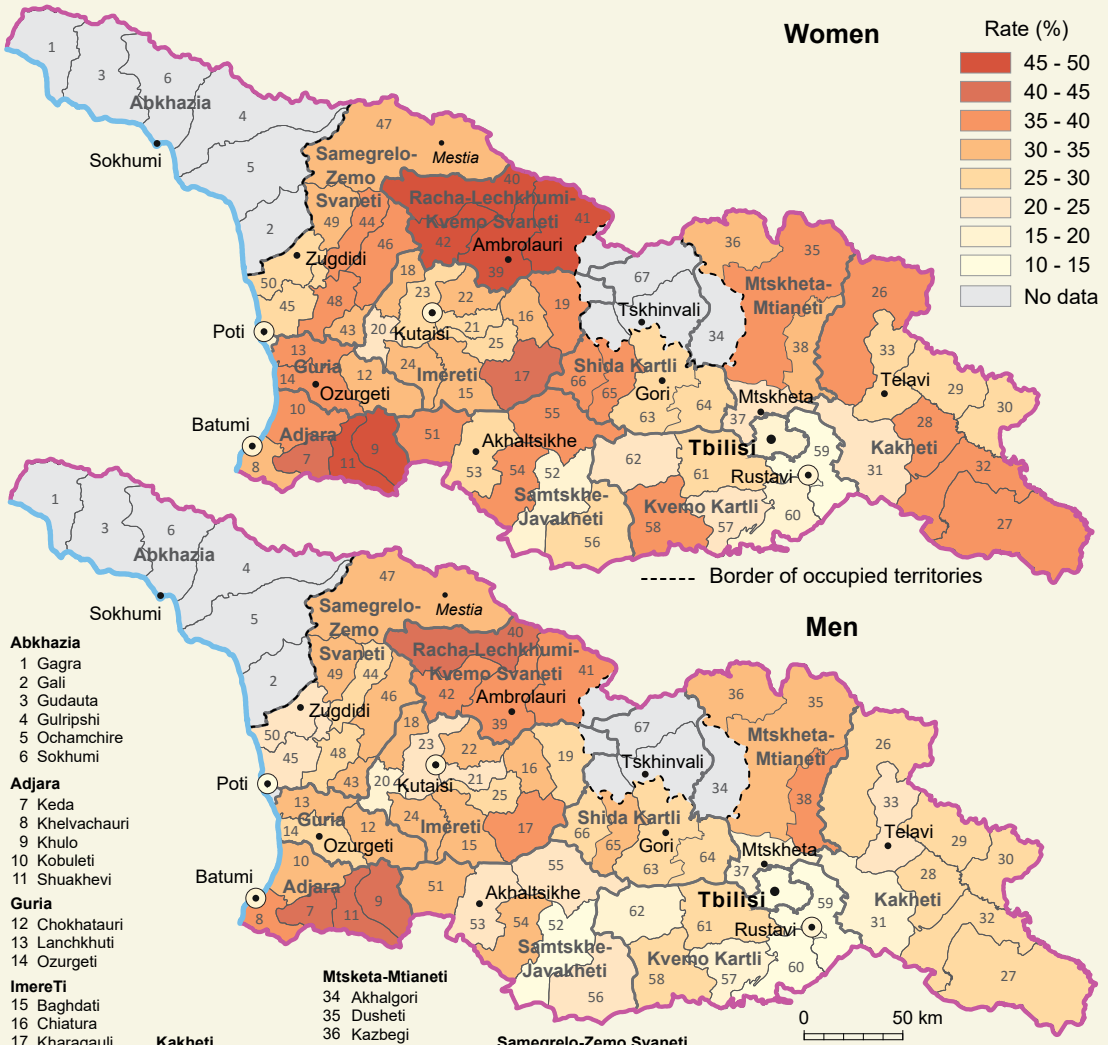


Sources : National Statistical Services; MLHSA-Georgia; FAO-data.
Graph by Manana Kurtubadze, GRID-Arendal, 2015.

Mental disorders and traumas also seem to be more prevalent in areas that are exposed to extreme events. The percentage of people with mental disorders in Adjara, an area prone to natural disasters, for example, is 13 per cent higher than the national average. When only looking at children, that number is 58 per cent higher than the national average. Similar findings have been recorded in Upper Svaneti, an area also highly exposed to natural disasters (MoENRP 2015). In addition to having higher exposure to natural disasters, lower access to healthcare, poor household constructions and higher poverty rates make mountain communities even more vulnerable to such events (CENN and ITC 2012; MoENRP 2015).

Since the 1980s, natural disasters alone have forced tens of thousands of people in Georgia, Armenia, and Azerbaijan to move away from their homes, either temporarily or permanently (Lyle 2012; CENN 2013a, CENN 2013b, CENN 2013c). The issue of environmental migrants or eco-migrants (i.e., people who are displaced due to natural hazards or environmental degradation) has increasingly caught the attention of the global community, with the recognition that climate change will increase this phenomenon. The first recognised case of eco-migrants in Georgia was in the 1980s when two severe landslides displaced approximately 40,000 people in the regions of Adjara and Svaneti (CENN 2013a). There are currently 11,000 families in Georgia that need to be resettled urgently, but the annual government budget is only sufficient to resettle 100 families per year (CENN 2013a). It is expected that climate-induced natural disasters, as well as the gradual degradation of natural resources (drought, desertification, water availability) due to climate change and human pressure, will increase the displacement of people in the region as a high percentage of the region's population live in hazard-prone areas. In Armenia alone, nearly half a million people live in areas that are at risk of landslides.

Rate of population below the poverty line in Georgia by districts and big cities in 2014



Source : Social Service Agency of Georgia.

Map by Manana Kurtubadze, GRID-Arendal, 2015.

Furthermore, increasing temperatures during the spring and summer months, coupled with reduced water availability in rivers, is also likely to enforce rural-urban migration due to the adverse effect on agriculture. 40 per cent of Armenia's arable land is already uncultivated due to a combination of climatic and socio-economic issues (CENN 2013b). Eco-migrants are especially vulnerable as they are currently not recognised under national legislative frameworks as Internally Displaced Peoples (IDPs), which places them outside of any legal protection from governments (CENN 2013a,b,c).

The frequency of extreme temperatures and heat waves has increased in South Caucasus (MoENRP 2015; MoENR 2010; MoNP 2015) and scientific studies show a direct link between extreme temperatures and increased risk for people with cardiovascular or chronic respiratory diseases, especially the elderly (McMichael *et al*. 2006; Cheng and Su 2010). Records from Azerbaijan show that during heat waves, the number of first aid calls related to blood, respiratory and neural diseases increases significantly (MoENR 2010). Urban heat stress is a particular concern in the region, though to a lesser extent in higher altitudes due to lower temperatures. Tbilisi, Georgia, for example, may see an increase in dangerously hot days from an annual average of 21 days between 1955 and 1970, to an annual average of 63 days between 2020 and 2049.

Several diseases associated with warmer weather are likely to become more prevalent in the South Caucasus, including vector-borne diseases such as leishmaniasis and malaria (MoNP 2015; MoEPNR and UNDP 2009). While the risk of malaria is currently low throughout the region, a warmer climate may lead to new outbreaks (MoENRP 2015; MoENR 2010; MoNP 2015). According to Azerbaijan's Second National Communication to the UNFCCC (MoENR 2010), a warmer climate has already increased the length of the epidemic season. Areas between 500 and 1,200 m.a.s.l have had the highest increase in the length of the season, by 15–30 days, compared to the Kura-Araz lowland, where the season has extended by 5–10 days. A study from Armenia found that the projected increase in air temperatures may cause malaria outbreaks along Lake Sevan, but also increases the risk of outbreaks in sub-mountainous and mountain areas due to the vertical shift of climate zones brought about by warmer temperatures (SHMS 2013). Warmer temperatures and extreme events, especially floods, are also thought to increase the incidence of food and water-borne diseases. There has been a marked increase in such incidents in Armenia as well as Azerbaijan during recent years (MoENR 2010; MoNP 2015)

The effects of climate change on human health and safety is unlikely to be distributed evenly among the people of the South Caucasus. One reason for this is the different lifestyles and unevenly distributed resources between men and women. A key parameter that determines the vulnerability of humans is the rate of poverty. For the South Caucasus, women tend to have fewer financial resources than men, leaving women with fewer means and possibilities to withstand or recover from climate change impacts (Social Service Agency Georgia). The financial opportunities for women to cope with the stress of climate change are fewer when compared to those for men, and even less in the mountain regions (UNDP 2013a). While men are often responsible for providing financial resources, women in the South Caucasus are typically tasked with securing basic resources such as water, food and energy, and this can be hindered if natural disasters occur. Perhaps influenced by these responsibilities, women are also found to be more psychologically affected by natural disasters than men. In addition, they face greater challenges when applying for relief aid, which further increases their vulnerability to climate change (CENN 2013).

The rates of migration in South Caucasus are highest in Armenia and Azerbaijan, and show substantially higher rates for men than women. The main reason for men leaving their communities is to work abroad. Most of the male migrants from Armenia and Azerbaijan are married, whereas the female migrants are typically single. In Georgia, gender does not seem to be a determinant of migration (Dermendzhieva 2011). When male migrants are married, this means that they are leaving behind a wife and possibly children. The daily responsibility of securing water, food and energy for the family is left entirely to the women. The out-migration of men from mountain villages not only has consequences for the family he leaves behind but also for mountain communities as a whole.

Key risks related to climate change

The main risks associated with climate change are related to the economy, human safety and security, and changes in ecosystem services. Considering their relevance to concrete adaptation measures, the risks are clustered below according to key economic activities and ecosystems. The identified risks result from interaction between possible hazards fully or partly triggered by climate change and vulnerabilities of existing human systems.

Summary of Key hazards, vulnerabilities and risks

Climate hazards	Key vulnerabilities	Key risks[8]
Ecosystems		
• Increase in temperature, changes in precipitation. Droughts. Intensity and frequency of extreme heat. • Increase in number of natural disasters land slides, mudslides etc.	• Predicted upward shift of climatic zones and vegetation. Loss of control of pests and disease, fires, landslides, flooding, erosions etc. Reduction in provision of services (e.g. food, livestock).	• Reduction of ecosystem services (water purification, preservation of soil). • Loss or change of ecosystems (e.g. water ecosystem, forest ecosystems). Loss of endemic species, mixing ecosystem types, increase numbers of invasive spices. • Increase in wildfires
Agriculture		
• Increase in temperature, changes in precipitation pattern. • Extreme weather events such as hail storms, late frosts, strong winds, heavy rainfalls, droughts etc.	• Vulnerability of agriculture sector, vulnerability of selected social groups including rural remote communities. • High degree of land degradation and desertification, soil erosion etc. • Poor land management. Poor water management in and between economic sectors. • Limited ability of framers to adapt and administrative systems to respond. Poor compensation mechanisms in cases of breakdowns.	• Decrease in productivity and decrease in crop yields (and livestock) leading to outbreaks in food availability and security of seeds. • Risk of resource loss e.g. agro-biodiversity and land. • Lost agriculture and pastureland or reduction in its productivity. • Damage of infrastructure. • Increase in conflicts between the water-based sectors such as energy and agriculture.

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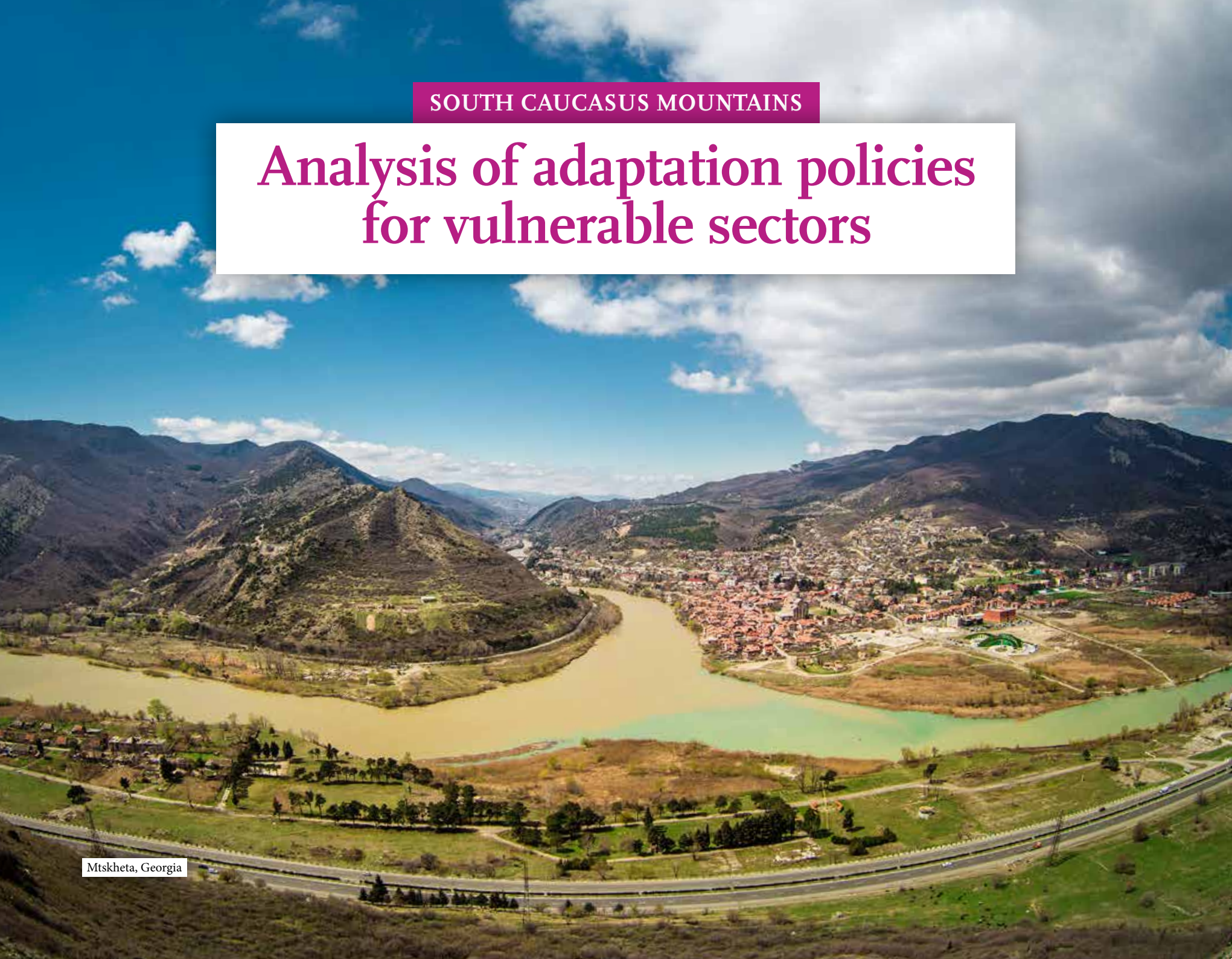
Summary of Key hazards, vulnerabilities and risks *(continued)*

Climate hazards	Key vulnerabilities	Key risks
Energy		
• Increase in temperature including extremely hot days; • Extreme weather events such as strong winds/storms, heavy and intense rainfalls etc. • Increase in number of natural disasters land slides, mudslides etc.	• Vulnerable water resources for hydropower plants and thermal/atomic plants for cooling. • Vulnerability of entire energy grid system.	• Interruption of energy supply for population and industry. • Increase in energy demand. • Risks for cooling systems. • Persistent use of traditional energy sources such as firewood leading to deforestation.
Mining industry		
• Increase in number of natural disasters in mining areas, through heavy rainfalls, etc. • Increase in number of natural disasters land slides, mudslides etc.	• Vulnerability increase of mining infrastructure and employee security. • Increase in vulnerability of active mining infrastructure. • Increase in vulnerability of old mining infrastructure (tailing ponds, waste sites etc.).	• High risks in casualties and injuries. • High risks in pollution outbreaks. • Damage to mining infrastructure and financial losses of industry from natural hazards.
Tourism		
• Increase in temperatures; events such as floods, landslides, mudslides, avalanches etc.	• Vulnerability of tourism sector e.g. winter sports. • Vulnerability to infrastructure, indirect vulnerability through food and water supply.	• Safety and security of visitors, reduction in visitors, loss of tourism sector revenue, risk to health, energy and water availability.
Human health and security		
• Increase in temperature; including number of extremely hot days. • Events such as floods, landslides, mudslides, avalanches, windstorms etc.	• Limited ability to cope, particularly for elderly people and population already suffering from different diseases. • Vulnerability of economically active population working for enterprises with low safety standards. • Vulnerability of population approaching or below the poverty line and/or socially vulnerable groups.	• Injuries and casualties. • Migration triggered by aggravating environmental conditions. • Destruction of property, livelihoods and infrastructure. • Increase in poverty.

SOUTH CAUCASUS MOUNTAINS

Analysis of adaptation policies for vulnerable sectors



Mtskheta, Georgia

Prominence of climate change adaptation in national policy

The countries of the South Caucasus are parties to the United Nations Framework Convention on Climate Change and referred to as Non-Annex I countries (UNFCCC 2014). Armenia ratified the Convention in 1993 and the Kyoto Protocol in 2003, Azerbaijan ratified the Convention in 1995 and the Kyoto Protocol in 2000, while Georgia ratified the Convention in 1994 and Kyoto Protocol in 1999.

During the last decade these countries have been mostly reliant on donor support for their climate related actions. As mitigation activities have become increasingly important for its international partners, the focus on actions related to mitigation in the South Caucasus countries has also increased in prominence. This has led to a number of initiatives at the national and local level including the Covenant of Mayors (EU 2014a), to which almost all Georgian self-governing cities are signatories (13 cities so far), with a further 10 city signatories in Armenia, and one city in Azerbaijan.

The shift of focus to climate change adaptation is a fairly new phenomenon even for European countries; the EU itself only formalised its adaptation strategy in 2013 (EU 2015). Similarly in the South Caucasus countries, attention is gradually shifting to adaptation through international processes and negotiations. However, none of these countries have yet to establish specific adaptation plans or strategies. In the case of Georgia, since signing its Association Agreement with the EU, emphasis has been placed on the elaboration of a National Adaptation Programme of Action (NAPA) which is a mandatory component of the EU Agreement under article 310, which states: "Based on mutual interests, the cooperation [of the parties] shall cover, *inter alia*, the development and implementation of: (a) NAPA" (EU 2014b). Armenia and Azerbaijan are also making progress and have committed to develop national adaptation strategies through different government decisions and policy documents. However, through analysis of existing policy papers it is clear that climate change adaptation is still at an early stage: studies and actions are yet fragmented and insufficient, while coordination of actions is scarce.

The prospects for possible cooperation in the South Caucasus region are very limited. Due to the geopolitical situation in the region, countries in the region can't take full advantage of the opportunities and benefits of regional cooperation. Joint regional approaches are therefore lacking, in particular at the regional policy development level. The only non-binding policy document, that is recognised by all of the three countries and which refers to climate change adaptation in a regional context, is the Ecoregional Conservation Plan (WWF/CBC 2012).

The focus of this assessment is to provide an overview and analysis of national policy frameworks and institutional set-ups related to climate adaptation in the South Caucasus countries.

Climate adaptation in national laws

All three South Caucasus countries, as parties to the UNFCCC, formally recognise the provisions and principles of the Convention and therefore their national legal frameworks should comply with the requirements of the convention. In addition to the UNFCCC, the counties are party to number of other international treaties that also view climate change adaptation as a priority area for action – such as the Convention on Biological Diversity (CBD), United Nations Convention to Combat Desertification (UNCCD) (UNCCD 2012).

The national constitutions of all three countries state that everyone has a right to live in a healthy and favourable environment, to have free access to environmental information and that the state guaranties implementation of those basic rights (NARA 1995; President of Azerbaijan 1995; Parliament of Georgia 2013a). In addition, the Georgian Constitution considers mountain regions separately, Article 31 states that: "Special privileges to ensure the socioeconomic progress of high mountain regions shall be established by law" (Parliament of Georgia 2013a).

Another similarity across the three countries in relation to both climate change adaptation and mitigation, is the lack of national laws specifically addressing climate change. However, this should

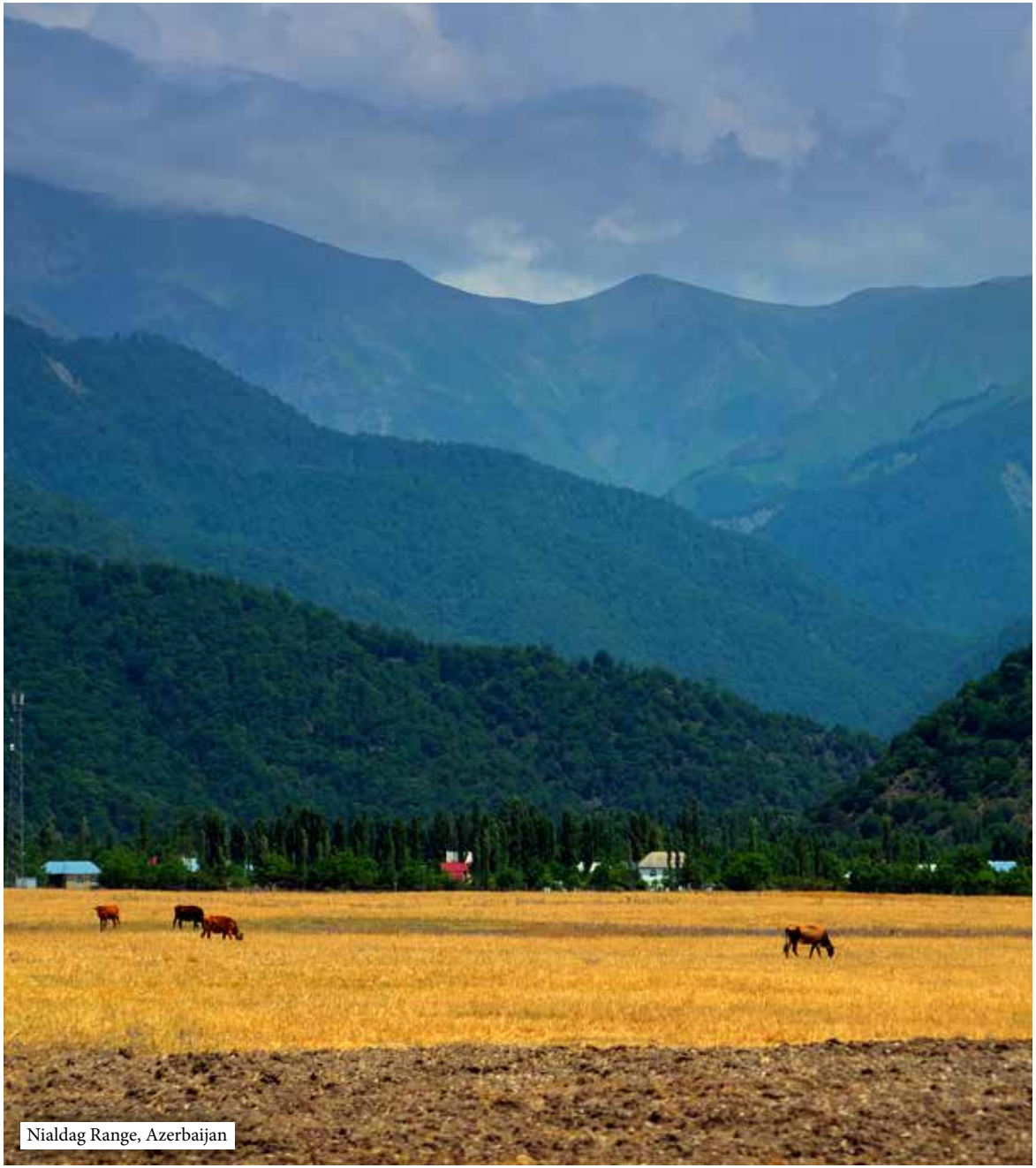
Meadow outside Stepanavan, Armenia

not be seen as a weakness, especially in terms of adaptation, as with proper planning and implementation, existing climate change adaptation challenges can be addressed by national adaptation plans/strategies and/or by the mainstreaming of climate change adaptation into sectoral and development policies. Therefore, the development of specific laws (i.e. "superior" legal acts) may not be necessary to address this issue.

However, to strengthen the focus on vulnerability and to bring climate adaptation to greater prominence on the political agenda it would be beneficial to integrate certain principles and climate change priorities into the existing sectoral laws, such as those on water, biodiversity, soil protection, renewable energy, forestry, etc.

Armenia

The main environmental laws of Armenia are the Laws on Nature Protection and Nature Utilization Payments and the Law on Atmospheric Air Protection (Ecolex 1994). The recent amendment to the Law on Atmospheric Air Protection prohibits burning of vegetable residues in areas with dry vegetation, including pastures and grasslands, as well as in agricultural, forested, and protected areas. While initially aimed at restoring and storing organic carbon in soil and ground vegetation, the amendment, among others, provides regulations to protect the soil and soil layer from erosion and



Nialdag Range, Azerbaijan

desertification. Moreover, Article 34 of the said law states: "State bodies, enterprises, establishments and organizations can carry out the actions directed on artificial change of atmospheric air and atmospheric phenomena in the economic purposes from the permission of authorised state bodies in the sphere of atmospheric air protection and only provided it will not result in adverse influence on weather and climate" (Ecolex 1994).

Azerbaijan

The basis for national environmental legislation is the Constitution, which defines living in a healthy and clean environment as a right of the population. The two main environment-related laws safeguarding this right – the Law on Environmental Protection (1999) and the Law on Environmental Safety (1999). The Law on Environmental Protection is a framework law and covers all related sectors such as waste management, protection of fauna, protected areas, ecological expertise etc. Unfortunately, issues related to climate change mitigation and adaptation are not explicitly reflected in Azerbaijan's environmental laws.

Climate change issues are also reflected in the government's main strategic documents.[19] For example, a special 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. More importantly, climate change is also addressed in the forthcoming National Adaptation Plan (NAP).

Georgia

The Law on Environmental Protection (1996), which was developed as a legal framework to define key environmental competencies and areas of action,

includes a section on climate change. Though it is mainly focused on mitigation actions, the law also defines the responsibilities of the Ministry of Environment and Natural Resources Protection, and states that it is responsible "for organizing measures on climate adaptation and mitigation".

The Law of Georgia on the State Budget for 2014 (Parliament of Georgia 2013b) envisaged preparation, in 2014, of the National Action Plan on adaptation to climate change and implementation of special adaptation measures. The law also outlined the need for specific mitigation actions such as development of the Low Emission Development Strategy (LEDS), specified in turn, under the Cancun Agreements of the UNFCCC. Yet, implementation of adaptation measures was not included in the State Budget of the following year of 2015 (Parliament of Georgia 2014).

In 2013, the Parliament of Georgia adopted the National Forest Concept for Georgia (see more details in the section – Sectoral Policy papers) that stipulates the need for adaptation action in the country's forests.

In terms of mountain regions and ecosystems, mountain-related legislation in the South Caucasus countries has been limited to:

- The newly adopted Georgian Law on the Development of High Mountain Regions (Parliament of Georgia 2015), which considers only social and economic issues; and
- Certain references to mountain regions in the sectoral legislation of all three countries, but again in only a social and economic context.

Thus, the countries acknowledge the need to specifically address the social and economic development in mountain regions under national laws, but do not consider the need for specific conservation or climate change actions.

Climate adaptation policy

The development of adaptation policies to adequately address the challenges of climate change, and its impact on physical infrastructure, the environment, cultural heritage and/or the economy, should be a priority for mountainous countries in the South Caucasus. However, due to a number of reasons Armenia, Azerbaijan and Georgia still do not have comprehensive climate adaptation policies that include climate change adaptation plans and/or strategies. Nevertheless, all three countries have declared the need for development of NAPs:

Armenia through the Government Decree on Approval of the Action Plan of the Republic of Armenia on Obligations Emanating from a Number of International Environmental Conventions made a commitment to develop a climate change adaptation concept with an ecosystem approach and a NAPA. In April 2015, the government outlined its plan in its Intended Nationally Determined Contributions (INDC) statement, which covered mitigation and adaptation measures using an ecosystems approach. The INDC states that the natural ecosystems approach is pivotal for its adaptation strategy and actions/contributions and a basis for development

Avalanche in Georgia

of the National Adaptation Plan. A draft of the NAP roadmap is currently under development.

In addition, the Armenia government has adopted the following adaptation related regulations:

- "Procedures of the forecasting, warning and response to dangerous meteorological phenomena related to atmospheric excessive pollution, climate change and ozone-layer condition" (Government of the Republic of Armenia 2008a), which initially had been focused only on adaptation but has since been broadened to include both adaptation and mitigation measures, and the
- "Monitoring procedure" (Government of the Republic of Armenia 2009), which has a similar purpose. This procedure promotes state monitoring to define organic carbon content among 15 important indicators subject to soil and soil layer protection.

Azerbaijan currently has no laws that specifically reflect climate change adaptation or recognise the need to develop NAP. However, a number of draft strategies and actions do refer to a need to develop NAPs, for example, there is a draft Action Plan on Improvement of the Ecological Situation and Efficient Use of Natural Resources in the Republic of Azerbaijan (2015–2020).

Georgia committed itself to developing a NAPA when it signed its Association Agreement with the EU (EU 2014b). Moreover, the current government programme states that a NAP for Economic Sectors and Ecosystems will be elaborated (Government of Georgia 2015).

Presently, all three countries have already submitted their INDCs, which reflect national commitments to addressing climate change adaptation (UNFCCC 2015).

Azerbaijan's INDC states: "In order to reduce vulnerability of Azerbaijan towards climate change impacts, it is considered to develop relevant adaptation measures for decreasing or minimizing the losses that may occur at national, local and community levels per sector" (MoENR 2015a).

Georgia's INDC, refers specifically to highland/mountain regions within the context of extreme natural events aggravated by climate change. The document also identifies agriculture, coastal zones, tourism sector development, forestry and the health sector as at-risk areas. The document also identifies key actions and institutional measures for climate change adaptation in the abovementioned sectors (MoENR 2015b).

Armenia's INDC addresses the state of the landlocked mountainous areas that have vulnerable ecosystems, and considers climate change adaptation as a precondition for national security (Government of the Republic of Armenia 2015). In this context, the ecosystem approach to adaptation is seen as a tool for: a) harmonised and balanced development, b) coordinated implementation of international treaties and c) international cooperation. The INDC identifies the following sectors as being vulnerable to climate change: health, water resources, tourism, energy production, settlements, infrastructure, and agriculture (including fishery and forests).

Currently, National Communications to the UNFCCC remain the sole and most comprehensive climate change policy documents for the three countries. However, they are not formally reflected in national legally binding documents and are therefore not taken into account by the private sector or well-known by the general public. Thus, the National Communications to the UNFCCC remain standalone documents used by non-governmental stakeholders when elaborating or implementing their actions, but which the authorities at national, regional or municipal levels rarely consult in their activity planning. For example, although Georgian coastal zone municipalities frequently invest in infrastructure projects focused on addressing sea level rises and coastal zone protection from storms, none of these projects are referred to as adaptation projects within the framework of the National Communications envisaged to implement climate change adaptation activities.

It is also noteworthy, that National Communications of all the South Caucasus countries refer to climate change in the mountain regions and even specifically cover a number of mountain regions of the South Caucasus ecoregion. For instance, the Third National Communication of Georgia, through its assessments, covers the five mountain municipalities of Georgia (Akhmeta, Mestia, Khulo, Keda and Shuakevi), the Armenian Communication covers the Vayots Dzor Marz (region), while the Azerbaijani Communication covers Shamakhi and Ismayilly districts (MoNP 2015; MoENR 2010; MoENRP 2015).

If the National Communications were afforded legal approval within the countries, visibility of adaptation measures in general and specifically in mountain regions in national policy agendas would be greatly improved. However, such a shift in status would not replace the need for the countries to have formally adopted NAPs or strategies with a legally binding status. Of equal importance are the establishment enforcement mechanisms to implement action plans and strategies, including: awareness-raising at all levels, establishment of economic incentives for implementation, and the promotion of greater citizen involvement.

Development strategies

Almost none of the development strategies (such as sustainable development and/or poverty reduction

strategies) of the South Caucasus countries have an all-inclusive and adequate appreciation of climate change. Furthermore, climate change tends to focus on mitigation rather than adaptation measures. Notwithstanding this, there is a clear recognition by the national governments in the region of the vulnerability of the population, economy and infrastructure to natural disasters or other extreme events caused by climate change.

Armenia

Armenia approved its Sustainable Development Strategy in 2008 (Government of the Republic of Armenia 2008b). The document underlines the vulnerability of water resources to climate change and recommends the creation of a programme to protect national water resources, regulate river flows and ensure availability and rational use of water to prevent possible conflict among water users and that the amount of water and water take regimes are adequate for recovery. About 80 per cent of Armenia is exposed to different degrees of land degradation and desertification. To address this, the Sustainable Development Strategy acknowledges anthropogenic and climate-induced impacts on land resources and calls for measures to prevent soil degradation and desertification processes. In addition, the strategy considers spatial development and planning as a tool for balanced national development, while managed urban development is seen as a mechanism for reducing the impact of geological hazards. The strategy also accords special status to mountain populations and stresses the need to provide support to economic activities in these regions. Nevertheless, the strategy is lacking full-scale linkages between climate change and overall sustainable development.

The country's comprehensive and detailed Poverty Reduction Strategy (2003) has 2015 as its endpoint. Most of the targets within the strategy are for 2015, and the country has yet to evaluate how well it tackled the identified priorities, including issues related to populations in mountain regions and natural disaster risk reduction mechanisms – for example, one of strategy's goals was the "Development of a targeted system of privileges, discounts and allowances in the earthquake zone, near-border, mountainous and high mountainous regions and small communities" (p. 131). Implementation of this goal foresaw the replacement of a government-funded compensation scheme for damages caused by natural disasters by an insurance-based mechanism co-financed by the state, farmers and private insurance companies (Government of the Republic of Armenia 2003). Such an approach to risk reduction was considered innovative in 2003 when the strategy was developed.

The environmental protection section of the strategy covers issues like forest and land degradation and water shortages, however there is no reference to climate change which exacerbates these issues.

Azerbaijan

The year 2012 saw the adoption of the Azerbaijan 2020 Development Concept: A Look into the Future (President of Azerbaijan 2012). It covered the main strategic goals of development policy in all areas of life in the country, and is to be achieved through state programmes. The concept states: "As a manifestation of the environmental balance on the planetary scale, climate change and global warming are related to processes that can cause natural disasters (rivers bursting their banks, flooding of entire villages and cities, precipitation much higher than the norm, avalanches, etc.). All these are factors that directly affect the economic and social life of the country and need to be taken into account in the process of preparing necessary policy measures. The experience of recent years shows that in order to effectively fight natural disasters and their consequences, the state should prioritise relevant activities in emergencies and the establishment of rapid reaction mechanisms for the social security of the population in such situations" (President of Azerbaijan 2012). Desertification processes and land degradation, however, are highlighted in the context of anthropogenic stress and contamination, while forest restoration is seen within the context of air pollution. It underlines that the country has limited water resources with the least amount of water per area per capita in the South Caucasus region. This issue is, however, not considered to be at threat from climate change, but rather at threat from intensive contamination of freshwater sources that emanate from neighbouring countries.

Another of Azerbaijan's development programmes is the State Programme on Poverty Reduction and Sustainable Development, which emphasises the need to "reduce the negative impact of climate change on ecosystems and the economy". In addition, the document states the following: "Under overall management of mountainous and coastal ecosystems, creation of manufacturing facilities that do not require intensive use of natural resources will be supported in the mountainous and coastal areas to improve the living standards and employment opportunities of the local people" (President of Azerbaijan 2008a). It also states that technical and financial assistance will be provided in order to improve the condition of mountain and coastal area ecosystems that have suffered substantial damage. Therefore, the statement links the social and economic growth of mountain populations with the protection of mountain ecosystems.

Another important aspect, which is tackled by the programme, is protection of the agricultural sector from natural disasters through promotion

of insurance services and products: "the insurance mechanism will be improved to reduce damage to agricultural employers as a result of natural disasters" (p. 13 President of Azerbaijan 2008a). Hypothetically the State Programme on Poverty Reduction and Sustainable Development will be replaced with a new programme that will share the same values.

Also worth mentioning is that the above two policy documents are the only ones out of the development programmes of the three countries, which explicitly recognises climate change's economic impact.

In the local context, climate change adaptation initiatives are limited to small-scale projects, i.e. a number of pilot actions were implemented to introduce and disseminate practices and experience on climate change adaptation to local beneficiaries.

Georgia

The Georgian Social-economic Development Strategy 2020 states that: "Due to the fact that Georgia is one of the most sensitive places among the world's mountainous regions in terms of natural disasters, it is necessary to decrease the natural disaster risk, avoid loss of lives from such disasters and eradicate their negative results (damage to roads, bridges, industrial or residential premises and other infrastructure)" (Government of Georgia 2014). The strategy considers the UNFCCC mechanisms to support problem solving, and also other climate change adaptation instruments as potential sources of funding. Furthermore, the strategy highlights the problems of mountain regions but only in social terms.

In the State Strategy for Regional Development of Georgia – 2010–2017 (Government of Georgia 2014a) climate change and natural disasters are mentioned in relation to the protection of the Black Sea coast. The strategy underlines the need for planning and implementation of respective adaptation measures including: introduction of flood monitoring and early warning systems, which should be set up in the river deltas; as well as mainstreaming climate considerations into regional and municipal strategies. Both issues are tackled through the relevant chapters. The document considers the need for sustainable management of land resources under changing natural conditions and soil vulnerability as well as the negative impact of natural hazards. It is worth noting that the strategy only refers to mountain regions as a potential for tourism development.

The Regional Development Programme 2015–2017 (Government of Georgia 2014b) underlines the importance of disaster risk reduction (DRR), and is aligned with the objectives of Georgia's second National Environmental Action Plan (NEAP 2012–2016) which are:

- "Improvement/modernization of early warning systems;
- Prevention/reduction of the negative impact of floods and flash-floods from river basins of Georgia;
- Resumption of artificial influence activities on some hazardous events (hail, drought, snow avalanches)" (p. 67).

The Regional Development Programme has assigned an indicative budget of GEL 15.6 million (about US$ 7.8 million) for the Ministry of Environment and Natural Resources Protection, and another GEL 15 million to the Ministry of Regional Development and Infrastructure for natural disaster preventive measures for a three-year period. All this is considered in light of "the complicated mountainous terrain, specific atmospheric conditions and the negative impact of human activities" and potential damage to the national economy.

Socio-economic development in mountain regions and its demographic problems are highlighted in the Programme, however, at the end of practically each document it is stated that "The Regional Development Strategies, and the development of remote mountainous areas … are not "priorities" in a programming sense"; they are subsidiary programmes addressing the particular needs of the locations in question.

Regional Development Strategies (RDS) (MoRDI n/a) are developed for all Georgian regions and similarly to national development documents in that they focus on natural hazards and DRR; while mountain areas of particular regions are mentioned more in an economic context rather than in environmental and/or climate change contexts. Most of the Georgian municipalities also have their own development priorities reflected in their respective budgets. However, despite the fact that some of the priority programmes were supposed to be treated as purely climate change adaptation, municipal authorities at best perceive those projects as natural disaster prevention activities and in most cases consider the activities as infrastructure projects (ACT 2015).

Through analysis of the development strategies[20] of the South Caucasus countries referred to above, the following conclusions can be drawn (summaries in tables):

- Climate change adaptation is addressed by five of the strategies
- Mountain region specific actions in various contexts (social protection, economic development, natural protection, climate change, etc.) are mentioned in seven strategies
- Only two strategies specifically target climate adaptation actions in mountain regions

Areas covered under climate change adaptation can be summarised as follows: Azerbaijan and Georgia place greater emphasis on the increased frequency of natural disasters as a result of climate change, while Armenia focuses more on potential shortages of water resources; one Azerbaijani document addresses climate change impact both on mountain ecosystems and on the economy; and one Georgian strategy document indicates a need for adaptation in coastal zones.

Though there are variations between the countries, natural disasters are a key aspect of almost all policy documents analysed and similarities can be found in the recognition of the distinctiveness of social protection measures for mountain populations by all three countries. Some other issues potentially linked with climate change adaptation are also common to all of the strategies, such as forest degradation, the need for sustainable land management; protection of the agricultural sector from risks of natural hazards and the reduction of risks from natural events in general; and the rational use of water resources, especially in the agricultural sector.

Worth mentioning is that most of the development strategies address climate change through general declarations but very few of the strategies point to concrete adaptation actions. In addition, two of the development programme[21] that contain no references to climate change adaptation at all include actions which are in fact climate change related, but are not referred to in such a context.

References to climate change adaptation in development strategies (Only strategies in force are covered)

	Climate change adaptation covered		
Type of development document	**Armenia**	**Azerbaijan**	**Georgia**
State development strategies	Yes, explicitly water sectors	Yes, explicitly natural disasters	Yes, explicitly natural disasters
Poverty reduction strategies	No, only natural disasters risk mitigation mechanism in agriculture	Yes, explicitly economy and ecosystems	N/A
Regional development strategies	N/A	No	Yes, coastal zone management

References to mountain regions and adaptation in development strategies (Only strategies in force are covered)

	Armenia		Azerbaijan		Georgia	
Type of development document	**A**	**M**	**A**	**M**	**A**	**M**
State development strategies	Yes	Yes	Yes	Yes	Yes*	Yes*
Poverty reduction strategies	Yes	Yes	Yes*	Yes*	N/A	N/A
Regional development strategies	N/A	N/A	No	No	Yes	Yes

A - Adaptation in development strategies; **M** - Mountain regions.

* Document considers mountain regions and adaptation to climate change in one context

Sectoral policy papers

The form of presentation and prominence of climate change in the sectoral policy documents of the countries: a) clearly display for which sector the issue is important, and b) show a level of understanding of sector specific climate change impacts by policy makers and, to a certain extent, the willingness of sectoral decision makers to recognise that climate change impacts have to be integrated into sectoral policies that include other priorities. Accordingly, integration of climate change adaptation into environmental sectoral strategies is more perceptible than in other sectoral policy documents.

Environment

Framework policy

The main framework documents for the environmental sector in the three countries of the South Caucasus are those related to the National Environmental Action Programmes or similar guiding policy documents. Most recent versions of these policy documents were developed between 2008–2011, and are referred to as "second generation" NEAPs.

Azerbaijan

Armenia

The Armenian Second National Environmental Action Programme came to an end in 2012; and a replacement has not been developed yet (MoNP 2008). The document considered climate change and atmosphere protection. Under the chapter in the Action Plan on Atmosphere protection and climate change, among other mitigation measures, a recommendation was given to elaborate new inter-agency programmes stemming from international commitments. The newly adopted Obligations Emanating from a Number of International Environmental Conventions (Government of the Republic of Armenia 2011) encourages development of a climate change adaptation concept with an ecosystem approach and NAPAs. The chapter on climate change of the NEAP also calls for development of the joint Action Plan for identification of crosscutting issues between the Convention on Climate Change and other global and regional environmental treaties.

Azerbaijan

The government of Azerbaijan is in the process of final inter-agency consultations for approval of the Action Plan on Improvement of the Ecological Situation and Efficient Use of Natural Resources in the Republic of Azerbaijan (Alyev 2015). This document will have a specific chapter on climate change and will include a recommendation to elaborate a NAP.

Georgia

The Georgian Second National Environmental Action Programme 2012–2016 (MoEP 2012) also

has a special chapter on climate change and includes both adaptation and mitigation measures. The policy document identifies the following vulnerable regions: highlands/mountainous areas, the Black Sea coastal zone and semi-arid regions. The programme's long-term objective is ensuring the security of the population of Georgia through climate change adaptation measures. Short term objectives include:

- realization of adaptation measures in the regions vulnerable to climate change; and
- determination of the impacts of climate change on other regions and sectors.

The target measures within the policy document, which are developed on the basis of the Second National Communication include: the development of NAPAs, implementation of measures in the Black Sea coastal zone and Lentekhi municipality, undertaking a study on the Adjara and Upper Svaneti (Mestia) mountain municipalities and on the impact of climate change on glaciers (transformative impacts and impact on water resources) in Georgia. The document also outlines the development of operational plans to achieve a number of short-term objectives. In addition to the above, climate change is also integrated in other chapters of the document that cover its impact on sectors such as: forestry, land degradation, biodiversity and protected areas, mineral resources and natural disasters.

Given the above, it is clear that the NEAP includes the most comprehensive set of climate change adaptation measures in Georgian national policy documents to date.

Biodiversity

Regional context

Biodiversity conservation is the only area in which the countries acknowledge the need for joint action. The second edition of the Ecoregional Conservation Plan (WWF/CBC 2012), acknowledged by various stakeholders of the three countries, serves as regional methodological guide and, *inter alia*, refers to both climate change adaptation and mountain regions. The document states that: "Mountain forests, which make up the greater part of the forest biome in the South Caucasus Ecoregion, also play a critical role in preventing soil erosion and regulating water flow" and that "high mountain habitats cover about 17 per cent of the Ecoregion". Almost half of the priority conservation areas identified in the Conservation Plan are mountainous. Climate change is named as a factor that aggravates different negative impacts that threaten the biodiversity of the ecoregion. The Action

West Caucasian tur, Georgia

Plan presented in the document refers to a number of concrete measures over the short, medium and long-term that take into account national climate change trends and forecasts:

- By 2015, develop a framework followed by an Ecological Network plan for the entire Caucasus Ecoregion.
- Undertake all necessary measures to increase forest resilience to climate change.
- Protect and sustainably manage rivers and/or lake catchment areas.
- Develop and begin implementation of regional strategies and coordinate mechanisms for a number of species in light of the potential climate change-induced habitat changes in each country.

An interesting trend can be observed when comparing the previous Ecoregional Conservation Plan developed in 2006, with the updated 2012 plan (WWF 2006; WWF/CBC 2012). Given that harmonization of approaches and commitment for joint action between the CBD and UNFCCC is a fairly recent development, it is not surprising that climate change adaptation was not explicit in the 2006 version of the Ecoregional Conservation Plan. This can also be seen when comparing the priorities of the national strategies of the South Caucasus countries initially submitted to the CBD over the 1999–2006 period with more recently submitted national reports (CBD 2015). The same trend can be observed in the Strategic Plan for Biodiversity which was updated to include the Aichi Biodiversity Targets for the 2011–2020 period, and two specific targets on climate change (CBD n/a). In earlier strategy documents climate change and, in particular, climate adaptation is rarely mentioned, while recent documents, including both reports and strategies, address climate change related issues as top priorities.

In general, policy papers on the South Caucasus countries cover biodiversity better than any other environmental topic – all three countries have biodiversity strategies and consequently all have action plans under the strategies, which are regularly monitored and updated.

Armenia

The Biodiversity Strategy and Action Plan of Armenia (MoNP and GEF 1999) does not specifically address the issues of climate change nor its mountain regions. However, the recent national report submitted to the CBD in 2014, clearly addresses both issues (CBD 2014). Mountain ecosystems protection and conservation is central to this policy document, as one would expect in a report on such a mountainous country as Armenia. The main climate change threats – their causes and mechanisms – to ecosystems and important components of biodiversity, are addressed in a dedicated section. According to the report, as a result of climate change an expansion of the arid ecosystems, reduction of the areas covered by forests as well as sub-alpine and alpine landscapes, and increased vulnerability of forests are expected. Based on climate modelling of 452 species registered in Armenia's Red Book, ecosystem and habitat changes triggered by climate change will affect the survival of 74 species of high vascular plants. Moreover, climate change can increase water temperature in water reservoirs, such as Lake Sevan, which will threaten particular species. Also the report states that climate change will, in the long run, affect the well-being and health of the Armenian population through its impact on the food and water supply.

In light of the above, in the current draft Strategy and State Programme of the Republic of Armenia on Conservation, Use and Reproduction of Biological Diversity (2016–2020), climate change is mentioned as among the main threats to biodiversity (Ecolur 2015). The national target to "Improve protection of biodiversity habitats to prevent their degradation"


Georgia

is connected with Aichi target number five. The draft action plan includes planning of the following measure: "Carry out vulnerability assessment for key ecosystems of Armenia given the predicted climate change, including modelling of changes".

Azerbaijan

The National Biodiversity Strategy of Azerbaijan (President of Azerbaijan 2006) approved in 2006, as in the documents of the same period of the other two countries of the South Caucasus, has neither a reference to climate change, nor mountain regions. However, the Fifth National Report to the CBD clearly indicates the importance of protecting high mountain ecosystems, both in a regional and national context, and climate change is presented as one of the key pressures on biodiversity (MoENR 2014). In addition, issues specific to vulnerable ecosystems are also highlighted such as overgrazing, competition for scarce resources such as water, and

forest degradation (MoENR 2014). The section on biodiversity threats, impacts and trends (under the section on climate change) indicates adaptation as a main priority and states: "agriculture, optimal management of water resources, restoration of forests, afforestation, conservation and efficient use of agricultural biodiversity in arid and semi-arid zones, struggle against desertification are the main adaptation areas". Climate adaptation is also addressed in the section on agriculture (Chapter: Effectiveness of the mainstreaming of biodiversity into relevant sectoral and cross-sectoral strategies, plans and programmes).

Azerbaijan's most recent national report to the CBD takes into account recent CBD targets, including those related to climate change. The report states that development of the new Strategy on Conservation and Sustainable Use of Biodiversity will present climate change adaptation more conspicuously.

Georgia

The second National Biodiversity Strategy and Action Plan of Georgia 2014 – 2020 is structured according to sectoral chapters, which include strategic approaches and actions related to species, habitats and protected areas (MoENRP 2014). Climate change adaptation is addressed in two of those chapters:

- forest ecosystems and
- agricultural biodiversity and natural grasslands.

The strategy stresses a need for development of a separate legally binding document addressing the impact of climate change on the national forests – as climate change is likely to significantly affect Georgia's forests in future. According to the strategy, an overall understanding of the impact of climate change on Georgia's biodiversity is extremely limited and no credible assessments have been conducted to determine the influence of stress factors caused by climate change on high mountain areas, wetlands and semi-arid ecosystems. Climate adaptation is also addressed under the chapter on biodiversity of Black Sea.

The strategy's action plan covers a number of concrete climate change adaptation related measures starting from awareness-raising to development and adoption of relevant forest regulations and standards, through a participatory approach, that promote the sustainable use of non-wood products, the restoration of natural forest landscapes and adaptation to and mitigation of climate change. High mountain regions are earmarked as priorities for further study and action. Climate change impacts are also highlighted under other chapters of the strategy as a factor which should be taken into account in biodiversity protection and conservation measures.

Under the most recent national report to CBD, climate change impact was presented as a key threat to biodiversity in mountain ecosystems; with a particular emphasis on the mountain regions of Adjara, Zemo-Svaneti and Borjomi.

Water management

A number of different national laws regulate water management in the three countries of the South Caucasus. Armenian legislation has recognised the principle of river basin management since 2002. Azerbaijan and Georgia still keep their former legislative frameworks. So far, only Armenia has developed Integrated River Management Plans (IRMPs) under its national legal framework. Armenia's legal framework provides a list of issues to be covered by IRMPs which, among others, covers climate change adaptation. In the other two countries, climate change adaptation in the water sector is not covered by a legal framework, however, recent/ongoing EU and USAID pilot projects implemented in the South Caucasus countries address climate change aspects through water management plans.

CASE STUDY

Integrating Climate Change Considerations into the River Basin Management Plans of Armenia (RBMP)

Background and Legal Framework for Climate Adaptation Mainstreaming into RBMP

The main purpose of the Water Code of the Republic of Armenia Adopted by its National Assembly on June 4th, 2002 is the conservation of national water reserves, meeting the water needs of its citizens and economy through effective management of usable water resources, securing ecological sustainability of the environment, as well as the provision of a legal basis to achieve the objectives of this Code (Government of the Republic of Armenia 2002). The Code recognises the importance of integrated water management and river management principles.

In 2006, the Law on the National Water Programme was adopted. This law provides further clarity on various issues, including definition of the various types of "reserves", classification of water systems and identification of those of state significance, assessment of water demand and supply, development of a strategy for storage, distribution, and use of water resources, delineation of the issues in various water subsectors (for example, water supply and waste water collection, irrigation, hydropower), development of water standard guidelines, and improvement of water resources monitoring. Short-term (until 2010), medium-term (2010–15), and long-term (2015–21) measures for implementation of the National Water Programme were also identified (Winston *et al* 2014).

The Protocol decision of the Government of Armenia No. 4 was adopted on the third of February 2011 "On approval of the content of the model plan for water basin management". According to this decision consideration should be given to climate change factors while developing plans for the management of all of Armenia's major river basins. Recently three programmes were developed with international assistance. The Debed and Aghstev river basin management draft plans (EU), the Arpa river basin management draft plan (UNDP/GEF), and the Southern Basin Management Plan which will be submitted to the Armenian government in 2015 (USAID 2015).

Climate adaptation under the southern basin management plan

Sustainable use of water resources is linked to the establishment of balanced issuance of water permits and regulations with a focus on long-term environmentally sound planning of water resources. Currently such a decision-making support system is underway through assessments in the southern basin management area. It will enable evidence-based decision-making on the management of water resources considering hydrological, climatic and economic analysis (USAID 2015).

In order to have evidence-based decision-making, scientific data on water resources is required. With this in mind, the USAID "Clean Energy and Water" programme implemented a study on the impacts of current and future water use on the balance, depletion and recharge rates of ground water resources in the Ararat valley, using different development and climate change scenarios. The findings and recommendations of the assessment were presented to the Armenian government and national/international stakeholders in 2014. The Armenian government adopted two decisions aimed at the sustainable management of ground water resources in the Ararat valley: Decision No. 340-N (adopted on April 3, 2014) on "Approval of the procedure for issuing water use permits for illegally-operated and also non-operated wells, as well as on the procedure for liquidation and conservation of such wells" and Protocol Decision (adopted on June 26, 2014) on "Approval of the terms of reference for introducing centralised, automated management system for water use in the Ararat valley" (ARLIS 2015).

The development of the Southern Basin Management Plan is in progress, and the draft plan should be submitted to the Armenian government in 2015 (USAID 2015).

The southern basin, with an area of 4,498 km^2, covers the three major river basins – Vorotan, Voghji and Megriget. The main water consumers in the basin are industrial (mainly mining and power plants), agricultural (mainly producer of cereals and potatoes and cattle livestock) and households (ca. 141,000 inhabitants as of January 2014). More than 80 per cent of industrial enterprises are concentrated in the Voghji river basin, whereas electricity production is mainly concentrated in the basin of the river

Vorotan. The area is extremely diverse in its climatic conditions. The difference in altitudes is more than 3,600 m – from 374 to 3904 m above sea level. Due to this range of elevation and varying climate, eight successive landscape zones are represented in the area of the basin – from semi-desert to subnival, and almost all the major ecosystems characteristic of Armenia are found in the region. The river network density of the basin is 1.36 km/km^2, which is significantly greater than in the whole of Armenia – 0.85 km/km^2. The total number of rivers is 2,985, 97 per cent of which are less than 10 km long, but when combined add up to a length of 5,528 km. Only the Vorotan River has a length of over 100 km. In January 2014 the total water flow of all rivers of the basin was 1.174 billion m^3.[22]


Vorotan river

Development of pilot plans for watershed management, including mountain territories, especially with integrated climate change considerations is a step forward in application of legal provisions of integrated water management in practice; however, there are certain shortcomings presented below. The Southern Basin Management Plan does not sufficiently consider possible conflicts between the major water consumers in the energy and agriculture sectors. If the currently developed agricultural strategy to some extent takes into account climate change and proposes some measures for adaptation; hydropower sector development, especially small hydropower plants, does not reflect the projected decline in rainfall and other negative climate change outcomes.

The approach taken to river basin management takes not only water resources and climate change into account, but also socioeconomic aspects as appropriate; however, ecosystem considerations are absent. The management plan does not consider the conservation of natural ecosystems and the rational use of water resources. Therefore, the process of drafting river basin management plans should involve biologists, ecologists, physicians and epidemiologists to ensure an integrated ecosystem approach that effectively addresses climate change and nature conservation in general.

Moreover, getting final approval for new legislation involves a lengthy administrative process that is both complicated and time-consuming. This process requires a number of coordination events, approvals, revisions and consultations at different bureaucratic levels, which is often prolonged and delayed. Therefore, due to the poorly functioning bureaucracy it is often very hard to achieve desirable changes in the legal framework on any issue, let alone on climate change and water management.

Nevertheless, despite the abovementioned obstacles, the initiative is considered as innovative since it is the first time that a river basin management plan is being developed, due to its considerations on the effects from climate change, and because of the readiness of government structures to approve the RBMP.

Desertification and land degradation

All three countries of the South Caucasus are parties to the UNCCD (UNCCD 2014).

Armenia ratified the Convention in 1997 and recently received approval of its second National Strategy and Action Programme, which states that climate change leads to intensification of aridisation and consequently to land degradation and desertification (MoNP 2002).

The national Regulation on Land Monitoring Procedure (Government of the Republic of Armenia 2009) regulates protection of the soil and soil layer from erosion and desertification. This regulation requires organic carbon content, among 15 important indicators of soil and soil layer protection to be defined. Also a requirement is that organic carbon conservation, accumulation and storage in all categories of land through comprehensive measures shall be implemented.

Azerbaijan recently drafted its National Strategy and Action Plan to Combat Desertification based on requirements of the UNCCD, which is currently under inter-state procedures for consideration and adoption. Both the draft strategy and draft action plan refer to climate change as one of the parameters causing desertification. The plan covers concrete actions of adaptation to climate change related risks, such as preparation of measures for climate change mitigation, (e.g. related to drought and excessive precipitation) on the state and productivity of lands, and adaptation, etc.

Under the Georgian Second National Strategy and Action Programme to Combat Desertification (Government of Georgia 2014b) climate change is recognised as a contributing factor to desertification. The Strategy outlines the development of a joint national action plan or mechanism for the CBD, UNFCCC and UNCCD until 2017, and for 2020 to ensure that 40 per cent of the decision makers and 30 per cent of the population will be informed about the challenges and correlation between climate change, desertification and biodiversity protection. Other measures related to climate change can be summarised as follows:

- Review relevant legislation and policy to ensure consideration of climate change, desertification and biodiversity protection holistically,
- Encourage research and public awareness in all relevant areas,
- Advice on integrating all three of the abovementioned topics into Georgia's spatial planning policies.

Mountain forest degradation is presented as a phenomenon which intensifies desertification, and foothills and mountain pastures are perceived as areas vulnerable to desertification under anthropogenic and natural pressures.

Forestry

Climate change adaptation related to forests is underlined in a number of guiding documents of the South Caucasus countries, including the Ecoregional Conservation Plan (WWF/CBC 2012), and in key forestry development national policy documents.

Armenia

The National Forest Programme (Government of the Republic of Armenia 2005a) stresses the climate change vulnerability of forest ecosystems and emphasises the need for adaptation as well as the current lack of preventive measures. The Action Plan of the programme envisages evaluation of forest vulnerability and planning to increase the adaptive capacity of forested areas and to develop integrated approaches to land use planning in order to promote sufficient protection of forests. The programme emphasises the need to protect mountain forests, as well as its socio-economic and scientific values and, under the Action Plan, a recommendation is to improve mountain forest road planning and design. The programme document defines the optimal level of forest cover in Armenia at 20.1 per cent, which was calculated within the framework of the First National Communication to the UNFCCC, and taking into consideration climate change scenarios.

Moreover, the INDC (MoNR 2015) and Governmental Decree on Adoption of the National Forest Programme of the Republic of Armenia (Government of the Republic of Armenia 2005b) reconfirmed the abovementioned approach of the National Communication and the Action Plan. It also promotes forest protection and increased resilience of forests under climate change risks.

Azerbaijan

The new National Forest Programme of Azerbaijan, which is currently under consideration with an indicative approval date in 2015. In its climate change chapter it considers as appropriate the following measures for climate change mitigation and adaptation in the forest sector:

- "compliance with legislative acts on forest protection
- conduct reforestation measures and measures to stimulate natural regeneration
- a complete ban on a cattle grazing in the forests
- measures against forest pests and diseases and
- introduction of highly productive forest species to increase forest cover" (MoENR 2013).

To achieve these objectives the programme sets out the following targets:

- Elaboration of the National Strategy on Climate Change adaptation, including the strategies and

priority measures for the adaptation of forest management to climate change, and
- Strengthening institutions on the issue of adaptation of forest management to climate change, through undertaking scientific research and exchanging research results with relevant international institutions and programmes.

The document in its background specifies different types of Azerbaijan forest ecosystems, including mountain ones, and indicated that about 20 per cent of population lives in mountainous regions and that they dependent on forest resources.

Georgia

The National Forest Concept for Georgia (Government of Georgia 2014c) was approved by the Parliament as the basis for elaboration of both new legislation and policy for forest management in the country. Particular actions, which can support Georgia's forest adaptation to global warming, covered by the concept can be summarised as follows:

- Commissioning of an assessment of climate change impacts on forest areas, including impacts on the goods and services provided by forests
- Support national dialogues on possible adaptation strategies
- Categorizing forest stands according to forest composition and vulnerability to climate change and elaborating sustainable management guidelines, including adaptation measures, for each forest type
- Implementation of adaptation plans for climate vulnerable forest stands
- Equip forest management bodies and forest users with the best methods for carrying out vulnerability assessments.

It is worth noting that no specific actions to protect mountain forests are promoted by the concept.

Shepherd in Sevan, Armenia

Analysis of forest programmes and concepts of the South Caucasus countries demonstrates certain similarity of approaches, problems and challenges. Considering existing studies, both national and regional, it can be concluded that all countries are missing comprehensive and evidence-based research on the vulnerability of forest ecosystems to climate change in order to plan further detailed and complete action to increase the resilience of forests in the South Caucasus.

Agriculture

Agriculture is acknowledged as one of the sectors most vulnerable to climate change by a number of studies and assessments produced during the last decade in the three countries. Recent strategies of all three countries consequently reflect these research findings.

Armenia

The Strategy on Rural and Agricultural Development of the Republic of Armenia (Government of the Republic of Armenia 2010) considers both climate change adaptation and mountain region development. Climate change is mentioned as factor to which resilience of the entire agricultural sector should increase, while mountain and high mountain regions are where: a) economic growth should be promoted through special infrastructural projects and b) pasture and hayland protection measures should be implemented.

The new draft agricultural and rural development strategy for the period 2015–2025, also considers climate change as a threat to the sustainable development of agriculture. It recommends the establishment of an early warning system and the

introduction of harvest-forecasting methodologies for different crops and climatic/altitude zones and particular communities with regard to climate change risks. In terms of financial planning, the document considers climate change and its impact on Armenia's natural and climatic conditions.

Azerbaijan

The State Programme on the Reliable Food Supply of Population in the Azerbaijan Republic states that the combination of the increase in oil prices, the negative trends in the financial markets, as well as the rise in the demand for food products as a result of population increases, climate change, limited water reserves have contributed to increases in global food prices. As a result, food insecurity has risen in some countries (President of Azerbaijan 2008b). It proposes the implementation of the following actions:

- Development and cultivation of agricultural plant varieties which are more resistant to the effects of drought, frost, diseases and pests
- Improvement of farming methods and technologies
- Improvement of irrigation methods and water use efficiencies
- Reduction and elimination of the use of dangerous pesticides and fertilisers.

Moreover, it proposes activities aimed at improving the efficient use of water irrigation and prevention of soil degradation to mitigate the effect of climate change. The programme also underlines that up to 40 per cent (3.4 million hectares) of the land in mountainous areas had been subject to erosion of various degrees and therefore envisages land-reclamation activities in 657 thousand hectares of the irrigated land.

Considering recent climate change assessments and the commitment to address climate risks in the programme for 2008–2015 and other policy documents in Azerbaijan, the assumption is that the new programme or strategy will reflect climate change challenges in more detail.

Georgia

The Agriculture Development Strategy of Georgia (MoA 2015) is divided into strategic directions and measures. In the Strategic Direction: Climate Change, Environment and Biodiversity, the document envisages:

- Creation of a gene bank for the conservation of agro-diversity and endemic species and thus increasing agricultural sector resilience to climate change especially in arid and semi-arid zones, and in general
- Promotion of climate smart agriculture (CSA) practice in agricultural production to ensure economic and social welfare of farmers and other types of vulnerable groups.

It states: "it is important to promote a Climate Smart Agriculture approach that simultaneously addresses three intertwined challenges: ensuring food security through increased productivity and income, adapting to climate change and contributing to mitigation of climate change". This measure promotes strong coordination of action among different stakeholders, including government institutions, local authorities, NGOs and private sector representatives, to develop relevant national and municipal programmes. As well as development of capacities, introduction of relevant technologies, it envisages research to ensure increased agricultural production resilience to climate change impacts. Moreover, climate change is mainstreamed under other strategic directions and measures such as the reduction of soil degradation and desertification processes.

According to the strategy to define and support rural development and investment strategies for each region, the Ministry of Agriculture shall collaborate with other entities and local authorities to draft a rural development policy, which, in turn, shall be based on local, social, economic and cultural specifications. A unified action plan shall be developed incorporating short, medium and long-term measures. Special attention shall be given to high mountain regions.

Energy

Energy segment development and regulation in all three countries incorporate laws and strategies on conventional and alternative/renewable energy sectors. Some of them recognise climate change as a phenomenon and promote action to mitigate climate change but none of them consider the reverse effect of climate change on renewable energy sources and/or on physical infrastructure or potential heating or cooling demand through climate change. The energy sector resilience in the South Caucasus countries is an under-researched issue and even National Communications to the UNFCCC do not cover this sufficiently.

Armenia's INDC (MoNP 2015) underlines energy sector vulnerability, both for hydro- and thermal power plants, to climate change through modification of hydrology regimes or glacier melting. A number of other studies and documents cover similar issues. However, as it is assumed that over a fifty-year perspective (the average lifespan of hydropower plants), no significant changes to river hydrology regimes are expected, policy makers in the energy sector do not consider adaptation as a priority issue. Therefore, no adaptation actions have been planned or implemented in this area so far.

Tourism

Among the three countries of the South Caucasus only Armenia has a policy related to the potential impact of climate change on the tourism sector.

Snowboarding in Georgia

Armenia's Tourism Development Concept Paper (2010–2030) (USAID/CAPS n/a) recognises tourism's vulnerability to climate change threats, however, this is only in the long run. The policy paper in a general way states that climate change may affect the ability and capacities of Armenia to promote sustainable tourism. At the same time the country's mountain and high mountain regions are considered only as potential tourist attractions to be developed. Among the principles and values listed in the concept paper: are sustainable development, biodiversity and environmental protection, and rural community involvement. On the other hand, Armenia's INDC (MoNP 2015) highlights the vulnerability of tourist attractions to climate change and sets up measures to adapt to changing weather conditions.

Azerbaijan, so far, has had two state programmes on tourism development but none of these are in force at this stage. However, the country recognises tourism as a key development sector (President of Azerbaijan n/a) and currently is in the process of drafting a new tourism strategy – it is not known whether the new strategy will consider climate change issues or not. Georgia will finalise its Tourism Development Strategy for 2015–2025 by the end of 2015 (USAID/CAPS n/a). Similarly to Azerbaijan, at this stage it is not known whether the new strategy will incorporate climate change and adaptation considerations or not.

The tourism development strategies of all the three countries should consider climate change not only as a factor directly impacting tourist mobility and numbers (shifting of tourist seasons), but should also address the vulnerability of tourist infrastructure to different natural disasters triggered by climate change. The policies should also reflect general standards of tourist security and safety under climate change considerations.

Human health

In contrast to the energy sector, human well-being and health is included by National Communications to the UNFCCC as one of the areas most vulnerable to climate change in the short- and medium-term; though, no specific policy documents have been developed to tackle this issue. Moreover, none of the countries have comprehensive strategic policy papers in which relevant issues such as potential impacts of climate change on populations with respiratory, blood circulation, infectious and parasitic disease issues are mainstreamed.

Other factors, especially in mountain regions, which may exacerbate the effect of climate change, are poverty and low human security and safety, e.g. according to the Ministry of Health and Social Security of Georgia mountain regions in western Georgia, in comparison with other regions of the country, are characterised by extreme poverty. In addition to the above issues, natural disasters triggered by climate change affect not only physical infrastructure but also human lives and therefore should be considered under the relevant health protection and social security strategies.

Natural disasters

Armenia

In 2012 the Armenian Government approved the decree on "National strategy on disaster risk reduction of the Republic of Armenia and the Action Plan for of the national strategy on disaster risk reduction" (No. 281-N, dated 7 March 2012). All climate change related natural disasters are considered under this umbrella and consequently all relevant actions are planned to respond to climate risks. The Government of Armenia adopted a decision on formation of the ARNAP (DRR National Platform) Foundation in line with the strategy. Being a non-governmental organization, it provides opportunities for state, non-governmental, private and international institutions to participate in decision-making and consultation processes. At the same time, it provides opportunities for organizing and managing day-to-day operational activities and implementing long-term projects. It also provides the necessary flexibility to respond to new challenges (DRR National Platform Armenia 2010). The National Platform also functions as a coordination mechanism for managing cooperation between the different agencies and stakeholders on the issue.

Azerbaijan

The "Azerbaijan-2020: Look into the future" Development Concept (President of Azerbaijan 2012) states that in order to effectively prevent natural disasters, the state should prioritise both relevant activities in emergency situations and the establishment of rapid reaction mechanisms for the social security of the population in such situations. At the same time, while drafting and implementing infrastructure projects in the regions of the country, the high likelihood of natural disasters should be taken into account, and relevant requirements should be considered when designing and building infrastructure facilities of vital importance to ensure that they retain their functionality as required.

Georgia

The President of Georgia approved the State Operation Plan on the Response on Natural and Technological Disasters in 2008 (President of Georgia 2008). The plan was developed to ensure a coordinated and effective response by government agencies to natural or technological disasters that may occur. However, the plan does not include any risk reduction or mitigation measures, nor does it ensure that there are adaptation activities for responding to climate change risks. In this light, it is worth noting that natural disasters are named as one of the key risks affecting different economic sectors of the country in different policy documents, including the INDC (MoNRP 2015).

The impact of natural disasters, especially those triggered by climate change, on economic sectors and ecosystems services should be considered and appropriate adaptation measures should be integrated into sectoral policy documents.

Conclusions on the analysis of sectoral policies

The analysis of the sectoral policies of the three countries of the South Caucasus reveals that:

- More recent policy documents are more comprehensive in their coverage of adaptation issues. For example, the National Environmental Action Programmes and Biodiversity Strategies adopted before 2010 did not include climate adaptation, while documents adopted and/or drafted after 2010 do cover the subject.
- Economic feasibility issues are only addressed in the short-term (for instance, renewable energy policy papers do not cover issues that impact in over 50 years' time).
- Some sectors are not covered by specific sectoral strategies but development strategies (for example, industry).
- Lack of consistency and timely updating of sectoral strategies. Some strategies are not replaced in a timely manner or were not followed at all, or cover issues in completely new manner or for new areas.
- Lack of availability of applied research and studies on sector vulnerability to climate change (energy strategies do not cover the potential increase of energy demand in the summer and winter months, as well as other aspects of sector developed against the projected climatic changes, as no studies have been conducted on this issue).

Overview of Presence of Climate Adaptation and Mountain Regions in Current Sectoral Strategies (Strategies under development or ones with expired term are not considered in the table)

	Armenia*		Azerbaijan		Georgia	
	A	**M**	**A**	**M**	**A**	**M**
Environment						
National Environmental Action Plan	N/A	N/A	N/A	N/A	Yes	Yes
Biodiversity	No	Yes	No	No	Yes**	Yes**
Water	N/A	N/A	N/A	N/A	N/A	N/A
Desertification	Yes	No	N/A	N/A	Yes	Yes
Forestry	Yes	Yes	Yes	Yes	Yes	No
Agriculture	Yes	Yes	Yes**	Yes**	Yes	Yes
Energy	No	No	No	No	No	No
Tourism	Yes	Yes	No	No	N/A	N/A
Transport, Infrastructure, Communication	No	No	N/A	N/A	N/A	N/A
Industry	N/A	N/A	N/A	N/A	N/A	N/A
Human Health	N/A	N/A	No	No	No	No
Natural Disasters	Yes	No	N/A	N/A	No	No

A - Adaptation in development strategies

M - Mountain regions

* Some actions/measures consider mountain regions, without explicitly stating this as most of Armenia can be considered as mountainous

** Mentioned in a single concept

Buynuz, Azerbaijan

Another characteristic of the sectoral policies reviewed is that most of the strategy documents do not provide specific climate change adaptation measures or activities, or only contain declarative references to climate change/adaptation. This can be explained by a lack of comprehensive, detailed and locally applicable research on the issue. For this reason, many strategy documents call for further assessments and studies to be undertaken on climate resilience and adaptation issues.

The table on the left presents an inventory of climate change adaptation activities and existing references to mountain regions and ecosystems in sectoral policies in force in Armenia, Azerbaijan and Georgia as of October 2015. It is worth noting that only two strategy documents make specific reference to climate change adaptation in mountain regions.

Implementation of adaptation measures

Approaches in the implementation of adaptation measures shown under the different strategies of the South Caucasus countries are strongly linked with: (a) the mandate of actors involved in planning and implementation of any adaptation measures in the countries, (b) the legal status of the strategies elaborated, both independently by different stakeholders or under National Communications to the UNFCCC, and (c) the efficiency of implementation mechanisms for climate adaptation strategy enforcement.

Actors involved in climate change adaptation

While development of policy documents and regulatory instruments is the responsibility of national authorities, implementation of grassroots adaptation measures or elaboration of local action plans in all three countries is supported by aid from donor agencies and countries through non-governmental or relevant international organizations.

Legal status of climate adaptation strategies

As mentioned under the section on climate adaptation policy, for a number of regions (including mountainous ones) regional development strategies were developed through the Third National Communications: in Armenia for the Vayots Dzor Marz (region); in Azerbaijan for the Shamakhi and Ismayilly districts; in Georgia for the Kakheti (including the semi-mountainous municipalities of Akhmeta and Lagodekhi) region (UNDP 2014b), the Upper Svaneti (Mestia mountainous municipality) region (UNDP 2014a), and Adjara (includes mountain municipalities of Khulo, Keda and Shuakevi) Autonomous Republic (UNDP 2013c). Likewise, under the Second National Communications similar strategies on climate change were prepared. A number of local/municipal draft action plans were also put in place; developed by different non-governmental organizations and international agencies.

However, all the above policy documents suffer from the same problem – the absence of a nationally recognised and legally binding status.

Implementation mechanisms of adaptation strategies

The major shortcoming of the climate adaptation strategies and policy documents that address the development and implementation of adaptation plans, is their lack of a legally binding status, and the absence of implementation and enforcement mechanisms (both institutional and financial).

Those two issues are strongly interlinked with prioritization of different measures planned especially

CASE STUDY

Georgia

Georgia prepared the Second National Communication on Climate Change (MoENRP 2015) with the financial support of the Global Environment Facility (GEF). One of the main components of the Communication was a climate change strategy, based on which significant investments related to the climate change sector were made in Georgia.

Over the period 2009–2014 total funding through foreign grants was US$ 176 million.

The analysis under the Third National Communication (Chapter 6) demonstrated that most of this was consistent with the actions planned within the Strategy on Climate Change for 2009 and the actions planned or implemented within the strategy were fulfilled with almost 80 per cent, while the implementation of some activities is still under way.

The proportion spent on vulnerability/adaptation and mitigation actions in implemented projects is 42 per cent to 58 per cent, and the grants in money terms for mitigation activities are three times more (27 per cent and 73 per cent respectively). It is difficult to say what proportion of this spending was allocated specifically to mountain regions and lowlands.

under the limited budgets of municipalities. Local authorities consider urgent social or economic needs as higher priorities (e.g. social assistance, infrastructural projects, rehabilitation of schools, hospitals and roads, etc.) than climate change strategies, programmes and plans (including ones for mountain regions). This prevents local authorities from formal adoption and further implementation actions.

This situation has been improved by recent awareness-raising campaigns, but the problem is still acute. Public awareness can significantly change existing practice and create incentives for approval of local climate actions, even with existing limited budgets. This is true for Georgia, where, in a number of municipalities, adaptation related infrastructure projects, such as construction of dams or measures aimed at protecting against sea storms or river flooding, are implemented and financed or co-financed through local budgets.

However, within an existing institutional context characterised by limited municipal budgets and a lack of public awareness, regional/municipal/ local climate action plans and guiding documents developed by different non-governmental actors remain ineffective and non-feasible tools from an implementational viewpoint.

Another option for implementation of climate strategies is donor funding. A common approach for donor-funded elaboration of local/municipal action sees "visibility" being combined with "feasibility". In addition to a research and planning component, donor-supported projects, usually incorporate pilot activities, which can be considered as an initial implementation of the action plans/strategies or, in other words, "seed money".

It is noteworthy, that in the planning of climate change projects, non-governmental and international organizations often refer to the National Communications to the UNFCCC or policy documents.

There is also variety in the status of strategies which are approved by national governments (see Azerbaijan case study). Such strategies and action plans or programmes usually have monitoring and financial mechanisms, as well as responsible government agencies, which are supposed to ensure the progress of their implementation.

Hirkan national park, Lankaran, Azerbaijan

CASE STUDY

Azerbaijan

The National Programme on the restoration and expansion of forests in the Azerbaijani Republic (2003–2008), among others, considered forest restoration as part of broader climate change impacts which "increase the rate of pests and diseases, and reduce fertility and quality of seeds" (MoENR 2003).

According to the ENPI FLEG programme, since the approval of the "National Programme on restoration and expansion of forests in the Azerbaijani Republic" a number of forest restoration actions have been carried out on more than 71,634 hectares of forest land, and a large number of trees were planted (ENPI FLEG 2015).

Financial mechanisms

For the last decade donor technical and financial support remains a primary source of funding for climate change activities (e.g. the Adaptation Fund, Global Environment Facility (GEF), European Union (EU), European Bank for Reconstruction and Development (EBRD), The World Bank, United States Agency for International Development (USAID), The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) & The Federal Ministry for Economic Cooperation and Development (BMZ), KfW Development Bank (KfW), United Nations Development Programme (UNDP), United Nations Environmental Programme (UNEP), Austrian Development Agency (ADA), etc.) (see the case study on Georgia above). However, the situation on the ground is slowly beginning to change as governments increase their expenditure on climate change related actions. The pace of this trend is a factor of the different emerging development trends (along with the ratio of frequency of natural disasters) across the counties.

The last few years has seen an increase in the frequency of extreme climate events in all the South Caucasus countries, and also in the amounts spent on dealing with their consequences. For example, in Azerbaijan it is estimated that natural disasters (flooding, mudflows, etc. triggered by heavy rainfalls and other exposures to climate change) cost Azerbaijan US$ 70–80 million annually (WWF 2008). It should be assumed that losses in the other two countries are also significant. For example, a recent natural disaster in Georgia's capital, Tbilisi, which was caused by unusually heavy rainfall in 2015, claimed the lives of more than 20 inhabitants and significantly damaged the city's physical infrastructure. It resulted in pay-outs from private insurance companies of up to 2.5 million euros to those affected, not to mention tens of millions of euros required for compensation of losses and rehabilitation works from municipal and state budgets.

Given these economic costs governments are slowly adjusting their expenditure planning. In Georgia, for example, under the Regional Development Programme (Government of Georgia 2014b), two government agencies – the National Environmental Agency and the Ministry of Regional Development and Infrastructure have been tasked with providing more than US$ 30 million over a three-year period for natural disaster prevention. In Azerbaijan, in 2010 alone, and following the Kura river floods, the country spent more than 400 million AZN (approximately US$ 500 million according to historical exchange rates) to tackle disaster-related problems and to take adaptive/prevention measures to reduce future flooding risks. In Armenia, as early as 2013, the government created an environmental fund to establish the relevant financial mechanism for climate change mitigation (GHG emissions reduction and carbon sink development) and adaptation (combating climate change impact) measures (see Armenian case study).

View on mountain Ararat

CASE STUDY

Armenia

The Third National Communication to UNFCCC: *"The Armenian government adopted Protocol Decree No. 16, dated 25 April 2013 "On approval of the concept of the establishment of innovative financial – economical mechanisms in the field of environment". On this basis, the government adopted Protocol Decree No. 47, dated 14 November 2013, "On approval of the concept of the establishment of innovative financial and economical mechanisms in the field of environment".*

These documents show the Armenian government's commitment to developing proposals on establishing a civic revolving investment fund. The fund is aimed at establishing the relevant financial mechanism for climate change mitigation (GHG emissions reduction and sinks development) and adaptation (combating climate change impact) measures. Fund resources should be created through companies' environmental fees (those using natural resources and having an impact on the environment)" (MoNP 2015).

It is also worth noting that the more detailed and focused governmental policy documents are, the more likely it is that they include plans for sustained budget financing and therefore, the greater the chance that they will achieve tangible post-implementation results and outputs (see Azerbaijan case above).

Finally, property and/or agricultural insurance mechanisms can also be seen as a financial tool for mitigation of climate change risks. While property insurance is not yet widely available in the South Caucasus countries, agricultural insurance, especially public-private, is a suitable protection mechanism for farmers. For example, Georgia has recently established a public-private agro-insurance mechanism which is quite affordable for even small-scale farmers. In 2015, mechanism demonstrated its effectiveness when it offered protection from financial losses arising from a series of extreme weather events.

Financial mechanisms to support economic and social development of mountain and high mountain regions are also foreseen by different governmental programmes in the three countries. However, those programmes do not explicitly refer to any climate related actions as such.

National coordination mechanisms on climate adaptation

Armenia

Armenia established the Inter-Agency Coordination Council on Climate Change in 2012 (Prime Minister of Armenia 2012). The Council is composed of the representatives of 14 ministries, 2 independent state agencies, the Armenian Public Services Regulatory Commission, the Armenian National Academy of Sciences, and the UNFCCC National Focal Point. The Chair of the Council is the Minister of Nature Protection. The Council was established to implement UNFCCC provisions, in particular, to implement measures defined by the Decree on "Approval of the Action Plan of RA Obligations Emanating from a Number of International Environmental Conventions" (Government of the Republic of Armenia 2011). The Council safeguards cooperation between regional, intergovernmental and international organizations, participatory approaches with regard to communities, civil society and the scientific community, and capacity building. It meets twice a year and, between meetings, uses formal channels of intergovernmental cooperation. To support the operations of the Council a working group was established comprised of representatives of state agencies, as well as climate change experts (MoNP 2015).

Azerbaijan

To ensure coordination to meet the country's commitments to the UNFCCC, the State Commission on Climate Change was established (President of Azerbaijan 1997). The Climate Change and Ozone Centre within the mentioned ministry served as a secretariat for the Commission. At present, the Ministry of Ecology and Natural Resources coordinates all reporting processes under the framework of the UNFCCC Convention, and also ensures coordination of climate action among government agencies. Besides this, the Ministry is nominated as the designated authority to represent the country at the Adaptation Fund. Moreover, before submission of the National Communications to the UNFCCC, the Ministry submits it to the Cabinet of Ministers to begin the state approval process, where related line ministries provide their comments and suggestions to the relevant sectoral parts.

Georgia

The Government Commission on Climate Change was established in 1996 (President of Georgia 1996). The Chair of the Commission was the Minister of Environment and Natural Resources Protection. Under the same decree, the National Climate Change Programme and composition of the Commission were approved. However, the decree was repealed, and the programme closed in 2005. At this stage no formal inter-agency national coordination mechanism on climate adaptation exists. Though the Ministry of Environment and Natural Resources Protection remain responsible body for climate adaptation action planning and coordination at national level.

For the purpose of providing input to the National Communications, there are national working groups within all three countries, representing all related ministries and state agencies, the academic and private sector and NGOs. However, it is rare that these working groups include representatives of the local authorities and the local population.

In contrast, international and non-governmental organizations deploy a more inclusive approach when implementing projects for development of regional/local/municipal climate strategies or actions; establishing working groups or steering committees that typically include both local authorities and local population representatives.

Stakeholder consultations

All three countries are parties to the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters. Azerbaijan ratified this in 2000, Georgia in 2000, and Armenia in 2001 (UN 2015). The relevant national legislations also reflect the principles and provisions of the Convention. Therefore, stakeholder consultations are held on most of the government policy documents related to environmental protection and/or climate change. However, mechanisms used for consultations are not yet sufficient. Even when policy documents reach the local and/or municipal levels local stakeholders, due to a variety of reasons, have no capacity to examine the documents and/or to comprehensively contribute to consultations.

During the planning of adaptation action at municipal or local levels performed by international organizations or non-governmental organizations, consultation processes are more reflective and sophisticated. However, as yet, none of the local action plans on adaptation have been approved or adopted by local authorities. This can be explained by the inability of non-state actors to justify and properly explain the financial implications for implementation, given the limited funding opportunities within local budgets. Consequently, such consultations are often ineffective.

Beshbarmag mountain, Azerbaijan

Monitoring and evaluation

Almost all the programmes and strategies mentioned above include a monitoring and evaluation mechanisms, application of which is the duty of a responsible government body as stipulated within the relevant policy document. However, the monitoring and evaluation capacity of these bodies is often insufficient.

Furthermore, as none of the countries have climate change adaptation strategies, none of them use climate change adaptation policy as an umbrella for sectoral policy papers. Hence, there is no comprehensive monitoring mechanism, which might be used as a tool for evaluation of climate actions planned under sectoral policy papers. Monitoring is therefore also fragmented. Since ratification of the UNFCCC, National Communications drafted with financial support from the GEF and implemented with the support of UNDP, remain the only and most comprehensive tool of monitoring and evaluation of climate adaptation actions in Armenia, Azerbaijan and Georgia.

Georgia

Conclusions on analysis of adaptation policies for vulnerable sectors

The findings of the study in Chapter 2: Analysis of adaptation policies for vulnerable sectors be summarised as follows (see also table on the right):

- None of the South Caucasus countries have specially designated legal acts on climate change (neither on mitigation nor on adaptation);
- All the countries made commitments to elaborate NAPAs or National Adaptation Strategies;
- Development strategies and programmes of the all countries in most cases, refer to climate vulnerability; however, they do not consider tangible adaptation measures;
- Environmental sectoral policy documents at best have references to vulnerability to climate and propose particular adaptation actions; especially in biodiversity and forestry sectors. Moreover, these two sectors do refer to mountain region/ ecosystem vulnerability to climate change;
- Agricultural policies of the all three countries consider the need to increase the resilience of the sector to climate change;
- Most of other sectoral policy documents do not consider climate change adaptation as a priority; however, some of them consider climate change mitigation actions, e.g. in the energy sector;
- Most of the countries do not have specially designed financial mechanisms for adaptation, besides national budgetary and international funds;
- Most of the countries do have specific national coordination mechanisms;
- All the countries share similar approaches to stakeholder consultations, mostly defined by

Analysis of the institutional framework for climate change adaptation

	Armenia	Azerbaijan	Georgia
Special climate legal acts	No	No	No
Climate adaptation strategy/action	–	–	–
Existence of adaptation strategy/action	No	No	No
Commitment to develop nation policies	Yes	Yes	Yes
Climate adaptation in development strategies	Mostly yes	Mostly yes	Mostly yes
Climate adaptation in sectoral strategies	–	–	–
Environmental strategies	Mostly yes	Mostly yes	Mostly yes
Agriculture strategies	Yes	Yes	Yes
Health strategies	No	No	No
Infrastructure/Transport strategies	No	N/A	N/A
Energy strategies	No	No	No
Tourism strategies	Yes	No	N/A
Natural Disasters strategies	Yes	Mostly yes	No
Special financial mechanisms for climate adaptation	Yes	No	No
Coordination mechanisms at governmental level for climate adaptation	Yes	Yes	No
Common monitoring & evaluation mechanism for climate adaptation	No	No	No
Designated authority for climate action	MoNP	MoENR	MoENRP
Stakeholder consultation mechanisms	Yes	Yes	Yes

Georgia

provisions within the Aarhus Convention on public participation;

- In all three countries the designated authority for development and planning of adaptation actions is the ministry for the environment. But it is worth noting that these agencies do not have sufficient capacity, especially for development of methodologies and conducting monitoring and evaluation.
- All of the countries share a similar approach to monitoring and evaluation of progress, i.e. through National Communications to the UNFCCC, and none of them have nationally adopted comprehensive all-inclusive universal instruments for this purpose;
- Another common trend for all countries is consideration of mountain and high mountain regions in social rather than an economic context; very few strategies and policy documents refer to mountain region/ecosystem vulnerability and/or propose special actions to increase their resilience to climate change. Those documents that do, relate to forestry resilience and biodiversity.

SOUTH CAUCASUS MOUNTAINS

Gap analysis

Girdimanchay river near Lahij, Azerbaijan

Major barriers to planning and implementation of adaptation measures

The following major barriers to planning and implementation of adaptation measures, are described below:

National level

- Despite positive developments in the recent decade, systematic national climate monitoring networks are still insufficiently developed;
- Lack of historical and observational data to monitor the climate change sensitivity/vulnerability of different sectors and ecosystems on the basis of unified and recognised system of indicators; as well as insufficient and/or publicly unavailable spatial data;
- Lack of unified and publicly available methodologies for elaboration of climate change related assessments;
- Fragmented and unsystematised nature of studies and assessments at national levels, and as result a lack of comprehensive regional assessments;
- Lack of a coordinated approach for the elaboration of climate change related policy documents especially at the local level;
- In some countries a lack of finances and inability to utilise existing resources in efficient manner;
- Insufficiency of regional coordination mechanisms.

In addition to the abovementioned, responsible agencies of all three countries (ministries of environment, climate change centres and agencies responsible for climate monitoring and observation, modelling, statistical information collection, as well as sectoral agencies) need capacity building to enable them to effectively plan and implement coordinated climate change adaptation actions.

Moreover, to develop sufficient national scenarios and forecasts, the countries of the region have to be able to utilise and exchange monitoring/observation data with neighbouring countries. This is due to the fact that national climate monitoring/observation networks cannot always provide sufficient data especially for bordering areas.

Municipal level

At the municipal level problems are similar, however, there are some specific barriers as well, such as a lack of relevant knowledge and guidance, a significant lack of financial and human resources, and also the fact that the current system of decentralization and the statutory functions limitations of local authorities do not provide room for independent decision-making on the issue.

Landslide in the Dariali Gorge, Georgia

Technology gap analysis

Systematic climate observation and modelling

All the Third National Communication reports describe existing monitoring/observation data for climate exposures, such as changes of temperature, participation, humidity, evaporation, etc. within the countries.

The Armenian Hydromet Service is carrying out standard full-scale hydro-meteorological observations (horizontal visibility, cloudiness, atmospheric phenomena, soil temperature on surfaces and in different depths, ambient air temperature and humidity, atmospheric pressure, wind direction and velocity, precipitation, and sunshine duration) at 47 stations; among those, forty stations and two observation points carry out agro-meteorological observations (MoNP 2015).

In Azerbaijan, meteorological, agrometeorological, hydrological and oceanographic observations are conducted by the National Hydrometeorology Department of the MoENR. Environmental pollution observation (soil, water and air) is conducted by the National Monitoring Department of the MoENR.

Armenian highlands

In Georgia, the Hydro-meteorological Department (under the National Environmental Agency of MoENRP) collects and monitors information from twenty-one weather and ninety-five hydro-meteorological posts, among which thirty are automated stations (MoENRP 2015).

However, the Third National Communications do not evaluate in detail the efficiency of existing territorial expansion of the networks of hydro-meteorological, water or other monitoring/observation stations and posts. The Armenian Third National Communication states that at a horizontal elevation of 2,500–3,000 m there are no observation stations; the National Communication for Georgia states that predictions made on Svaneti glaciers are made based on number of assumptions (MoENRP 2015); in the Second National Communication of Azerbaijan there are clear gaps in both monthly and yearly databases (MoENR 2010).

The Technology Needs Assessments of Georgia and Azerbaijan (UNFCCC 2015), for 2012 and 2013, refer to insufficient monitoring/observation and the lack of historical data needed for accurate forecasts and projections for almost all identified sectors, such as energy, tourism, natural disasters, agriculture, forestry, water etc.

Another disadvantage of climate change forecasts lays in the use of Global Climate Models (GCM) for prediction of climate change and the downscaling resolution (20–25 km) (Climateprediction.net 2015) practised under regional models used in the countries. For example, the methodology used for climate change forecasts and projection described in Georgia's Third National Communication to UNFCCC is sufficient for demonstrating climate change trends at the country level, but is not precise enough for vulnerability assessments at the municipal or community levels given the country's complicated mountain terrain (MoENRP 2015). This disadvantage, certainly common for many countries, can be tackled through improvement of the existing monitoring/observation networks and climate modelling capacity building of relevant agencies.

In addition, it is assumed that some data can be obtained through knowledge sharing with regional and/or international bodies and from information sources which can provide updated methodologies for monitoring/observation.

Vulnerability assessments and research

Indicators

The section above lists certain challenges and disadvantages that are evident in the monitoring/observation and modelling of climate exposure. A much more complicated issue is measuring the climate change sensitivity of ecosystems, including mountain ones, and economic sectors. Here, the setting of comprehensive and consistent quantitative and qualitative indicators for each sector or ecosystem is key. However, a comparison of sensitivity in a spatial context to expose the most sensitive areas of a country is hampered by: a) lack of sufficient observational data, b) lack of applicable statistical data, both from a historical and contemporary, perspective, and c) lack of spatial data.

Currently, almost all initiatives on climate change vulnerability assessments use their own sets of indicators, which are often created without the consultation or agreement of the responsible government authorities. Studies and research papers are fragmented and, therefore, it is hard to create a comprehensive picture of sensitivity and to judge which economic sector or type of ecosystem is more sensitive to climate impacts at a country level.

Moreover, most of the studies, completed so far, are quite general and sometimes based on assumptions, and their applicability under concrete local adaptation action planning is rarely feasible. Policy documents also point to the fragmented nature and shortcomings of the research, and many of the policy documents recommend further assessments for different sectors.

Similar problems are observed when evaluating the adaptive capacity of climate sensitive sectors or ecosystems, without assessment of which vulnerability to climate change cannot be assessed. Therefore, assessment of the vulnerability of mountain regions/ecosystems to climate change can often only be evaluated on the basis of sets of general assumptions, thus making prioritization of climate action in a country context rather complicated.

Methodology and research

As mentioned above, almost all climate adaptation initiatives are using their own methodology – as government agencies are unable to provide common, formally agreed and adopted methods for vulnerability assessments. Many of those assessments do not share the same approaches for data collection, indicator selection, and methods of analysis. Due to fact that there is insufficient official data within relevant government agencies, they are often forced to collect information through surveys, questionnaires, etc. As a result, information collected is not always reliable or representative; many projects/initiatives are also overlapping each other. Therefore, as was already underlined above, it is hard to compare or find correlation between existing studies and identify vulnerability areas at a country level.

Areas uncovered by studies

As mentioned above, existing studies are fragmented and do not always cover the entire territory of the countries; therefore forecasts are often unreliable. In addition, there are some sectors, which are not yet covered by any studies, e.g. energy sector vulnerability and a number of others. Studies identifying potential financial losses from climate change impacts are also very limited or almost absent.

In one remarkable study, conducted under the Third National Communication of Georgia to the UNFCCC, a group of experts assessed the vulnerability of the cultural heritage of one of the mountain regions of Georgia (Upper Svaneti). It was made clear that climate change will affect this sector, *inter alia* through the increased frequency of different natural disasters such as wind erosion, heavy rainfalls, extreme temperatures, etc. However, no further research has been conducted on this sector.

Fragmentation is common for the studies such as on forests, biodiversity, land resources, agriculture, water, protected areas, tourism, glacier fluctuation, physical infrastructure vulnerability (settlements, railroads, roads, etc.). Existing reports on vulnerability assessments broken by sector and country typically

Alpine toundra, Georgia

address the forestry, biodiversity, agriculture sectors and desertification/land degradation, etc. (see table: National Climate Change Vulnerability Assessments Availability by Sector/Country).

The mountain regions of the South Caucasus countries are to certain extend covered by about half of the national vulnerability reports. In addition, the following aspects for mountain regions are covered through regional studies:

Multiple areas: The Climate Change in the South Caucasus (UNDP 2011) study, which is based on official country information from the communications to the UNFCCC and from the Regional Climate Change Impact Study for the South Caucasus Region, and which was funded by UNDP, produced a number of research papers. The study covers relevant aspects of mountain region vulnerability to climate change derived from the Second National Communications to UNFCCC.

The study by the WWF, Climate Change study for the Southern Caucasus, impacts on nature, people and society (WWF 2008), considers certain climate change impacts on agriculture, water and biodiversity in mountain regions of the three countries.

Agriculture: The study on Building Resilience to Climate Change in South Caucasus Agriculture (Ahouissoussi *et al.* 2014), produced by the World Bank, includes analysis of issues such as climate impacts on crops and water availability, and priority measures for agricultural adaptation in mountains through regional actions.

Water: The KfW assessment report on Adaptation to Climate Change in the Kura-Aras River Basin (Kerres 2010) refers to adaptation challenges and measures of water resources including ones formed in mountainous regions of the South Caucasus countries. The report also states that: "Once the glaciers disappear completely (estimates suggest that hardly any glaciers might be left by 2100), the hydrology will lose one of its main drivers and regulators. In areas where total average discharge decreases, this will contribute to water quality degradation, since less water has less potential to dilute pollutants".

Forests: The Report on Adaptation of Forests to Climate Change (WWF 2012), produced with support from the EU, provides an analysis of the vulnerability of different species growing in mountain and high mountain regions.

All regional reports are desk studies and mostly utilise information from the National Communications to UNFCCC.

Policy gap analysis

All the countries of the South Caucasus made a commitment to develop separate policy documents on climate change adaptation, either internationally or nationally. Such commitments derive not only from international obligations, but also from certain vulnerability studies conducted so far in the region.

One integrated national strategy on adaptation to climate change (agreed among different government agencies and stakeholders and constructed on the basis of reliable studies), may help countries to 'gather' and incorporate all relevant actions into one policy document; while its provisions can be further mainstreamed in more detail into sectoral policy documents. At this stage, however, there is a still a lack of coordination of climate actions and priorities within existing policy documents.

National policy papers should specifically address mountain region adaptation to climate change, especially in the context of improving ecosystem resilience. Each of the relevant sectoral policy documents should include corresponding actions regarding climate change; either concrete ones, based on existing assessments, or ones focused on finding existing gaps in climate vulnerability assessments.

Rural landscape, Azerbaijan

However, despite progress made by the countries on mainstreaming climate change into policy documents – a number of issues persist, as presented in the previous chapters, which prevent full-scale action in this direction:

- As explained in Chapter: Technology gap analysis, vulnerability assessments are still fragmented;
- To include adaptation measures in policy documents government agencies should have a clear justification of their importance, as with mainstreaming climate change into policy documents, they will facilitate imposing responsibility on relevant agencies for their implementation and allocation of financial resources from national budgets. Otherwise actions will either be too general or, as in case of the INDC or Georgia's Nationally Appropriate Mitigation Actions (NAMA), commitments will be made with caveats;
- Low-level of awareness about the issues among government and local authorities and the general public is preventing full climate action deployment in all three countries;
- Insufficient institutional memory within relevant agencies often leads to poor action planning and implementation;
- And finally, a lack of knowledge of different innovative financial mechanisms, and an inability to sufficiently leverage existing financial resources without substantially increasing expenditures, also hampers the mainstreaming of climate change actions into sectoral strategies.

National Climate Change Vulnerability Assessments Availability by Sector/Country

	Armenia		Comments/references	Azerbaijan		Comments/references	Georgia		Comments/references
	A	M		A	M		A	M	
Biodiversity	Yes*	Yes	Vulnerability Assessment of Selected Semi-Arid Regions and Agrobiodiversity to Climate Change in Armenia (2012). REC Caucasus.	Partly**	No***	The Fifth National Report to CBD. 2015.	Partly	Partly	Situation analysis to National Biodiversity Strategy and Action Plan. NACRES.
	Partly	Partly	National Climate Vulnerability Assessment: Armenia (2014). Climate Forum East (CFE).	Partly	No	Vulnerability Assessment of Selected Semi-Arid Regions and Agrobiodiversity to Climate Change in Georgia (2012). REC Caucasus.	Partly	No	Vulnerability Assessment of Selected Semi-Arid Regions and Agrobiodiversity to Climate Change in Georgia (2012). REC Caucasus/EU.
Water / Glaciers	Partly	Partly	National Climate Vulnerability Assessment: Armenia (2014). Climate Forum East (CFE).	Partly	Yes	Azerbaijan Second National Communication to the UNFCCC. GEF/UNDP. 2010.	Partly	Partly	Environmental Assessment: Integrated Natural Resources Management In Watersheds Of Georgia. INRMW/USAID.
	Yes	Party	Armenia's Third National Communication to the UNFCCC; UNDP/GEF, 2015.	Yes	Yes	Azerbaijan Third National Communication to the UNFCCC. GEF/UNDP. 2010.	Partly	Partly	Glacier Fluctuation in Svaneti. 2011. USAID/ Deloitte Consulting.
				Partly	Partly	Central Kura River Basin Management Plan (RBMP), 2014, EU project.	Partly	Partly	National Climate Vulnerability Assessment: Georgia (2014). Climate Forum East (CFE) and Georgia National Network on Climate Change, 2014.
							Partly	Partly	Reducing the Vulnerability of Georgia's Agricultural Systems to Climate Change. EBRD/WB.
							Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
Desertification	Partly	No	Armenia's Third National Communication to the UNFCCC; UNDP/GEF, 2015.	Partly	Partly	National Action Plan to Combat Desertification. 2015-2020.	Yes	No	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
							Yes	No	Georgia's Second National Communication to UNFCCC. GEF/UNDP. 2009.
Land degradation				Partly	No	Azerbaijan Second National Communication to the UNFCCC. GEF/UNDP. 2010.	Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
							Partly	Partly	Georgia's Second National Communication to UNFCCC. GEF/UNDP. 2009.
Forestry	Yes	Partly	Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia, UNDP/ GEF Medium-Size Project, 2013.	Partly	No	Azerbaijan Second National Communication to the UNFCCC. GEF/UNDP. 2010.	Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
	Partly	No	Armenia's Third National Communication to the UNFCCC; UNDP/GEF, 2015.	Yes	Yes	Final report on climate change impact (including social and economic impact) to local forests of Azerbaijan, as well on relevant capacities on climate change mitigation and adaptation. FLEG II Programme/EU. 2015.			
				Partly	Partly	National Forestry Development Plan (2015-2020) Project.			
Energy							Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.

Continuation

	Armenia		Comments/references	Azerbaijan		Comments/references	Georgia		Comments/references
	A	M		A	M		A	M	
Agriculture	Yes	No	"Climate Change Impact Assessment" UNDP/00049248 (2008-2009).	Yes	No	Azerbaijan Second National Communication to the UNFCCC. GEF/UNDP. 2010.	Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
	Yes	Partly	Armenia's Third National Communication to the UNFCCC; UNDP/GEF, 2015.	Yes	Partly	Reducing the vulnerability of Azerbaijan's agricultural systems to climate change: impact assessment and adaptation options. EBRD/WB. 2015.	Partly	Partly	Georgia's Second National Communication to UNFCCC. GEF/UNDP. 2009.
	Partly	Partly	Vulnerability Assessment of Selected Semi-Arid Regions and Agrobiodiversity to Climate Change in Armenia (2012). REC-Caucasus.				Partly	Partly	Reducing the Vulnerability of Georgia's Agricultural Systems to Climate Change. EBRD/WB.
	Partly	No	National Climate Vulnerability Assessment: Armenia (2014). Climate Forum East (CFE)				Partly	No	Vulnerability Assessment of Selected Semi-Arid Regions and Agrobiodiversity to Climate Change in Georgia (2012). REC-Caucasus.
Tourism							Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
							Partly	Partly	Georgia's Second National Communication to UNFCCC. GEF/UNDP. 2009
Transport, Infrastructure, Communication	Partly	No	Armenia's Third National Communication to the UNFCCC; UNDP/GEF, 2015.				Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
	Partly	No	National Climate Vulnerability Assessment: Armenia (2014). Climate Forum East (CFE).						
Human Health	Partly	No	National Climate Vulnerability Assessment: Armenia (2014). Climate Forum East (CFE).	Yes	No	Azerbaijan Second National Communication to the UNFCCC. GEF/UNDP. 2010.	Partly	No	National Climate Vulnerability Assessment: Georgia (2014). Climate Forum East (CFE) and Georgia National Network on Climate Change, 2014.
	Partly	No	Armenia's Third National Communication to the UNFCCC; UNDP/GEF, 2015.				Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
Natural Disasters	Yes	Partly	Mitigation of Climate Change Risks of Rural Communities Through Improved Local Development Planning: UNDP; Ongoing.	Partly	Partly	Azerbaijan Second National Communication to the UNFCCC. GEF/UNDP. 2010.	Yes	Yes	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
	Yes	Partly	Armenia's Third National Communication to the UNFCCC; UNDP/GEF, 2015.						
Physical Infrastructure	Partly	No	National Climate Vulnerability Assessment: Armenia (2014). Climate Forum East (CFE).	Partly	No	Azerbaijan Second National Communication to the UNFCCC. GEF/UNDP. 2010.	Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.
Cultural Heritage							Partly	Partly	Georgia's Third National Communication to the UNFCCC. GEF/UNDP. 2015.

A - Adaptation in development strategies **M** - Mountain regions

Note: No assessments in the industry.

* Yes - covers completely territory/sector ** Partly - cover territory/sector partly *** No - does not cover any

Financial barriers

The three countries of the South Caucasus, when compared to most European countries, have limited financial resources: Armenia's GDP is US$ 10.8 billion, Azerbaijan's US$ 75.2 billion and Georgia's GDP is US$ 16.5 billion (World Bank 2015); the financial gap is also exacerbated by the high inflation that affects all three countries. However, this does not mean that countries cannot consider different and innovative ways of reducing climate risks through knowledge sharing and leveraging the know-how of developed countries, or reviewing existing expenditures on different infrastructural projects in order to mainstream climate considerations into their implementation.

In addition, improvement in the coordination of existing actions (implemented with donor support) by the government will help to increase the efficiency of the response to climate change challenges.

Despite the fact that some of the countries have already started to allocate funds for adaptation measures, the share of resources spent on adaptation from national budgets is still low and insufficient.

Wildflowers in the Ismailli mountains, Azerbaijan

Coordination and monitoring of climate change adaptation

Coordination

Coordination mechanisms can be clustered in the following way: (a) intergovernmental councils (b) inter-ministerial/agency national councils, (c) government experts groups, (d) donor coordination mechanisms, (e) experts and stakeholder coordination groups, and (f) consultation mechanisms. A brief overview of coordination mechanisms within the countries is presented below (see also table):

(a) Intergovernmental councils – application of this mechanism in the South Caucasus remains challenging; however, there is a need for some sort of coordination of activities among the countries on climate change adaptation, which is acceptable to all the three counties, and which should be considered to ensure appropriate and feasible regional assessments.

(b) Inter-ministerial national councils – in two countries this mechanism of decision-making and coordination exists, and governments should further ensure its proper functioning.

(c) Government experts group – are created for implementation of particular projects or initiatives.

(d) Donor coordination mechanisms – this mechanism addresses environmental protection in general, for example, the one in Georgia is led by the EU Delegation in Georgia; however, such an approach to coordination is not feasible as it does not offer specific coordination mechanisms and is weakened by a lack of government backing.

(e) Expert and stakeholder coordination groups – these are present in all initiatives and projects, and some ministries do organise regular consultations with stakeholders; however, this mechanism cannot function properly within given non-institutionalised mandates and current ways of sharing information.

(f) Stakeholder consultation mechanisms – as mentioned above, relevant agencies should establish a system under which all interested stakeholders will be able to: a) receive advice and obtain vulnerability assessment methodologies; b) select the best available experts for different issues – this can be done through setting up a roster of experts (as has been done in Armenia where the names and contacts of experts are publicly available); and c) receive advice, within their mandate and interest, on areas where climate action is more appropriate. Establishment of this mechanism may require capacity building within governmental structures, as climate change offices do not currently have sufficient time nor capacity to implement this. Moreover, if this mechanism is to function properly, all other mechanisms described above, will require proper support to improve their functional efficiency.

Existence of Coordination Mechanisms on Climate Change (As described above)

	Armenia	Azerbaijan	Georgia
Intergovernmental councils	No	No	No
Inter-ministerial councils	Yes	Yes	No
Governmental experts group	No	No	No
Donors' coordination mechanisms	No	No	Yes
Expert and stakeholder coordination groups	Yes	Yes	Yes
Consultation mechanisms	No	No	No

Svaneti village, Georgia

Some of these mechanisms, where appropriate, should be applied at the municipal level to ensure overall efficiency and improved coordination of activities. Linkages and information exchange between all the abovementioned mechanisms is also vital.

Other means of coordination: The countries of the South Caucasus may take the same approach to coordination as the EU Climate Adaptation Platform (Climate-ADAPT 2015). However, government approval of tools and methodologies is important, as is the sharing of the data, studies, plans and assessments that are accepted by the relevant national authorities.

Monitoring

The monitoring of activities implemented is strongly linked with the enforcement of coordination mechanisms. Monitoring tools should be applicable, comprehensive and unified for all initiatives implemented. They should include both narrative and spatial monitoring instruments and be shared publicly, for example via web portal similar to Climate-ADAPT, described in section above.

All stakeholders involved in adaptation activities should share information with national governments using unified monitoring forms. This will facilitate the development of a comprehensive picture of climate change actions and the identification of gaps in national policies and practices.

Acronyms

ADA	Austrian Development Agency
AZN	Azerbaijani Manat
BMUD	Building and Nuclear Safety
BMZ	Federal Ministry for Economic Cooperation and Development
CAPS	Competitive Armenian Private Sector
CBD	Convention on Biological Diversity
CENN	Caucasus Environmental NGO Network
CEPF	Critical Ecosystem Partnership Fund
CSA	Climate Smart Agriculture
DRR	Disaster risk reduction
EBRD	European Bank for Reconstruction and Development
ENPI	European Neighborhood and Partnership Instrument
ENVSEC	Environment and Security Initiative
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FLEG	Forest Law Enforcement & Governance
GCM	General Circulation Model
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographical Information Systems
GLOF	Glacial Lake Outburst Floods
Ha	Hectare
IDP	Internally Displaced People
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IRMP	Integrated River Management Plans
KfW	German Development Bank
LEDS	Low emission development strategy
REC	Regional Environmental Center for Central and Eastern Europe
M.a.s.l	metres above sea level
MoA	Ministry of Agriculture of Georgia
MoNP	Ministry of Nature Protection of Armenia of the Republic of Armenia
MoENR	Ministry of Ecology and Natural Resources of the Republic of Azerbaijan
MoENRP	Ministry of Environment and Natural Resources Protection of Georgia
MoRDI	Ministry of Regional Development and Infrastructure of Georgia
N/A	Not available
NAMA	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Actions
NEAP	The National Environmental Action Plan
NGO	Non-Governmental Organization
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
OSCE	Organization for Security and Co-operation in Europe
RDS	Regional Development Strategies
SNC	Second National Communication to the UNFCCC
TNA	Technology Needs Assessment
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations Office for Disaster Risk Reduction
UNWTO	United Nations World Tourism Organization
USAID	United States Agency for International Development
USGS	U.S. Geological Survey
WB	The World Bank
WTTC	World Travel & Tourism Council
WWF	World Wide Fund for Nature

Notes

1. With some exceptions in Armenia where water supply is covered by Water Management Plans under development as required by legal provisions.
2. The recommendations have been proposed following consultations held at the Regional Stakeholder Meeting "Climate change and adaptation in the South Caucasus mountains", 29–30 September 2015, Tbilisi, Georgia. They do not necessarily reflect the views or policies of any governmental authority or institution.
3. Taking into account the respective political environment allowing for such an approach.
4. Armenia, Azerbaijan, Georgia, the Russian Federation, Turkey, and Iran.
5. Non-Annex I parties are mostly developing countries that have ratified or acceded to the UNFCCC but are not required to reduce their greenhouse gas emissions. The Convention was ratified by Armenia on 14 May 1993, by Azerbaijan on 16 May 1995, and by Georgia – 29 June 1994. The Kyoto Protocol was ratified by Armenia on 25 April 2003, by Azerbaijan on 28 Sept 2000, and by Georgia on 16 June 1999.
6. The climate in the Greater Caucasus ranges between cold-moderate mountain and high mountain meadow while the foothills are predominantly thermo-moderate and humid mountain. The climate in the Lesser Caucasus is predominately temperate semi-arid, temperate semi-humid and temperate arid mountain. The foothills are thermo-moderate and humid mountain and thermo-moderate-arid
7. Study does not include all glaciers in the region.
8. The estimation assumes no adaptation within a scenario of medium impact (Ahouissoussi *et al*. 2014).
9. Under the Medium Impacts Scenario, with assumption of no adaptation and no constraints on irrigation water (Ahouissoussi *et al*. 2014).
10. Under the Medium Impacts Scenario, with assumption of no adaptation and no constraints on irrigation water (Ahouissoussi *et al*. 2014).
11. Under the Medium Impacts Scenario, with assumption of no adaptation and no constraints on irrigation water (Ahouissoussi *et al*. 2014).
12. Under the Medium Impacts Scenario, with assumption of no adaptation and no constraints on irrigation water (Ahouissoussi *et al*. 2014).
13. The reduction in river flow is expected to continue to a reduction of 25 per cent by 2070 and 40 per cent by 2100 (MoNP 2015).
14. Previous collective farming in Georgia.
15. (Decree No. 276, dated 19 February 2009)
16. Georgia´s share of total primary energy supply in 2013 was natural gas: 35.6 per cent, oil: 25.3 per cent, hydro: 18.3 per cent, biofuels/waste 12.4 per cent, geothermal/solar/wind 0.4 per cent, coal 8.1 per cent.
17. Azerbaijan´s share of total primary energy supply in 2013 was natural gas 65.0 per cent, hydro: 0.9 per cent, oil: 33.0 per cent, biofuels/waste 1.1 per cent.
18. Armenia´s share of total primary energy supply in 2013 was gas: 62.2 per cent, nuclear: 20.5 per cent, hydro: 6.2 per cent, oil 10.8, biofuels/waste 0.3 per cent.
19. Azerbaijan-2020: Look to the future Development Conception (President of Azerbaijan n/a); State Programme on poverty reduction and sustainable development (2008–2015) (President of Azerbaijan 2008a); State Programme on Ensuring Reliable Food Provision to Population (2008–2015) (President of Azerbaijan 2008b)
20. Regional development strategy of Azerbaijan (2014–2018) was disregarded in this analysis, as it has no reference neither to climate change adaptation or other relevant issues, nor to mountain regions
21. Programme documents have more concrete character and usually envisage specific funding allocation per measure indicated.
22. Report on the project "Management plan for South water basin of Armenia", USAID, Armenia, July 2015.

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