

Climate Change in Southern Caucasus:

Impacts on nature, people and society



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Contents

1. Executive Summary	3
2. Introduction	5
3. Caucasus: A unique and diverse region with troubled history	7
4. Current and future impacts of climate change in Southern Caucasus	10
5. Conclusions with Strategic recommendations	32
6. List of contributors	34

1. Executive Summary

Climate change has already started to have a significant impact on nature and people in the Southern Caucasus region – effects that will become even more severe in the future. This will create an extra burden on the development of societies in all the three countries of Armenia, Azerbaijan and Georgia, which still struggle to embark on a more sustainable path, including eradicating widespread poverty. Climate change also poses an additional risk for the political stability of the region.

The purpose of this report is to summarise current and future impacts of climate change in Armenia, Azerbaijan and Georgia in the Southern Caucasus region and to provide a perspective of climate change in relation to sustainable development - especially poverty and the Millennium Development Goals (MDGs), biodiversity, energy production, and political security. In addition, the national and international response in relation to each of the issues was reviewed.

The Southern Caucasus region is globally significant with a rich diversity of both cultures and biological values. After the collapse of the Soviet Union the countries went through a difficult transition period with a dramatic drop in economy and with social and political restructuring. At the same time, the region was hounded by armed conflicts leading to displacement of hundreds of thousands of people. These conflicts still hamper the overall development of the region. Despite successes in terms of macro-economic development during the last ten years, all three countries still show high levels of poverty. The Human Development Index falls within the mid-range of countries in the world, and the GDP per capita is still low, particularly from a European perspective. Whilst the industrial and service sectors are slowly recovering, agricultural output has stagnated or even declined, which creates socio-economic challenges in rural areas where most people still live. Deforestation is a problem mainly in Armenia and Azerbaijan. All three countries still suffer from the lack of access to safe drinking water and water shortage is a particular problem in Azerbaijan and Armenia, where Azerbaijan has very high water consumption per capita.

With regard to climate change, the Southern Caucasus region already shows climate induced changes with increasing temperatures, shrinking glaciers, sea level rise, reduction and redistribution of river flows, decreasing snowfall and an upward shift of the snowline. More extreme weather events have also characterized the last ten years with flooding, landslides, forest fires and coastal erosion with significant economic losses and human casualties as a result. Reported damages due to flooding, frost and drought in the three countries amounted to more than US\$ 175 million, and from the Azerbaijan part of the Caspian Sea, more than US\$ 2 billion of damages from coastal erosion and flooding were reported during a 20-year period. The current trends in the region will continue with large-scale changes of ecosystems in both lowlands and mountains and negative impacts on economic activities, especially agriculture and food production, but also health further aggravated.

On the issue of biodiversity and climate change, many species in the Southern Caucasus with specialised habitat requirements will likely decline. Particularly vulnerable are species dependent on alpine habitats in the Lesser Caucasus where the amount of living space will dramatically reduce, and species confined to already fragmented habitats like

wetlands will suffer. Species already facing threats from other human activities like livestock grazing in arid lowland areas will also experience problems to cope.

Through increasing temperature, decreasing water availability, increased damage from floods and storms, sea level rise and associated coastal erosion, climate change will no doubt put a challenge to the future development in the Southern Caucasus. To reduce impacts will require the enhancement of ecosystem resilience and the introduction of specific climate adaptation measures with regard to water management, land use, food production, coastal management and health. Some initial estimates from Azerbaijan indicate adaptation costs well above US\$ 3 billion. However, in contrast to many other countries in the world, no National Adaptation Programmes of Action (NAPAs) have yet been established in these countries. Furthermore, climate change has not been adequately integrated into the MDGs, including the associated Poverty Reduction Strategy Papers. Some initial efforts have been made to integrate climate change issues into other policies, mainly for risk prevention and to reduce disasters, but a more comprehensive inclusion of climate change aspects into sustainable development is still lacking. In particular, climate adaptation is a key topic in relation to all three pillars - the economic, ecological and social dimensions - of sustainable development. Only by addressing climate aspects simultaneously in relation to all three dimensions can the prospect of creating a more sustainable society in the future be enhanced.

The three Southern Caucasus countries show a rather different energy profile, with Azerbaijan consuming mainly its oil and gas resources, Georgia relying on hydropower production, and Armenia with a more diversified supply system of hydro and nuclear power. All three countries have embarked on the development of renewable energy resources supported by many international agencies, but only a few projects have actually started. Of the three countries, Armenia plans the largest investments in geo-thermal and wind power generation and also to reduce overall GHG emissions.

In addition to investments improving the energy efficiency and the introduction of renewable energy sources, the Clean Development Mechanism (CDM) under the Kyoto Protocol provides a financial tool for mitigation measures in the Southern Caucasus region, although implementation of the first CDM projects in Armenia, Azerbaijan and Georgia has only just begun. The identified priorities include improvement of heat and hot water distribution systems, energy efficiency measures in industrial production, small hydropower stations, wind farms, landfill gas capture, biogas and improvement of transport systems. So far, very little attention has been given to carbon sequestration projects, such as reforestation and afforestation schemes, although - due to increased deforestation particularly in Armenia and Azerbaijan - the forest ecosystems are gradually losing their functions as carbon sinks. Financing of such projects could also have a dual advantage – reducing carbon emissions at the same time as improving the climate adaptation capacity of nature. Also in terms of climate adaptation, almost no projects or investments have started despite the huge and increasing needs. The ideas and principles of the global Forest Carbon Partnership Facility launched in late 2007 could also well apply to the Southern Caucasus region, although the three countries do not qualify for any financial support. In several instances, the three Southern Caucasus countries are also not eligible for international funding support through funding mechanisms established under auspices of the UN Framework Convention on Climate Change, UNFCCC – a gap that should urgently be addressed by the international community. There is also important role

for the petroleum industry – both domestic and foreign – to support the climate change agenda in the region.

Climate change is also a key strategic issue also in terms of political security. Through impacts such as droughts, water scarcity and soil degradation, climate change could exacerbate already existing conflicts leading to greater instability. The Southern Caucasus shares this feature with many other security “hot spots” of the world. Based on strategic recommendations provided by the German Advisory Council on Global Change (WBGU), the Southern Caucasus countries need to pay particular attention to adapting water resource management and agriculture/food production to climate change, strengthening disaster prevention, and conserving the terrestrial carbon stocks (particularly forests). To incorporate climate adaptation in the management of the Kura-Aras/Araks River Basin is particularly important for the future stability and well-being of the region, including northern Iran.

A number of recommendations for national governments, the international community, and the wider civil society, including corporate sector, are provided. At the national level, it is proposed to mainstream climate change into Poverty Reduction Strategies and Sustainable Development initiatives. Since climate change is still largely unknown in the wider society, much more efforts are required to reach out to media and to mainstream the messages in main communication efforts – such as through national “Stern Reports” - and through education. Other measures include the development of National Adaptation Programmes of Action (NAPA) with the participation of the wider society, launching climate adaptation pilot projects in climate ‘hot spots’, fund land use related CDM projects, and invest much more in innovative, renewable energy solutions with the aim of reducing Greenhouse Gas Emissions. To meet the international commitments vis-à-vis the Convention on Biological Diversity, it is also important to introduce climate adaptation when planning, designing and implementing protected areas and species programmes.

The international community needs to significantly step up funding and coordination of climate mitigation and adaptation measures in the Southern Caucasus region. With the current lack of support of climate adaptation measures in the region, it is proposed to boost the work through the establishment of a special “Climate Adaptation Facility for Southern Caucasus”. Other recommendations include mainstreaming climate adaptation into bilateral and multilateral support to poverty reduction, natural resource management and humanitarian aid, including disaster prevention, and to develop a regional climate adaptation strategy for water management of the Kura-Aras/Araks river basin. It is also proposed to secure the “terrestrial carbon stock” by investing in an existing “Caucasus Protected Areas Fund”, and to undertake a vulnerability and risk assessment on climate change in relation to political security with recommendations on preventive measures in identified ‘hot spots’.

Finally, for the wider civil society including corporate sector, it is proposed that the national and international petroleum industry invests in climate mitigation and adaptation activities.

2. Introduction

The urgency of addressing climate change has recently been fully recognized as an essential part of the wider human development and global political agenda. Climate change is no longer seen as solely an environmental problem. The 2007/2008 Human Development Report¹, for example, focuses its attention on climate change and forecasts that climate change will “undermine the international efforts to combat poverty” unless precautionary and urgent measures are taken.

The Human Development Report concludes that climate change is “hampering the efforts to deliver the MDG promise”. The Millennium Development Goals were adopted by the International community in September 2000 as an attempt to alleviate poverty by 2015 and their aim is to:

- 1) eradicate extreme poverty and hunger,
- 2) achieve universal primary education,
- 3) promote gender equality and empower women,
- 4) reduce child mortality,
- 5) improve material health,
- 6) combat HIV/AIDS and other diseases,
- 7) ensure environmental sustainability, and
- 8) develop a global partnership for development.

“Climate change is the greatest challenge facing humanity at the start of the 21st century. Failure to meet that challenge raises the spectre of unprecedented reversals in human development.”

UNDP Human Development Report 2007/2008

With this perspective in mind, a study was undertaken to summarise current and future impacts of climate change in Armenia, Azerbaijan and Georgia in the Southern Caucasus region and to provide a perspective of climate change in relation to sustainable development – especially the MDGs, biodiversity, energy production, and political security together with the national and international response in relation to each issue. At the end, a response framework was developed outlining a number of potential actions at the national, regional and international level.

To start with, the report provides a more general overview of the Southern Caucasus region – some of the outstanding values, a summary of political and socio-economic changes after the collapse of the Soviet Union - followed by a more in-depth analysis of the efforts made in Armenia, Azerbaijan and Georgia to address sustainable development with the focus on MDG 7; this will serve as a basis for the rest of the report focusing on climate change.

The information presented is based on a review of published reports and interviews of people from governments, international institutions and civil society organisations in Armenia, Azerbaijan and Georgia during the period 31 October to 9 November 2007 (see section 6). References are provided throughout the document in the form of footnotes.

¹ “Human Development Report 2007/2008, Fighting climate change – human solidarity in a divided world”, UNDP 2007

3. Caucasus: A unique and diverse region with troubled history

3.1. Geography and nature

Southern Caucasus lies on the isthmus between the Black Sea and the Caspian Sea, with the greater Caucasus mountain range as the northern demarcation and the smaller Caucasus Mountains as a southern one. The region spans from the subtropical forests of the south-east Black Sea coast to the high peaks of Greater Caucasus and steppes and semi-deserts of the lowland east.

The Caucasus is ranked by Conservation International as one of the planet's 25 most diverse and endangered biodiversity hotspots. The region is rich in old growth forests with carbon stocks in forest mass of 296 million tons (Mt) CO². Caucasus is a biological 'crossroads', where animal and plant species from Europe, Central Asia and the Middle East mingle with a large number of endemic species. The varied topography allows for an unusually large number of climates and nature types in such a limited area. Over 6,500 species of vascular plants are found in the Caucasus, at least a quarter of them unique to the region – the highest level of endemism in the temperate world. The Caspian, Azov and Black Seas hosts seven species of the rare sturgeon, much valued for its caviar they. Europe's last big cat, the highly threatened Caucasus leopard, still roams in southern Armenia and Azerbaijan.

The region is also a globally significant centre of cultural diversity, where a multitude of ethnic groups, languages, and religions intermingle over a relatively small area.

All three countries of the region suffer from degradation or non-sustainable use of natural resources. Deforestation and desertification pose significant challenges in Armenia and Azerbaijan, while all three countries suffer from land degradation (overgrazing, soil pollution, and erosion). Azerbaijan suffers from water shortages (consuming 2.000 m³ per year per capita, almost three times as much as the Georgian average consumption), while the population of both Armenia and Georgia lack access to safe drinking water in certain areas. In terms of consumption of resources both Armenia and Azerbaijan live beyond their ecological means.² CO²-emissions are still significantly below 1990-levels, due to the significant economic setback in the 1990ies, with Armenia in 2004 emitting 3.6 Mt (1.2 ton/capita), Georgia 3.9 Mt (0.8 ton/capita) and petroleum producing Azerbaijan 31.3 Mt (3.8 ton/capita).³

3.2. Economy, politics and development

After the collapse of the Soviet Union in 1990 and the following independence of Georgia, Armenia and Azerbaijan, the traditional economic ties were broken and the new states began the transition from planned to market economies. The three Southern Caucasus countries underwent a similar development with a dramatic drop in the economy, social and political restructuring, and embarked on the difficult path of building new societies.

² Living Planet Index.

³ UNDP: Human Development Report 2007/2008. The average emissions of high income OECD countries are 13.2 ton per capita.

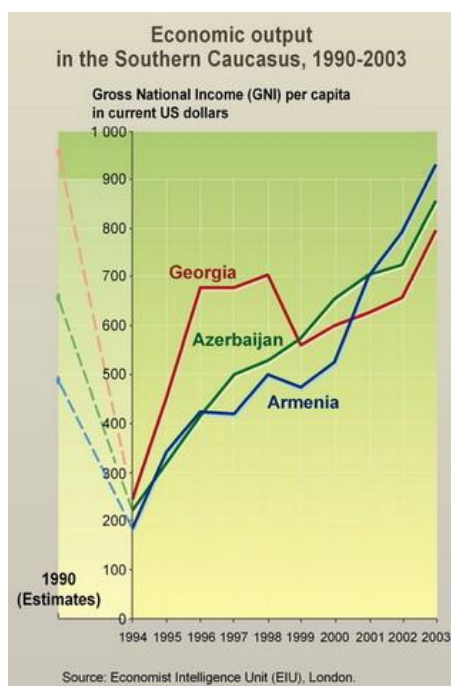


Fig 1. GNI per capita in Southern Caucasus 1990-2003. Source: UNEP/GRID-Arendal.

Although the three countries share a recent history, they have developed in partly different directions since 1990/91 depending on their specific political, socio-economic and natural situation.

In terms of the UN global Human Development Index of 2005, all three Southern Caucasus countries belonged to the Medium Development Countries with Armenia ranking highest (83) followed by Georgia (96) and Azerbaijan (98). All three countries are low income countries, both in a regional (Central and Eastern Europe and the Commonwealth of Independent States) and world perspective.

Table 1. Ranking of Armenia, Azerbaijan and Georgia in relation to some other countries in terms of UN Human Development Index of 2005.

Country	Human Development Index Value 2005 ⁴	HDI Rank 2005	GDP Per Capita (PPP US\$) 2005	Poverty Rate (% below 2 US\$/day) 2002 ⁵	Poverty Rate (% below 4 US\$/day) 2000-04
Armenia	0.775	83	4,945	31.3	80.5
Azerbaijan	0.746	98	5,016	33.4	85.9
Georgia	0.754	96	3,365	25.8	61.9
CEE and CIS	0.808		9,527		
Medium Human Development	0.776		4,876		
World	0.743		9,543		

⁴ Human Development Report 2007/2008, Fighting climate change – human solidarity in a divided world”, UNDP 2007

⁵ “Policies for a Better Environment: Progress in Eastern Europe, Caucasus and Central Asia”. OECD, 2007

Although each of the three countries have showed a remarkable economic recovery, the GDP per capita growth in the South Caucasus region during the last 15 years is rather insignificant⁶. In terms of sectors, the biggest growth is seen by industry and the service sector whilst the agriculture sector has become almost stagnant – or even declined (in Georgia). In that respect, the South Caucasus region demonstrates a similar pattern to most other countries in Southeast and Eastern Europe and Central Asia. The share of agriculture in the total economy has also diminished. These structural changes and economic constraints make it difficult for the countries of Southern Caucasus to rapidly improve their performance to meet the targets of the MDGs, including the environment.

With regard to environmental sustainability (see table 2 below), all three countries suffer from land degradation. Desertification is a problem in Armenia and Azerbaijan. Access to safe drinking water provides a challenge to all three countries. In terms of water consumption, Azerbaijan and Armenia currently abstract 40-60% of the available resources whilst Georgia, with a much richer supply, less than 10%⁷. Azerbaijan also shows the highest per capita consumption of the three (2.000 m³ per year) followed by Armenia (960 m³ per year) and Georgia (697 m³ per year). Based on the Living Planet Report 2006⁸, both Armenia and Azerbaijan live beyond their ecological means (“ecological debtor countries”) in contrast to Georgia, which show an ecological reserve (“ecological credit country”). Together, carbon dioxide from fossil fuels, croplands and grazing land account for more than 90% of the ecological footprint.

Table 2. The main environmental challenges related to climate change in Armenia, Azerbaijan and Georgia.

Country	Main environmental challenge
Armenia ⁹	Deforestation & illegal logging Desertification Use of solid fuels Access to safe drinking water in rural areas Management of Lake Sevan
Azerbaijan ¹⁰	Deforestation Desertification and land degradation Deteriorating air quality Water shortage & insufficient water sanitation
Georgia ¹¹	Land degradation (overgrazing, soil pollution and erosion) Illegal logging Regional water shortage (particularly in eastern regions) Lack of access to safe drinking water

⁶ Sustainable consumption and production in South East Europe and Eastern Europe, Caucasus and Central Asia, Joint UNEP-EEA report on the opportunities and lessons learned, UNEP and EEA 2007

⁷ Europe’s Environment, the Fourth Assessment, European Environment Agency 2007

⁸ Living Planet Report 2006, WWF, Zoological Society of London and Global Footprint Network 2006

⁹ Millennium Development Goals: Nationalization and Progress, National Report 2005, Armenia

¹⁰ State Programme on Poverty Reduction and Economic Development 2003-2005, Azerbaijan Progress Toward the Achievement of the Millennium Development Goals, Progress Report 2003/2004, Baku 2005

¹¹ “Millennium Development Goals in Georgia”, Government of Georgia and UNDP, 2004

To summarise, the Southern Caucasus region is globally significant with a rich diversity of both cultures and biological values. After the collapse of the Soviet Union the countries went through a difficult transition period with a dramatic drop in economy and social and political restructuring. At the same time, the region was havocked by armed conflicts leading to displacement of hundreds of thousands of people. These conflicts still hamper the overall development of the region. Despite successes in terms macro-economic development during the last ten years, all three countries still show high levels of poverty. The Human Development Index of 2005 falls within the mid-range of countries in the world, and the GDP per capita is still low, particularly from a European perspective. Whilst the industrial and service sectors are recovering, agricultural output has stagnated or even declined, which creates socio-economic challenges in rural areas where most people still live. Deforestation is a problem mainly in Armenia and Azerbaijan. All three countries still suffer from the lack of access to safe drinking water and water shortage is a particular problem in Azerbaijan and Armenia, where Azerbaijan has very high water consumption per capita.

4. Current and future impacts of climate change in Southern Caucasus

4.1. Climate patterns

The climate in the Southern Caucasus varies vertically and horizontally. Precipitation decreases from west to east and mountains generally receive higher amounts than low-lying areas. The absolute maximum annual rainfall is 4100 mm around the Mt. Mtirala in south-west Georgia (Adjara region), whilst the rainfall in southern Georgia, Armenia and western Azerbaijan varies between 300 and 800 mm per year. Temperature generally decreases as elevation rises. The highlands of the Lesser Caucasus Mountains in Armenia, Azerbaijan and Georgia are marked by sharp temperature contrasts between summer and winter months due to a more continental climate.

The Caucasus Mountains are known for a high amount of snowfall. The Greater Caucasus Mountains (especially south-western slopes) are marked by heavy snowfall and avalanches are common from November to April. Snow cover may reach 5-7 meters in several regions of the western part of the Greater Caucasus, such as northern Abkhazia region in Georgia. The Lesser Caucasus Mountains are somewhat isolated from the moist influences coming from the Black Sea and therefore receive considerably less snow precipitation than the Greater Caucasus Mountains. The average winter snow cover in the Lesser Caucasus Mountains ranges from 10-30cm.

The following information is, to a large extent, derived from the First National Communication Reports from these countries to the UN Framework Convention on Climate Change - Armenia 1998¹², Georgia 1999¹³, and Azerbaijan 2001¹⁴. All three countries are

¹² “First National Communication of the Republic of Armenia under the United Nations Framework Convention on Climate Change”, October 1998.

¹³ Georgia’s initial national communication under the United Nations Framework Convention on Climate Change, Tbilisi 1999

¹⁴ Initial Nation Communication of Azerbaijan Republic under the United Nations Framework Convention on Climate Change, Baku 2000

currently working on their second National Reports, with funding from GEF/UNDP, and which are expected to be ready within the next 1-2 years.

4.2. Current impacts of climate change

Changes in temperature and perspiration patterns

The Southern Caucasus region already shows climate induced changes with increasing temperatures, shrinking glaciers, sea level rise, redistribution of river flows, decreasing snowfall and an upward shift of the snowline. The climate of the Southern Caucasus region is changing.

In Armenia, the average temperature increased by 0.4 °C between 1935 and 1990, and in Azerbaijan by 0.5 to 0.6 °C since 1880s - with the highest registered temperatures during the last 10 years.¹⁵ In Georgia, since 1906 the mean annual air temperature has increased in the eastern part of the country, whilst it has actually decreased in the west, including in the Greater Caucasus Mountain areas (Fig. 2).

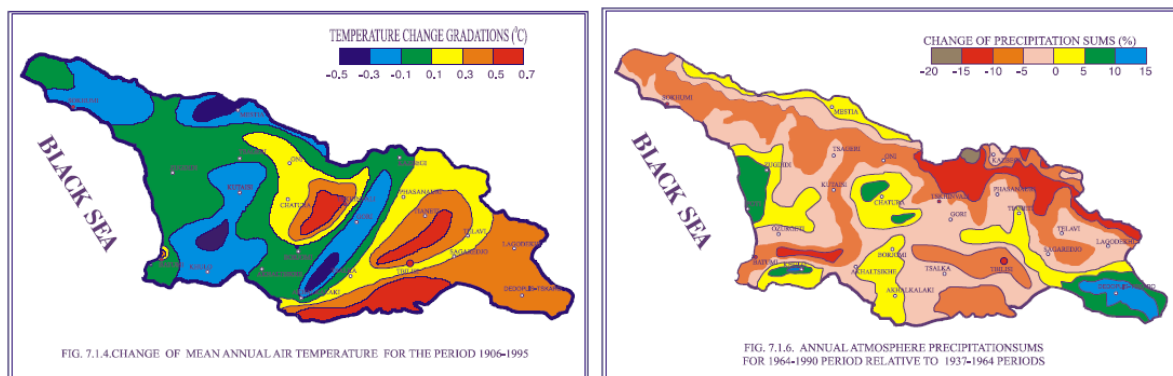


Fig. 2 (left): Change of mean annual temperature in Georgia 1906-1995 (Taghieyeva: 2006).
 Fig. 3 (right): Georgia, annual precipitation 1964-1990 relative to 1937-1964 (Taghieyeva: 2006).

Regional differences are also reported from Azerbaijan with the highest temperature increase in the Greater Caucasus and Kura-Aras lowlands, and from Armenia with the warmest regions in the Ararat lowlands and in a belt stretching from the border of Georgia south-east to Lake Sevan. Studies from Azerbaijan demonstrate reduction and redistribution of river flows. During the last decades, the share of snow alimention has rapidly decreased and the seasonal snow line has risen) from 1,300-1,500 meters to 1,800-2,000 meters.

Precipitation has decreased by 6% in Armenia from 1935 to 1996, but only “insignificantly” in Azerbaijan. In Georgia the changes in rainfall vary significantly in different parts of the country (Fig. 3) and the same is reported from Armenia.

Studies from Azerbaijan also demonstrate the reduction and redistribution of river flows. During the last decades, the share of snow alimention has rapidly decreased and the seasonal snow line has risen from 1,300-1,500m a.s.l. to 1,800-2,000m a.s.l.

¹⁵ “Problems of forecasting: The key natural hydrometeorological phenomena affects ecological safety of the South Caucasus in the context of Azerbaijan”, Umayra Taghieyeva, National Hydrometeorological Department, Republic of Azerbaijan, 2006

The glaciers of the Caucasus are melting rapidly, in accordance with the global trend (Fig. 4 and 5). During the last century, the glacial volume in the Caucasus declined by 50%.¹⁶ In a recent study, it was shown that 94% of the glaciers had retreated up to 38 m/year.¹⁷ In the Georgian part of the Greater Caucasus, the glaciers currently retreat by 5 to 10 metres per year, with a maximum value of 25 m/year.¹⁸



Fig. 4 and 5: The glaciers of Caucasus are melting rapidly; the Labola Glacier, Georgia, 1972 (left) and 2002 (right). Source: Professor Ramin Gobejishvili, Institute of Geography, Tbilisi University, Georgia.

The rapid melting of glaciers creates a shorter-term abundance of water, but also generates big ice-rock avalanches. The most published case is from the southern part of Russian Caucasus, where an avalanche sheared off almost the entire Kolka Glacier and devastated the Genaldon valley and burying the town of Karmadon in September 2002 (Fig. 6).

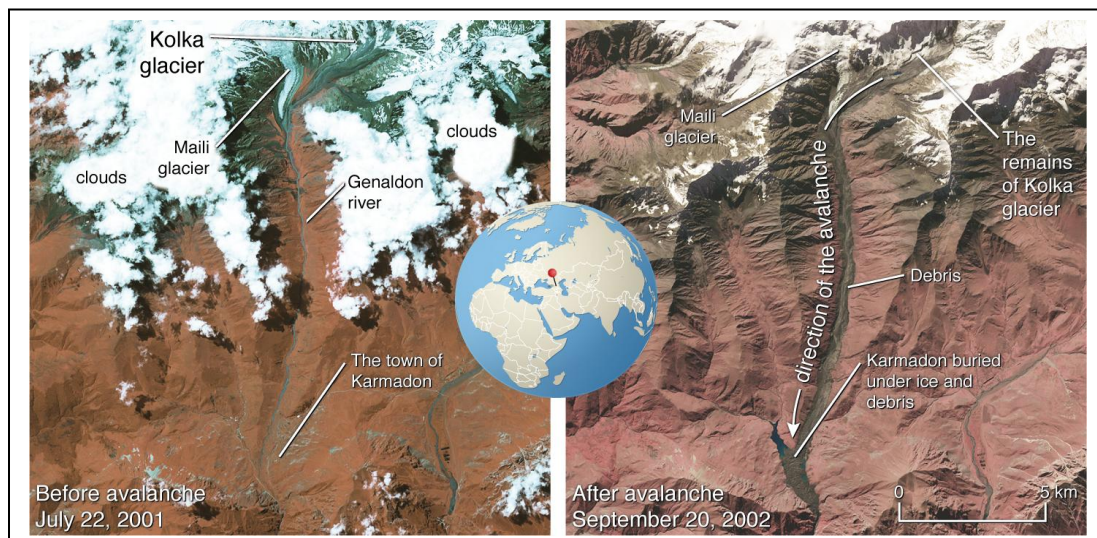


Fig. 6: The avalanche in Genaldon valley, Russian Caucasus, September 2002. Source: UNEP/GRID-Arendal.

Socio-economic and environmental problems of the Caspian Sea have evolved as a result of development of natural resources in the sea and in coastal areas. These problems have been aggravated by fluctuations of the sea, which have recently been influenced by global climate change impacts on river flow. During 1978-95, the river flow increased by 10-11% which, in

¹⁶ Ice melt indicators published by the Earth Policy Institute (see: www.earth-policy.org).

¹⁷ « Late 20th century changes in glacier extent in the Caucasus Mountains, Russia/Georgia », C.R. Stokes, S.D. Gurney, M. Shahgedanova and V. Popovnin, *Journal of Glaciology* (52): 99-109, 2006.

¹⁸ Professor Ramin Gobejishvili, Vakhusti Bagrationi Geographic Institute, Tbilisi.

turn, contributed to a 2.5 m rise in sea level. During this period, 485 km² of Azerbaijan's coastal area have been flooded, leading to coastal erosion and economic losses estimated to about US\$ 2 billion¹⁹.

More extreme weather events

More extreme weather events have characterized the weather in Southern Caucasus the last ten years, which have led to flooding, landslides, forest fires and coastal erosion with significant economic losses and human casualties as a result.

Rainfall has shown a far more irregular pattern with heavy downpour, often leading to flooding and large economic losses. In July 1997, for example, 30% of Azerbaijan was flooded when half of the annual rainfall occurred within four days, causing the loss of 15 people and economic losses of US\$ 50 million. It is estimated that these kinds of events now cost Azerbaijan US\$ 70-80 million annually. In the Kura-Aras river basin, mainly situated in Azerbaijan, more than 300,000 people are considered to live in a risk zone.²⁰

In April/May 2005, heavy rainfall, warm temperatures and a sudden onset of the seasonal snow melt resulted in extensive flooding across large parts of Georgia, including landslides and mudflows in many mountain areas.²¹ The natural disaster destroyed infrastructure and homes, and created problems in terms of health, sanitation, food and water. Within a few days, the event generated around US\$ 1 million in international aid from more than 10 countries, UNDP, USAID, and UNICEF. The costs for an appropriate follow-up were estimated at millions of US\$.

In Armenia, between 2000 and 2005, the following climate related economic losses were reported in the agriculture sector: drought causing losses of 67 million US\$ (10% of gross agriculture product), frost damage to fruit production and viticulture causing losses of 25 million US\$, and impacts of hail, floods and frost on crop yields effecting losses of 15 million US\$. In addition more than 30,000 ha of the Ararat Valley (Armenia's most valuable farm land) was reported to be at risk from salinisation.²²

¹⁹ Initial National Communication of Azerbaijan Republic under the United Nations Framework Convention on Climate Change, Baku 2000

²⁰ "Problems of forecasting: The key natural hydro-meteorological phenomena affects ecological safety of the South Caucasus in the context of Azerbaijan", Umayra Taghiyeva, National Hydro-meteorological Department, Republic of Azerbaijan, 2006.

²¹ Flooding in Georgia: An Overview of Needs and Assistance Actions, Disaster Management Team, 10 May 2005.

²² "Climate change impacts on Armenian agriculture: vulnerability and adaptation assessment measure", Climate Change Information Center of Armenia

Table 3. Summary of reported economic losses linked to climate change in Southern Caucasus 1978-2007. The list should merely indicate the scale of the costs related to climate change in the region.

	Year	Cause	Cost
Azerbaijan	July 1997	Floods/erosion	50 million US\$
Azerbaijan	2000-2007	Floods and erosion (est. 70 mill/year)	490 million US\$
Georgia	May 2005	Floods/erosion (low estimate)	3 million US\$
Armenia	2000-2005	Drought, frost, floods on agriculture	107 million US\$
Armenia	Sept 2006	Drought/forest fires	9 million US\$
Azerbaijan	1978-1995	Caspian Sea, floods and coastal erosion	2000 million US\$
Sum			2659 million US\$

Malaria is back

Climate-related impacts on health have also emerged. In Armenia, malaria was exterminated in 1960 but reappeared after 1996 and is currently increasing.²³ Also in Georgia, the first cases of malaria were detected in 1996 and between 1998 and 2002 the number of cases increased 30-fold.²⁴ An alarming upsurge in malaria in Azerbaijan also occurred during the mid-1990s with more than 13,000 cases reported in 1996. Although the situation with malaria since then has been brought under control, increasing risks due to climate change impacts on water resources in particular are looming. Also other infectious diseases such as Crimean hemorrhagic fever and acute intestinal diseases are likely to spread as a result of the climate change.²⁵

4.3. Future impacts of climate change

According to the UN Intergovernmental Panel on Climate Change's (IPCC) forecasts²⁶, the Southern Caucasus lie within a belt where the average temperature is expected to increase between 2 and 4°C until the end of the century. Model projections carried out by government institutions in the region breaks this down by country as follows: Georgia: 1-1.5°C by mid-century (where western parts may become colder), Armenia: 1.7°C by 2100²⁷, Azerbaijan: 4.1-5.8 °C by 2100.

IPCC also predicts that precipitation will decline in the Southern Caucasus region between 10 and 20% by the end of the century (Fig. 7 and 8). The national estimates for Armenia are a 10% decline and for Azerbaijan a decrease of up to 19% (with more rainfall in winter and less during summer). At present, forecasts for Georgia only exist at the regional level.

²³ Mrs. Diana Harutyunyan, UNDP Climate Change Annual Work Plan Manager, Ministry of Nature Protection

²⁴ Roll Back Malaria Monitoring and Evaluation Fact Sheet for Georgia, WHO, April 2005

²⁵ Russia and neighbouring countries: environmental, economic and social impacts. WWF Russia, Oxfam, 2008.

²⁶ Climate Change 2007: The Physical Science Basis, Summary for Policy Makers, IPCC, February 2007.

²⁷ Consequences of climate change in Armenia, Climate Change Information Center of Armenia (www.nature-ic.am)

Projected Patterns of Precipitation Changes

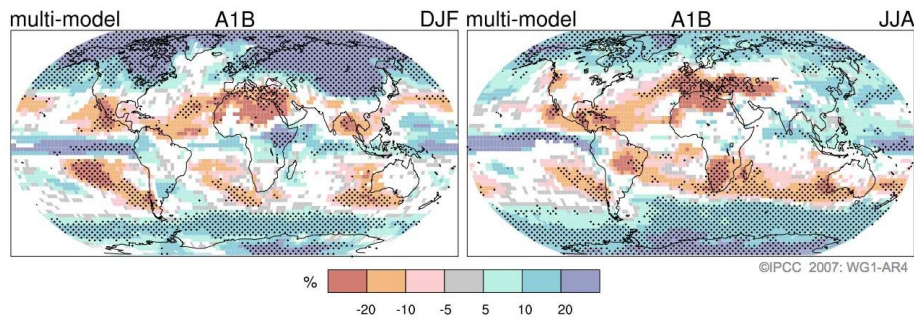


Fig. 7. Projected changes of precipitation until the end of the century (source: IPCC 2007)

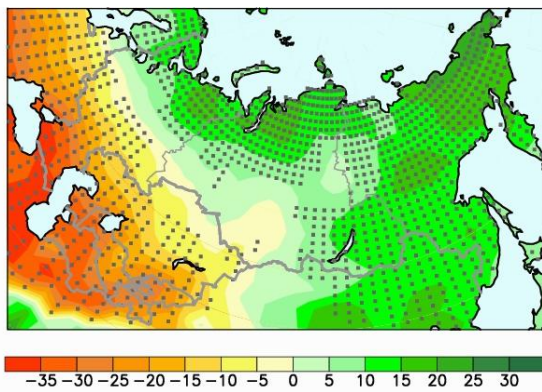


Fig. 8. Precipitation changes in the summer by the end of the 21st century, for A2 emission scenario. The stippling indicates areas where at least 2/3 of 16 models agree on the sign of change²⁸.

The First National Communication Reports also provide some interesting forecasts for each of the three countries on the potential impact of climate change on ecosystems, natural resource production and economy, which are summarized below. The forests and alpine ecosystems will show a significant altitudinal shift upwards, semi-desert and desert areas will expand, river flows decline, and agriculture production and livestock breeding will suffer significantly. The eastern part of the region will be most impacted, especially Azerbaijan.

²⁸ Climate Change Projections and impacts in Russian Federation and Central Asia countries. Report No.1: Climate Change projections for Russian Federation and Central Asia. 2008.

Table 4. Climate change impact on the ecosystems and natural resource use in Armenia, Azerbaijan and Georgia.

Country	Ecosystem Impacts	Natural Resource Use
Armenia ²⁹	<ul style="list-style-type: none"> • Altitudinal shift of alpine zone 100-150 m and 21% reduction • 30% expansion of semi-desert and desert areas • 4% expansion of steppe belt and upward shift by 150-200 m • Forest belt will move upward 100-200 m • Annual river flow will decline by 15% • 13-14% increased evaporation from surface of Lake Sevan 	<ul style="list-style-type: none"> • 8-14% reduction of plant cultivation efficiency • 9-13% reduction of cereal production • 7-14% reduction of vegetable output • 8-10% reduction of potato production • 5-8% reduction of fruit production • 30% reduction of livestock • 19-22% less pastures in the sub-alpine and alpine belts • 7-10% decrease of mountain hay production
Azerbaijan ³⁰	<ul style="list-style-type: none"> • Extension of semi-desert and dry steppe areas will increase by 2.4 to 3.4 times • 10-15% increased erosion • 10-20% decrease of river flow • Reduced rainfall during spring and summer and increases in autumn and winter • Changes in precipitation may increase the current water deficit from 5 km³ to 11-13 km³ • 10-15% increased salinisation in the Kura-Araz lowlands 	<ul style="list-style-type: none"> • With regard to the fisheries in the Caspian Sea, only the spawning terms will change • Since 80% of the agriculture is produced within the arid and semi-arid parts and more than 80% of the output come from irrigated land, food production will face significant problems
Georgia ³¹	<ul style="list-style-type: none"> • With increasing temperatures in the Eastern part, desertification and degradation of steppe ecosystems are expected in the lowlands • Altitudinal shift upwards of forests in the Eastern part of the Greater Caucasus by 150-180 m, which will reduce the alpine vegetation zone • 150-200 m upward shift of ecosystems in South Georgia at the expense of certain forest types and alpine systems • Altitudinal change of the relict Colchic forest ecosystems in SW Georgia and expansion of Mediterranean types in the lowlands • Expansion of introduced and invasive species in a belt from the west to the east across the country 	<ul style="list-style-type: none"> • Due to decreasing rainfall and increasing temperatures in Central and Eastern Caucasus, substantial degradation of agriculture land and alpine pastures • With an increasing water runoff of 4-7% an extra 340 million kWh could be generated through hydro power production due to more favourable climate conditions in Western Georgia • Due to more favourable climate conditions in Western Georgia, tea and maize production could increase (maize with up to 30-40%) • In Eastern Georgia, with decreasing rainfall and increasing temperatures, wine (minus 10-15%) and cereal (minus 30-60%) production is expected to decrease

IPCC has also assessed the impacts of temperature increase on water, ecosystems, food, coasts, and health (Fig. 9).³² The assessment shows that already from an increase of 1-2 degrees, we see significant detrimental effects relevant for the Southern Caucasus; decreasing water availability and increasing droughts in mid-latitudes and semi-arid low latitudes, up to 30% of species at increasing risk of extinction due to increased stress and species range shifts, increasing wildfire risks, negative impacts on subsistence farmers and fishers, tendencies

²⁹ Consequences of Climate Change in Armenia, Climate Change Information Center of Armenia

³⁰ Initial National Communication on Azerbaijan Republic on Climate Change, Phase 2, Baku 2001 plus information in the First Communication Report to UNFCCC (2002)

³¹ Georgia's initial national communication under the United Nations Framework Convention on Climate Change, Tbilisi 1999

³² Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability, Working Group II Contribution to the Intergovernmental Panel on Climate Change, Fourth Assessment Report, April 2007.

cereal productivity decrease especially in low latitudes, increased coastal floods and erosion, increased mortality from heat waves, floods and droughts, and changed distribution of some disease vectors (ref. the reappearance of malaria). These are types of changes we already see in Southern Caucasus as a result of temperature increase of up to 0.7°C in the 20th century. More of this can be expected as the temperature is projected to increase further up to 1.7°C during the 21st century. In addition, Southern Caucasus is likely to see a further increase in extreme weather events and greater regional weather differences.

The rapid melting of Caucasus' glaciers will continue, possibly to an extent where hardly any glaciers will be left at the end of the 21st century. This will have severe impacts on river flows, as glaciers store water and ensure a steady supply of water to the river systems during the warmer and drier parts of the year. At first, there will be increasing water flows due to the melting of the water stored in the glaciers over hundreds of years causing floods and increased erosion. The when less and less glaciers are left, the water flow of the rivers of Caucasus will gradually become more shifting with strong flows following rainy seasons and lower than current average flows during the warm and dry periods. This will have a significant negative impact on agriculture and water availability.

The IPCC estimates that a temperature increase of 2-3°C constitutes a threshold where detrimental effects accelerate and multiply. With a projected temperature increase of 4.1-5.8°C during the 21st century Azerbaijan is clearly extremely vulnerable to climate change. (Also eastern Georgia and northeastern Armenia risk temperature increases of above 2°C.) The tendencies described above are likely to be maximized for Azerbaijan, with water shortage, severe risk of large scale species extinction, terrestrial ecosystems becoming a net carbon source (as drier landscapes replace more lush ones), severe wildfire risks, marked decrease in cereal productivity³³, and significant increase in infectious diseases and mortality from extreme weather events causing a substantial increased burden on health services.

³³ Russia and neighbouring countries: environmental, economic and social impacts. WWF Russia, Oxfam, 2008.

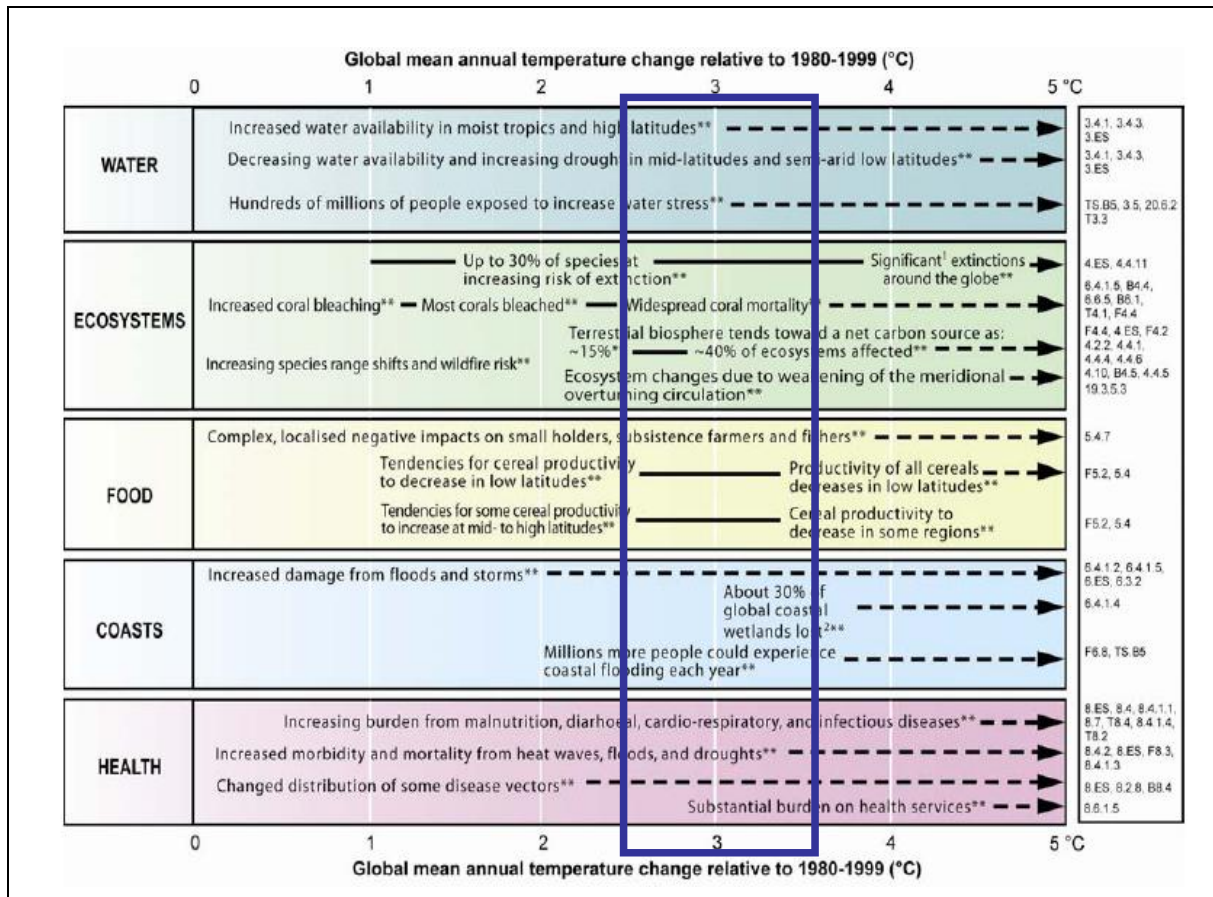


Fig. 9. IPCC assessment of impacts of temperature increase on water, ecosystems, food, coasts, and health (April 2007). The blue box in the graph indicates the forecasted increase range in average temperature to be expected by end of the century in the Southern Caucasus.

A recent study in *Geophysical Research Letters* projects a steady decline of Caspian Sea levels by 9 meters at end of the century and possibly continuing into the next century, due to large increases in evapotranspiration over land and the sea surface.³⁴ Enclosed sea areas are highly sensitive to climate variability and change, where small changes in the long-term balance between precipitation and evaporation can produce significant changes in sea levels. In fact, the Caspian Sea level underwent sudden changes of up to a few meters in the 20th century in response to regional climate shifts, with devastating consequences for the economies and environment of the surrounding region. The study notes “Given the high sensitivity of the Caspian Sea to climate variability, it is possible that anthropogenically induced climate changes might have disastrous impacts on the region with worldwide consequences associated with the Caspian basin resources (e.g. oil).”

To summarise, the current trends in the region will continue with large-scale changes of ecosystems in both lowlands and mountains and negative impacts on economic activities, especially agriculture and food production, but also health further aggravated.

³⁴ “Projected changes in Caspian Sea level for the 21st century based on the latest AOGCM simulations”, by Elguindi, N. and Giorgi, F., in *Geophysical Research Letters* vol. 33 L08706, American Geophysical Union 2006.

4.4. Impacts on biodiversity

In Armenia, a number of wetland types, such as the lakes and in the Ararat Valley and saline bogs, are in danger of complete disappearance and with them a number of endemic and rare plant species and several red-listed birds. In the steppe areas, the ecologically-valuable *Stipa* grasslands are expected to decline. The lower altitude parts of the forests are forecasted to become much more vulnerable due to a combination of human interventions and increasing frequency of insect outbreaks. In terms of the alpine vegetation, the lower altitude types are the most vulnerable to the climate change and some typical plant and insect species are in danger of extinction. The high-altitude Darevsky's adder (*Vipera darevskii*) with a very limited distribution in north-eastern Armenia is forecasted to decline by up to 50% by the end of the century (Fig. 10). Also some mountain bird species, like the Caspian snowcock (*Tetraogallus caspius*) and Caucasian grouse (*Tetrao mlokosiewiczii*), are expected to retreat to higher altitudes.



Fig. 10. Two examples of endemic species in Southern Caucasus – the Caspian snowcock (from BirdGuides) and the Darevsky's adder (photo by Alexander Malkhasyan, WWF-Armenia), which will decline significantly due to the climate change).

In Georgia, a general decline of the economically valuable Sweet chestnut tree (*Castanea sativa*) is expected, and many high-altitude plant species associated with ice and snow cover are estimated to go extinct in the lower mountains of southern Georgia. Arid areas in eastern Georgia, which already are intensively grazed by livestock, are also seen as particularly vulnerable.

In addition to illegal hunting, climate change is seen as one of the major threats to biodiversity in the Caucasus³⁵.

In conclusion, many species in the Southern Caucasus with specialised habitat requirements will likely decline due to climate change. Particularly vulnerable are species dependent on alpine habitats in the Lesser Caucasus where the amount of living space will dramatically shrink and species confined to already fragmented habitats like wetlands will suffer. Species already facing threats from other human activities like livestock grazing in arid lowland areas will also experience problems to cope.

³⁵ Europe's Environment, the Fourth Assessment, European Environment Agency 2007

4.5. Adapting to climate change

Using current trends and climate forecasts, Georgia, Armenia and Azerbaijan, have already made some first efforts to outline adaptation strategies. In Armenia, for instance, a wide range of adaptation measures have been suggested to overcome the detrimental impacts of climate change on agriculture, from changing crops and adapting farming management practices to new and more effective irrigation schemes.³⁶ It is interesting to note that climate change adaptation can be a driver for updating and improving natural resource use.

Facing serious challenges of adaptation to climate change, the Azerbaijan government already in the first report to the UNFCCC in 2000 identified priority adaptation measures and tried to estimate costs. The list is impressive, from improving water management and infrastructure to optimize water use to rehabilitation of forests (see table 5).

Table 5. Priority adaptation measures identified in the First Communication Report from Azerbaijan to the UNFCCC³⁷. The total adaptation costs are estimated at more than US\$ 3.2 billion.

Sector	Objective	Measure	Cost (US\$ million)	Anticipated Outcome
<i>Water</i>	Reduction of losses of available resources and their rational use	Construction of water reservoirs and increase of efficiency of existing reservoirs on mountain rivers Improvement of water resources management system Reconstruction of main channels and irrigation systems Forestation and establishment of shelters around lakes, reservoirs and along rivers	> 745	Elimination of existing and forecasted water deficit due to climate change
<i>Agriculture</i>	Improvement of state and increase of productivity	Identification of regions most vulnerable to climate change Optimization of production with introduction of climate resistant crops and breeds Improvement of irrigation systems Implementation of desalinisation measures Planting of vegetation shelters	>650	Optimisation of food production
<i>Coasts</i>	Protection of settlements, industry and infrastructure, and improvement of ecological status	Re-settlement of 15 centres Relocation of 15 industrial complexes and administrative premises Improvement, relocation and protection of land transport infrastructure Protection of Baku harbour Re-cultivation of oil contaminated land Construction of drainage networks and water treatment facilities on the Absheron peninsula Clean-up of the Baku bay from oil contamination and solid waste	1,220	Protection of coastal areas
<i>Forestry</i>	Optimise forest cover and increase productivity	Rehabilitation of 200,000 ha of mountain forests Regeneration of 190,000 of low value plantations Improvement of 100,000 ha of forest stands Restoration of Tugai (riverine) forests (36,000 ha)	315	Expansion of forest area, improvement of protection functions and increased productivity
<i>Land resource</i>	Conservation of land resources	Reduction of mud flow problems through engineering protective measures Terracing of 105,000 ha of mountain slopes Afforestation of 26,000 ha on sandy soils	270	Protection from mud flows, reduction of desertification and erosion, and new land for agriculture production

Even the most stringent mitigation efforts cannot avoid further impacts of climate change in the next few decades, which makes adaptation measures absolutely essential, particularly in

³⁶ “Climate change impacts on Armenian agriculture: vulnerability and adaptation assessment measure”, Climate Change Information Centre of Armenia.

³⁷ Initial Nation Communication of Azerbaijan Republic under the United Nations Framework Convention on Climate Change, Baku 2000

addressing near-term impacts³⁸. Adaptation needs to pay particular attention to “the frequency and magnitude of extreme events”³⁹.

A basic element in any adaptation response to climate change is a strategy for enhancing the resilience of the ecosystems and natural resources and to secure the essential ecological services of benefit to human society⁴⁰. The knowledge of ecosystem adaptation is still in its infancy but, based on current knowledge, the following general measures have been recommended⁴¹:

- Protect adequate and appropriate space.
- Limit all non-climate stresses
- Use active adaptive management and strategy testing.

Amongst important elements of habitat protection are conservation of keystone species, planning along climate gradients (e.g. mountain altitudes), promoting connectivity (e.g. protected areas and corridors), fragmentation avoidance, and protection of climate refugia with especially resistant habitats.

A stepwise decision-making process has been developed assessing the opportunities to restore the natural processes inside or outside the area affected before changing the wider land use, introducing technical solutions or compensate for damage (Fig. 11).

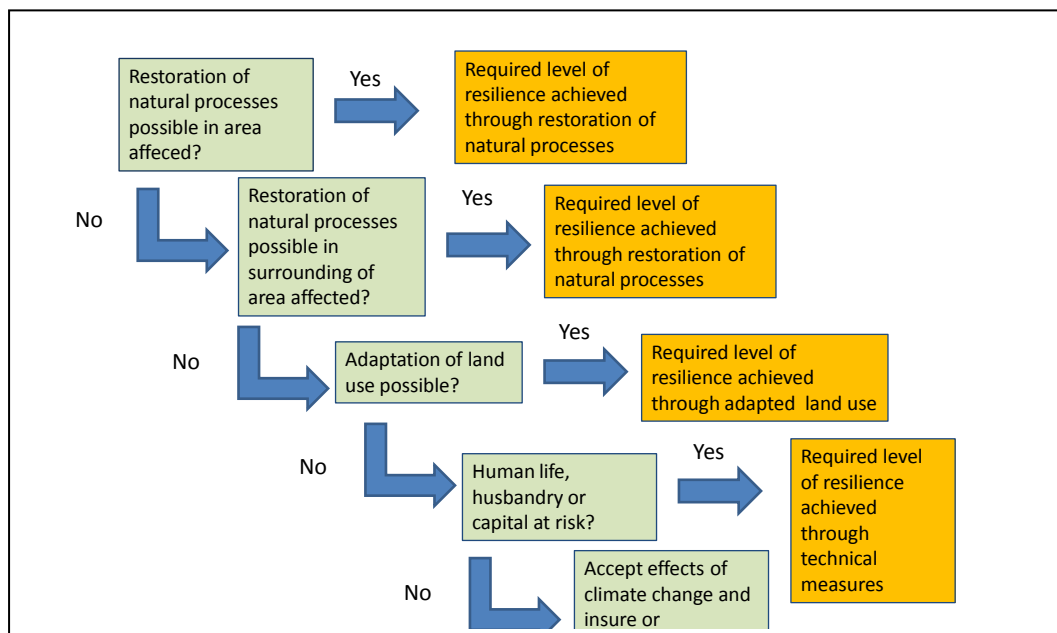


Fig. 11. Decision-making tree for building climate resilience of an affected area through restoration of natural processes (adapted from Stroming 2007).

³⁸ Ibid.

³⁹ Adaptation to Climate Change in the Context of Sustainable Development and Equity, Climate Change 2001: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Third Assessment Report of IPCC

⁴⁰ Ecosystems, their properties, good and services, Working Group II Report: Impacts, Adaptation and Vulnerability, IPCC 2007

⁴¹ “Buying Time: A User’s Manual for Building Resistance and Resilience to Climate Change in Natural Systems”, Editors: L.J. Hansen, J.L. Bringer and J.R. Hoffman, WWF 2003

The UNFCCC has developed specific methodologies and tools to evaluate climate change impacts and adaptation⁴². Amongst these are the “National Adaptation Programmes of Action (NAPAs)”, with particular relevance for Least Developed Countries (LDCs). Until November 2007, 23 NAPAs had been developed⁴³. The Programmes focus on urgent and immediate needs, use existing information (rather than focusing on scenario-based modelling), and are country-driven. One important aspect of the NAPAs is the need to undertake a “participatory assessment of vulnerability”, which should help the engagement of new audiences and facilitate outreach and awareness. Similar to PRSPs, the NAPA approach is multidisciplinary, engaging different government institutions, NGOs and the private sector. The end product should have a simple format and be easily understood both by policy-level decision-makers and by the public. In some instances, such as for Tanzania⁴⁴, it has been clearly stated “that sustainable development can only be achieved when strategic actions, both short term and long term, are put in place to address climate change impacts”. So far, no NAPAs have been developed in the three South Caucasus countries and communication of existing knowledge outside the expert audience has been rather limited.

Although climate change has already had serious impacts on humans and the economy, insufficient attention has been given so far to the issue in the wider development agenda, such as in the Millennium Development Goals⁴⁵. Climate change is only represented in the MDGs by indicators of changes in energy use per unit of GDP and/or by total or per capita emissions of CO₂. This is also reflected in the three Southern Caucasus countries where current poverty reduction strategy documents do not include any additional aspects on climate change, or adaptation. To ensure environmentally-sustainable growth and social progress, a two-way integrated process between climate and sustainable development must be ensured⁴⁶ (Figure 12).

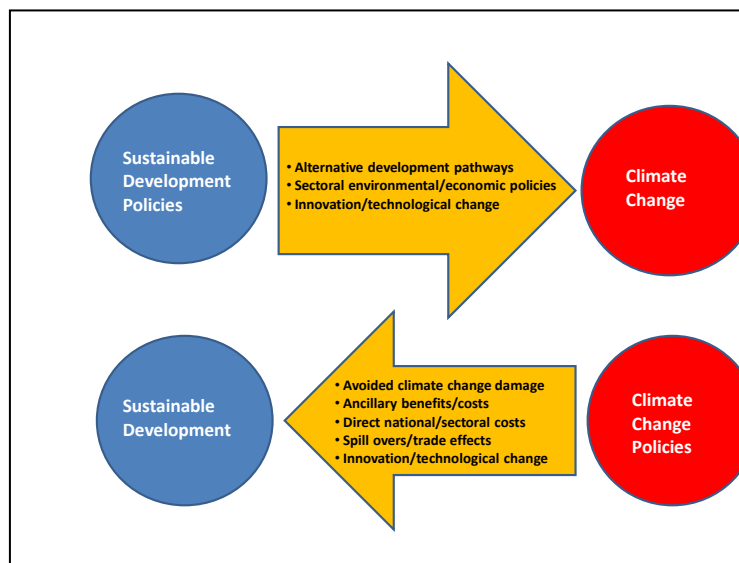


Fig. 12. Two-way linkages between climate change and sustainable development (source: IPCC 2007).

⁴² See: <http://unfccc.int/adaptation/methodologies>

⁴³ <http://unfccc.int>

⁴⁴ National Adaptation Programme of Action (NAPA), United Republic of Tanzania, UNEP and GEF 2007

⁴⁵ Perspectives on climate change and sustainability, Working Group II Report: Impacts, Adaptation and Vulnerability, IPCC 2007

⁴⁶ Perspectives on climate change and sustainability, Working Group II Report: Impacts, Adaptation and Vulnerability, IPCC 2007

Some efforts have been made in the Southern Caucasus countries to integrate climate change issues into other policies with a more direct relevance to the wider development agenda. The following example for Armenia could serve as an interesting case where climate change aspects are addressed directly or indirectly, mainly through disaster and risk prevention (Table 6).

Table 6. National policies and strategies in Armenia where climate change explicitly or implicitly has been integrated (source: Climate Change Information Center of Armenia).

- ❑ **Strategy on National Security (2007)** has special provisions: creation of favorable environment for vital activities of present and future generations; conservation and efficient use of natural resources; coordinated improvement of environmental conditions; country integration into organizations involved in monitoring and prevention of natural and technological disasters; reliable forecasting, prevention and mitigation of natural and technological risks; ensuring safety, reliability and stability of town-planning systems.
- ❑ **Agricultural Sustainable Development Strategy of the Republic of Armenia (2006)** is consistent with the Government's programme on "Poverty Reduction Strategy Paper" and defines a number of activities relevant to climate changes risk reduction. Although there is no clear formulation of climate change risks in the strategy, such actions as forecasting and prevention of natural disasters (drought, floods etc.) and implementation of complex measures targeted at mitigation of consequences are stated.
- ❑ **Food Security Policy (2005)** includes issues on climate change, desertification, biodiversity protection and biological security and stipulates that the agricultural policy should take into consideration the global warming, together with its consequences. The components of food security programme include: creation of data bank on natural resources usage, assessment and monitoring of natural resources; development and implementation of land consolidation projects, regeneration of valuable and rare ecosystems, creation of early warning system to prevent crop damage in case of dangerous hydro-meteorological forecasts.
- ❑ **National Forest Policy and Strategy (2004)** and **Forest National Programme (2005)** include issues on climate change risks. The following activities related to climate change are envisaged: assessment of forest vulnerability as a result of forecasted climate change; efficient use of international financing mechanisms in forest sector (as envisaged by Kyoto Protocol) for implementation of afforestation projects; assessment of the damage caused to forests by pests and diseases; application of integrated methods of forest protection (due to this statement, treated forest area increased 30 times from 2004 to 2007; forest maintenance improvement (budget allocations for construction of fire prevention roads, forest guarding, etc. increased by 60% from 2005 to 2007).
- ❑ **National Action Plan to Combat Desertification in Armenia (2002)** anticipates development and application of target programs for mountainous settlements, promotes traditional use of community pastures.
- ❑ **Strategy on Specially Protected Areas (2002)** envisages the following types of activities aimed to increase natural ecosystems adaptive potential: establishment of 12 new specially protected areas; optimization of the territory of existing specially protected areas.

To summarize, through increasing temperature, decreasing water availability, increased damage from floods and storms, sea level rise and associated coastal erosion, climate change will no doubt put a challenge to the future development in the Southern Caucasus. To reduce impacts will require the enhancement of ecosystem resilience and the introduction of specific climate adaptation measures with regard to water management, land use, food production, coastal management and health. Some initial estimates from Azerbaijan indicate adaptation costs well above US\$ 3 billion. However, in contrast to many other countries, no National Adaptation Programmes of Action (NAPAs) have yet been established for the countries in the Southern Caucasus region. Further, climate change has not been adequately integrated into the MDGs, including the associated Poverty Reduction Strategy Papers. Some initial efforts have

been made to integrate climate change issues into other policies, mainly as risk prevention and to reduce disasters, but a more comprehensive inclusion of climate change aspects into sustainable development is still lacking. In particular, climate adaptation is a key topic in relation to all three pillars - the economic, ecological and social dimensions⁴⁷ - of sustainable development. Only by addressing climate aspects simultaneously in relation to all three dimensions can the prospect of creating a more sustainable society in the future be enhanced.

4.6. Emission and energy production

The three Southern Caucasus countries have all ratified the UN Framework Convention on Climate Change: Armenia on 14 May 1993, Georgia on 29 July 1994, and Azerbaijan on 16 May 1995. To meet their commitments under Article 4 and 12 of the Convention, each of the countries developed their “First National Communication to the Conference of Parties” between 1998 and 2000.

The Kyoto Protocol was subsequently ratified by Georgia in June 1999, by Azerbaijan in September 2000, and by Armenia in May 2003⁴⁸. However, as ‘countries in transition’, these countries are not obliged to meet a specific emission reduction target by 2012 (with 1990 as baseline year) as are the countries listed under Annex B of the Protocol.

From a regional perspective, the emissions of three South Caucasus countries are, however, quite low compared to countries in Eastern Europe, Southeast Europe, and two out of five countries in Central Asia (Fig. 13).

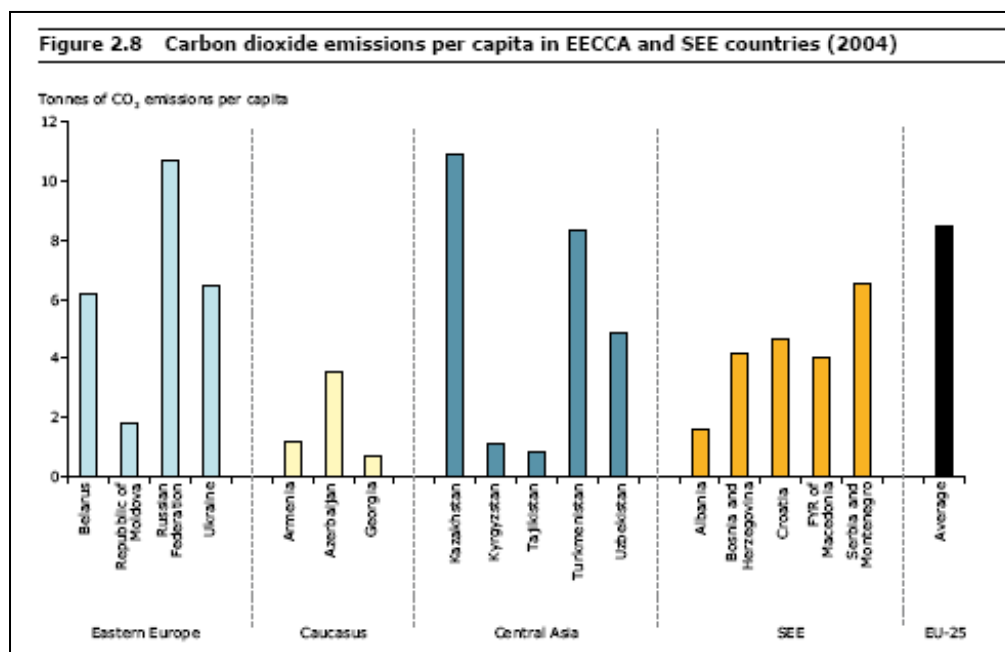


Fig. 13. Carbon dioxide emissions (Tonnes per capita) in Eastern Europe, Caucasus, Central Asia, South-East Europe (SEE) and 25 of the EU Member States (source: UNEP-EEA 2007).

⁴⁷ Perspectives on climate change and sustainability, Working Group II Report: Impacts, Adaptation and Vulnerability, IPCC 2007.

⁴⁸ <http://unfccc.int>

CO₂-emissions are still significantly below 1990-levels, due to the significant economic setback in the 1990ies, with Armenia in 2004 emitting 3.6 Mt (1.2 ton/capita), Georgia 3.9 Mt (0.8 ton/capita) and petroleum producing Azerbaijan 31.3 Mt (3.8 ton/capita).⁴⁹

The three countries are exposed to very different energy scenarios. Based on an Energy Master Plan, Armenia decided to increase the share of its own primary energy production for 2010 by increasing hydro, nuclear, geothermal and wind power generation⁵⁰. Overall, the country is modernizing production and supply system and introducing new tax and tariff systems, which will thus increase energy efficiency and lead to an overall reduction of carbon dioxide emissions as well by up to 50%. Armenia is promoting the introduction of renewable energy resources. A comprehensive assessment has been done evaluating the potential for renewable energy provision across each of the country's twelve regions, including mapping of the potential for different investments, like wind power installations. Concrete projects on hydropower and wind are underway with support of the EU, World Bank, and the governments of Iran and Kazakhstan⁵¹.

In contrast, Azerbaijan benefits from its own oil and gas resources. The country has developed an energy sector plan with the primary purpose to ensure economic growth⁵². Compared to 1990, the total energy consumption is planned to increase 1.5 to 1.7 times by 2025, with growth across all sectors (power generation, industry, transport, commerce, households and agriculture). Thermal power plants – fueled mainly by natural gas - will still provide the majority of power in 2025, but hydro power generation is planned to more than double compared to 1990 with priority given to small to medium-sized hydro power stations. Natural gas will become the dominating source of fossil fuels. Due to the rapidly growing GDP and energy saving measures, the energy intensity will decrease, but the total GHG emissions is expected to increase by around 50%. Also Azerbaijan has identified the need for developing renewable energy resources⁵³, with particularly large potentials in the areas of wind, hydro and biomass⁵⁴. Concrete projects have started on small hydropower plants, wind⁵⁵ and biogas⁵⁶, and other initiatives are underway in collaboration with the EU⁵⁷, Asian Development Bank (co-financed by the Government of Finland)⁵⁸, KfW⁵⁹, and EBRD⁶⁰.

Georgia shows a different energy scenario compared to Armenia and Azerbaijan. As in the two other countries, energy consumption dropped dramatically after 1990, which led to an energy crisis⁶¹. However, Georgia is rich in hydropower resources but hydroelectric plants

⁴⁹ UNDP: Human Development Report 2007/2008. The average emissions of high income OECD countries are 13.2 ton per capita.

⁵⁰ "First National Communication of the Republic of Armenia under the United Nations Framework Convention on Climate Change", October 1998

⁵¹ Renewable Energy Initiative, Armenia Country Profile, <http://www.ebrdrenewables.com>

⁵² Initial national Communication of Azerbaijan Republic under the United Nations Framework Convention on Climate Change, Baku 2000

⁵³ State Programme on the Use of Alternative and Renewable Energy Sources

⁵⁴ EBRD Renewable Energy Initiative, Azerbaijan Country Profile, <http://www.ebrdrenewables.com>

⁵⁵ "UNDP to support the Ministry of Industry and Energy in development of renewable energy in Azerbaijan", Press Release, 17 January 2007, <http://www.un-az.org>

⁵⁶ EBRD Renewable Energy Initiative, Azerbaijan Country Profile, <http://www.ebrdrenewables.com>

⁵⁷ <http://ec.europa.eu/europeaid>

⁵⁸ ADB Technical Assistance Report, Technical Assistance, Republic of Azerbaijan: Preparing the renewable Energy Development Project, December 2005

⁵⁹ Renewable Energy Initiative, Azerbaijan Country Profile, <http://www.ebrdrenewables.com>

⁶⁰ Renewable Energy Initiative, Azerbaijan Country Profile, <http://www.ebrdrenewables.com>

⁶¹ Georgia's initial national communications under the United Nations Framework Convention on Climate Change, Tbilisi 1999

produce only about 60% of their potential capacity due to a low level of maintenance. Georgia's energy sector lags well behind that of its neighbours and other countries in Central and Eastern Europe and still remains incapable of reliably meeting its current and future energy demands⁶². One obstacle has been the non-payment of the energy consumed, but through management improvements in the largest electricity distribution company (United Energy Distribution Company) this figure dropped from 80% in 2004 to 20% in mid-2006. The Ministry of Energy is currently implementing a four-year Georgia Energy Security Initiative financed by USAID, the German KfW and other donors. Amongst the activities is the rehabilitation of existing rural small-scale hydropower plants. Other promising renewable energy sources are wind and geothermal⁶³.

To summarize, the three Southern Caucasus countries show a rather different energy profile, with Azerbaijan consuming mainly its oil and gas supply, Georgia relying on hydropower production, and Armenia with a more diversified supply system of hydro and nuclear power. All three countries have embarked on the development of renewable energy resources supported by many international agencies, but only a few projects have actually started. Of the three countries, Armenia plans the largest investments in geo-thermal and wind power generation and also to reduce overall GHG emissions.

4.7. Financing climate change mitigation and adaptation

As non-Annex I parties to the Kyoto Protocol, the three South Caucasus countries can only participate in CDM projects. The EU (EuropeAid)⁶⁴ and GEF/UNDP have provided technical and financial assistance to implement CDM in all the countries, and the Ministries for Environment/Ecology/Nature Protection have been identified as the Designated National Authority (DNA).

In Armenia⁶⁵, 13 projects with a total investment of US\$ 77 million are in the pipeline with financing from the European Bank for Reconstruction and Development (EBRD), EU/TACIS, the private sector and carbon funds, and with participation from the Danish Environment Protection Agency (DEPA) and private companies in Armenia, Germany and Japan. The projects address several issues - landfill gas capture, biogas, afforestation, small hydropower stations, and the improvement of heat and hot water supply. Armenia has six priority sectors for CDM projects (energy, industry, waste, agriculture, forestry and transport) and has mapped out the geographical allocation of the different investments.

In Georgia⁶⁶, the legal and operational aspects for implementing CDM projects have been established and priorities identified⁶⁷ (natural gas transportation, chemical industry, cement production, transport, heat and hot water system, use of renewables, and landfill/waste management). A number of technical studies have been undertaken to facilitate CDM and UNFCCC implementation. In November 2007, a total of 11 projects are underway addressing

⁶² Energy and Environment, USAID Georgia (<http://georgia.usaid.gov>)

⁶³ Renewable Energy Initiative, Georgia Country Profile, <http://www.ebrdrenewables.com>

⁶⁴ <http://climatechange.telenet.ge/>

⁶⁵ Overview: Implementation of the Kyoto Protocol's Clean Development Mechanism in Armenia, Enabling Activities for the Preparation of Armenia's Second National Communication to the UNFCCC, Yerevan 2007

⁶⁶ Mr. Grigol Lazriev, Hydrometeorology and Climate Change Administration, Ministry of Environmental Protection and Natural Resources

⁶⁷ <http://climatechange.telenet.ge/>

issues such as hydropower stations, wind farm, reduction of emissions from industry and gas distribution networks.

Azerbaijan has just started its CDM work⁶⁸. The country was also part of the EU funded project (see footnote 69), which amongst several outputs generated a useful handbook on CDM implementation in Azerbaijan. With assistance from UNDP and financial support from the Norwegian Government, a two-year project started in July 2006 to further assist Azerbaijan with the development of CDM projects, including the nomination of priority sectors.

Due to increased deforestation, the forests in Azerbaijan are gradually losing their function as carbon sinks⁶⁹. It has therefore been proposed to initiate a 5,300 ha afforestation initiative in the floodplains of the Kura and Aras Rivers and foothills of the Greater Caucasus within the CDM framework. The outcome of the project would be 0.35 tones of fixed CO₂, over 20 years, 1 million m³ of round wood, and 220 permanent jobs.

What about the petroleum sector and its interest to assist with combating climate change in the region? In 2003, the Extractive Industries Transparency Initiative (EITI) was launched with the overall aim “that the revenues from extractive industries contribute to sustainable development and poverty reduction”⁷⁰. Azerbaijan joined the EITI in 2003, which means that the transparency provisions apply to all companies within its territory – foreign, domestic, private and state-owned, large and small. However, until now, almost no efforts have been made by the two biggest foreign companies – BP and StatoilHydro – to support either climate mitigation or adaptation measures in Azerbaijan or elsewhere in the Southern Caucasus region⁷¹. So far, the two main initiatives – The Future Communities Programme and The Regional Development Initiative – do not include any climate or energy components. Investments from the State Oil Fund of Azerbaijan (SOFAZ) in 2007, with a current capital of US\$ 2.2 billion, has supported improvement for refugees and IDPs, improvement of irrigation and water supply systems, and the upgrading of the Baku-Tbilisi-Kars railway⁷² – but, so far, direct climate mitigation and adaptation measures have not been considered. There is obviously a lot more scope for the petroleum sector to invest in climate mitigation and adaptation activities in the Southern Caucasus region, especially in Azerbaijan.

4.8. Security and Climate Change

In 2003, UNDP, UNEP and the Organization for Security and Co-operation in Europe (OSCE) launched the Environment and Security (ENVSEC) Initiative to “assess and address environmental problems, which threaten or are perceived to threaten security, societal stability and peace, human health and/or sustainable livelihoods, within and across national borders in

⁶⁸ Mr. Issa Aliyev, Head of International Cooperation department, Ministry of Ecology and Natural Resources, Azerbaijan

⁶⁹ “Elaboration of a catalogue of projects for the sustainable management of natural resources and the fight against the greenhouse effect in Azerbaijan, Chile, Colombia and Gabon”, Afforestation of state and private terrain in the Araxe and Koura plains and private terrain in the Greater Caucasus foothills, ONF International, Republic of Azerbaijan and Republic of France, 2004

⁷⁰ The EITI website – <http://www.eitransparency.org>

⁷¹ “A study on petroleum, sustainable development and civil society in Azerbaijan”, Bjarge Fors, October 2007, unpublished report for WWF-Norway

⁷² “SOFAZ Executive Director holds press conference”, November 2007, <http://www.sanepr.com>

conflict prone regions”⁷³. The North Atlantic Treaty Organisation (NATO), UNECE and the Regional Centre for central and Eastern Europe have joined as associate members.

ENVSEC has identified four focal regions: Central Asia, Eastern Europe, South Eastern Europe and Southern Caucasus.

An ENVSEC assessment of environment and security linkages in the Southern Caucasus⁷⁴ was completed and presented at the Ministerial meeting of EECCA countries in Tbilisi on October 22, 2004. On the basis of stakeholder consultation and national assessment reports, the following linkages between environmental stress and social tension were identified:

- Environmental degradation and access to natural resources in areas of conflict
- Management of cross-border environmental concerns: water resources, natural hazards, and industrial and military legacies
- Population growth and rapid development in capital cities

During 2007, the issue of climate change and security were raised independently by several institutions. In a report⁷⁵ the US Military Advisory Board concludes that “climate change poses a serious threat to America’s national security”. It has the potential to create “sustained natural and humanitarian disasters on a scale far beyond those we see today”. Climate change will likely foster political instability in some of the most volatile regions of the world. Through the impact freshwater (including flooding), food, health, and land, regions in Africa, Asia, Middle East and Europe will be affected. In the most industrial and prosperous part of Europe the capacity for adaptation is very high, but less so in “lesser developed places like the Balkans, Moldova and the Caucasus”. The report recommends that “the US should commit to a stronger national and international role to help stabilize climate change at levels that will avoid significant disruption to global security and stability”.

In September 2007, the Institute for Strategic Studies (IISS)⁷⁶ issued a warning in relation to climate change that “the security dimension will come increasingly to the forefront as countries begin to see falls in available resources and economic vitality, increased stress on their armed forces, greater instability in regions of strategic importance, increases in ethnic rivalries, and a widening gap between rich and poor”. It concludes that even if effective measures are adopted, there will still be unavoidable impacts on the environment, economies and human security.

In a German Advisory Council on Global Change (WBGU) report⁷⁷ climate change is seen as a “new security policy challenge”. Climate change could exacerbate existing environmental crisis such as drought, water scarcity and soil degradation, intensify land-use conflicts and trigger further environmentally-induced migration. A number of regional ‘hot spots’ have been identified as well in the report, however, not including the Caucasus.

⁷³ <http://www.envsec.org/>

⁷⁴ Environment and Security – Transforming Risks into Cooperation, The Case of the Southern Caucasus, UNDP, UNEP and OSCE, 2004

⁷⁵ National Security and the Threat of Climate Change, The CAN Corporation 2007

⁷⁶ Strategic Survey 2007 – The Annual Review of World Affairs, IISS 2007

⁷⁷ World in Transition : Climate Change as a Security Risk, WBGU, Earthscan 2007

Under the heading “Climate policy as security policy”, the WBGU provides a number of strategic recommendations (Table 7).

Table 7. Strategic recommendations by the German Advisory Council on Global Change.

I: Preventing conflicts by avoiding dangerous climate change	Ambitiously pursuing international climate policy <ul style="list-style-type: none"> • <i>Making the 2°C guard rail an international standard</i> • <i>Gearing the Kyoto Protocol towards the long term</i> • <i>Conserving natural carbon stocks</i>
	Implementing the energy turnaround in the EU <ul style="list-style-type: none"> • <i>Strengthening the EU’s leading role</i> • <i>Improving and implementing the Energy Policy for Europe</i> • <i>Triggering an efficiency revolution</i> • <i>Expanding renewables</i>
II: Preventing conflicts by implementing adaptation strategies	Supporting adaptation strategies for developing countries <ul style="list-style-type: none"> • <i>Adapting water resource management to climate change and avoiding water crises</i> • <i>Gearing agriculture to climate change</i> • <i>Strengthening disaster prevention</i>
	Stabilizing fragile states and weak states that are additionally threatened by climate change
	Managing migration through cooperation and further developing international law <ul style="list-style-type: none"> • <i>Developing comprehensive international strategies for migration</i> • <i>Integrating migration policy into development cooperation</i> • <i>Enshrining the protection of environmental migrants in international law</i>
	Expanding global information and early warning systems
III: Financing the initiatives	Avoiding dangerous climate change <ul style="list-style-type: none"> • <i>Transforming energy systems worldwide</i> • <i>Conserving terrestrial carbon stocks</i>
	Adaptation to unavoidable climate change <ul style="list-style-type: none"> • <i>Boosting official development assistance</i> • <i>Developing a UNFCCC adaptation strategy</i> • <i>Strengthening microfinance</i> • <i>Establishing an environmental migration fund</i>
	Financing international conflict prevention <ul style="list-style-type: none"> • <i>Adopting an integrated approach to the financing of crisis prevention, development cooperation and military spending</i> • <i>Strengthening the financial institutions in the UN system</i>

For the Southern Caucasus, the following recommendations are of particular relevance:

- Adapting water resource management to climate change and avoiding water crises
- Gearing agriculture to climate change
- Strengthening disaster prevention
- Conserving terrestrial carbon stocks
- Boosting official development assistance
- Strengthening microfinance

An interesting opportunity exists of conserving the “terrestrial carbon stock” in the Southern Caucasus. In March 2006, WWF together with the German Ministry of Economic Development and Cooperation, BMZ (through KfW) and Conservation International (CI) established Caucasus Protected Areas Fund with the aim of providing

long-term financial sustainability for priority protected areas in Armenia, Azerbaijan and Georgia⁷⁸. It has been argued⁷⁹ that the preservation of old-growth forests may have a larger positive effect on the carbon cycle than promotion of re-growth. To meet its full capacity of preserving the ecosystems in the Southern Caucasus – of which a substantial part consists of old-growth forests – the trust fund is aiming for an endowment capital of € 44 million of which about 20% is secured to date. Such an investment could have a positive impact not only on biodiversity but also in terms of climate change, mitigation as well as adaptation.

The Kura-Aras/Araks river basin, which covers a significant part of the Southern Caucasus region, including northern Iran (see Figure 14), is of particular, strategic importance, also for overall security situation in the region. The basin hosts a total population of more than 15 million people⁸⁰ and the river system is the principle source of water for all sectors and users: industry, agriculture, energy and domestic uses. The entire region is heavily dependent upon the river system for economic development and sustenance of the population. The Kura-Aras/Araks basin has been subject of several transboundary projects and UNDP has developed a GEF project⁸¹ to better coordinate on-going efforts through an Integrated Water Resource Management approach. With reduced river flow and increasing frequency of flooding due to climate change, the urgency to start this project has become even more apparent, and it would be advisable to incorporate a climate adaptation component as part of the future project (see overall recommendations under point 4).

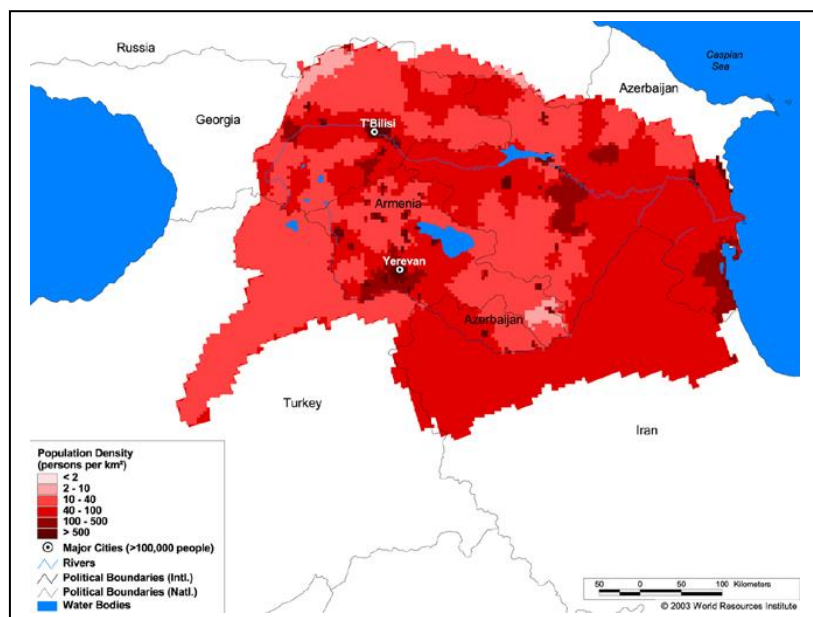


Fig. 14. The Kura-Aras/Araks river basin⁸².

⁷⁸ See <http://caucasus-conference.org>

⁷⁹ Schultze, E-D., Wirth, C. and Heimann, M. 2000, Managing Forests after Kyoto, Science 22 (289): 2058-2059

⁸⁰ Water Resources eAtlas – Watersheds of the World, www.iucn.org/themes/wani/eatlas

⁸¹ GEF, Project Identification Document: Reducing transboundary degradation in the Kura-Aras basin, UNDP, October 2007

⁸² Water Resources eAtlas – Watersheds of the World, www.iucn.org/themes/wani/eatlas

In summary, climate change is a key strategic issue also in terms of political security. Through impacts such as droughts, water scarcity and soil degradation, climate change could exacerbate already existing conflicts leading to greater instability. The Southern Caucasus shares this feature with many other security “hot spots” of the world. Based on strategic recommendations provided by the German Advisory Council on Global Change (WBGU), the Southern Caucasus countries need to pay particular attention to adapting water resource management and agriculture/food production to climate change, strengthening disaster prevention, and conserving the terrestrial carbon stocks (particularly forests). To incorporate climate adaptation in the future management of the Kura-Aras/Araks river basin should be seen as particularly important for the future stability and well-being of the region.

5. Conclusions with Strategic Recommendations

Climate change has already started to have a significant impact on nature and people in the Southern Caucasus region – effects that will become even more severe in the future. This will create an extra burden on the development of societies in all the three countries of Armenia, Azerbaijan and Georgia, which still struggle to embark on a more sustainable path, including eradicating widespread poverty. Climate change also poses an additional risk for the political stability of the region.

Based on the information provided in chapters 1-3 of the report, the following recommendations are given:

A. National Governments

- Mainstream climate change into Poverty Reduction Strategies and overall Sustainable Development, taking advantage of information in the Second Communication Reports from the countries to UNFCCC expected within the next 1-2 years
- Strengthen climate adaptation by developing participatory National Adaptation Programmes of Action (NAPA), involving a wide spectrum of stakeholders from both the public and private sectors
- Pilot field projects on climate adaptation in climate ‘hot spots’, ensuring adequate funding from the international donor community
- Identify and fund land use related CDM projects, especially addressing afforestation and deforestation, which potentially also could support climate adaptation
- Invest more in innovative, renewable energy solutions, such as wind, water, sun and geothermal, with the aim of reducing overall Greenhouse Gas Emissions
- Develop and launch national “Stern Reports” to increase awareness on the critical importance of climate change for sustainable economic development
- Mainstream the climate change issue in media, communications and education, through the creation of a national “Climate Outreach Forum” in each country with representation from a wide spectrum of organisations (including the socio-economic field) and some ‘high profile ambassadors’
- To meet obligations under the Convention on Biological Diversity (CBD), introduce climate adaptation for planning, design and implementation of biodiversity conservation, such as protected areas and species programmes,

B. International community

- Step up funding and coordination of support to climate change mitigation and adaptation measures in Southern Caucasus
- Provide new opportunities for renewable energy solutions through CDM projects
- Boost climate adaptation measures in each of the countries and in transboundary areas by establishing a special “Climate Adaptation Facility for Southern Caucasus”
- Implement the recommendations for various bilateral (e.g. NORAD) and multilateral agencies (e.g. World Bank) to integrate climate adaptation as part

of the support to poverty reduction, natural resource management and humanitarian aid

- Mainstream climate adaptation into disaster prevention strategies for all countries
- Develop a regional adaptation strategy for water management of the Kura-Aras/Araks River Basin, ensuring its integration into future coordinated efforts (e.g. GEF)
- Map out climate ‘hot spots’ in the wider Southern Caucasus region by pooling existing national forecast and modelling information
- Secure the “terrestrial carbon stock” by ensuring sufficient number of well managed protected areas in all three countries through investing in the newly established “Caucasus Protected Areas Fund”
- Undertake a vulnerability and risk assessment study on climate change and political security in Southern Caucasus with recommendations on preventive measures in identified ‘hot spots’
- Mainstream climate change into the work of the Environment and Security (ENVSEC) Initiative

C. Wider Civil Society, including Corporate Sector

- The national and international (especially BP and StatoilHydro) petroleum sector to invest in climate change mitigation and adaptation measures in Azerbaijan, but also in the wider Southern Caucasus region (including securing the “terrestrial carbon stock” through supporting the ‘Caucasus Protected Areas Fund’)
- Launch high-profile, innovative projects for settlements and urban development which mainstream sustainability standards compatible with ‘high quality of life’, especially applying a zero-carbon approach (for example, see the “One Planet Living” website: <http://www.oneplanetliving.org>)

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