PREFACE

This first Caucasus Environment Outlook (CEO) is a regional report and the result of work by experts from four countries: Armenia, Azerbaijan, Georgia and Russia. The GRID-Tbilisi office conducted overall project management, under the co-ordination and overall guidance of UNEP's Division of Early Warning and Assessment (DEWA) ~ Europe office, and Regional Office for Europe (ROE).

The major objectives of the CEO are to report on the status of the Caucasus environment, identify ongoing socio-economic "driving forces" and offer an integrated look at regional economic and environmental trends and appropriate policy measures for the last 30-year period, in order to analyze changes which have occurred since the Stockholm Conference (1972) to date. An important part of the report is the analysis of human vulnerability and insecurity vis-a-vis environment, conflicts, poverty and other factors, as well as the environmental outlook over the next 30-year period, based on three different development scenarios.

One reason for initiating this report is that the Caucasus region has not received much international attention, compared with other sub-regions in Central and Eastern Europe. One of the major challenges in resolving environmental problems of the Caucasus region in the trans-boundary context is the lack of a regional framework for environmental co-operation. Because of the fact that during the Soviet era, the Caucasus was part of a single country, it is now difficult to find bi- or multi-lateral agreements between the new states. Before the Soviet Union as a whole participated in international legal agreements; now it is necessary to develop inter-state agreements. The perspective of joining the European Union is yet too remote to act as a unifying factor.

Thus, it is hoped that this first CEO report will be only the beginning of a process which aims at improved and regular assessment and monitoring activities within the entire Caucasus region, as well as substantive measures being conceived and implemented for the overall region's environmental protection and rehabilitation.

A project team of Georgian experts and four national focal points from Armenia, Azerbaijan, Georgia and the Russian Federation was established and carried out the related work. These persons were as follows: Mariam Shotadze[1], MS. conducted overall project management. Doctor of Geographic Sciences, Professor Nikoloz Beruchashvili conducted the scientific edition of the report. These experts together with Dali Nickolaishvili and Valerie Melikidze, Candidates of Geographic Sciences, assistant professors drafted the report. Giorgi Zirakashvili (GRID-Tbilisi) collected baseline data and Manana Kurtubadze and Nino Megvinetukutsesi (GRID-Tbilisi) provided cartographic and graphic design[2]. Vierra Savelyeva (GRID-Moscow, Russia), Mzia Gvilava (Ministry of Environment/GRID-Tbilisi, Georgia) and Tatyana Danielyan (Ministry of Nature Protection, Armenia) played national focal point roles. From Azerbaijan, Fuad Akhunzade (Nature Protection Society) participated as an independent expert. This Site is developed by Shalva Ninidze, WEB-Developer and Programmer.

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1 - *Project manager during the initial phase of its implementation was Zurab Jincharadze, MS.*
2 - *A set of geographic maps has been provided by David Beruchashvili, Zurab Javakhishvili, Michael Elashvili and Tea Godoladze.*

ACKNOWLEDGEMENTS AND DISCLAIMER

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Individual experts engaged in the study of Caucasus issues also provided helpful comments and contributions. Especially: late Gunter Beuchel (Delegation of European Commission in Georgia), Irina Bredneva (CIP, Moscow),Galina Gladkevich (Moscow State University), Teimuraz Gogishvili (State Statistical Department of Georgia),

Matlab Hasanov (REC-Caucasus), David Kikodze (Dzelkva, Ltd, Georgia), Yuri Mazurov (Heritage Institute, Moscow), Ted Terner (Caspian Environmental Program), etc.

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Ron Witt, UNEP/DEWA/GRID-Geneva, conducted overall co-ordination of the project. Special thanks are offered to him for his editorial assistance, enabling the CEO team to prepare the final version of the report. Fran3oise Belmont of UNEP/ROE provided overall general support for and inputs to the project, and Merab Sharabidze of UNEP/ROE guiding political advice from the CEE and NIS countries' perspective.

Ultimately, this first edition of the CEO report and the material included therein are the responsibility of the CEO team under UNEP's supervision, and any factual errors or other mistakes should be reported to them.

INTRODUCTION

Location of the Caucasus. The Caucasus is a region where the oldest route connecting Europe to Asia is located.

For over 70 years, the Caucasus region was part of the Soviet Union. After the break-up of the USSR, three independent countries were established within the South (or Trans-) Caucasus: Armenia, Azerbaijan and Georgia. The northern part of the Caucasus (the North Caucasus) has remained a part of the Russian Federation.

The Caucasus region is traditionally located between the Kuma-Manich depression to the north and the Turkey-Iran border to the south. On the west, the Caucasus is bounded by the Black and Azov Seas and on the east by the Caspian Sea. In this respect, the Caucasus area comprises 440,000 km sq., and the population in 2000 was approximately 30.6 million persons.

Boundaries of the Caucasus. The issue of the Caucasus frontiers is constantly under review and fervent debates are still held on this issue. The question of whether the Caucasus is located in Europe or Asia is one of interest to many, and the answer is closely connected to the problem of the border between Europe and Asia. There are several viewpoints on this issue (Beruchashvili, 1996):

1. The Europe-Asia border passes through the Kuma-Manich depression, which in geological times connected the Caspian and Black Seas. In this regard, the entire Caucasus belongs to Asia.
2. The Europe-Asia border passes along the border of South Caucasus countries with Iran and Turkey. In this case, the entire Caucasus is in Europe.

Source: Beruchashvili N., 1998

The borders pass along the Main Caucasian Range, which is the most important factor determining regional climate. In this respect, the northern part of the Caucasus is in Europe and the southern in Asia. However, from the geological viewpoint, the Caucasus is a single entity, and overall geographically there is much in common between its southern and northern parts.

The rivers Rioni and Kura (Mtkvari) divide Europe and Asia. Herodotus, a Greek geographer of the 5th century B.C., shared this viewpoint. Nevertheless, neither the Rioni nor the Kura is difficult barriers to pass. Thus, the Colchian lowland (which is crossed by the river Rioni), Shida (Inner) Kartli plain and the Kura-Araks lowland (crossed by the river Kura) are a single entity from the geographical viewpoint.

5. The border between Europe and Asia passes along the landscape borders. In this case, it is connected with the landscapes typical to Europe and Asia and passes along the Javakheti-Armenian highlands with landscapes

typical to Asia. At the same time, it penetrates the territory of Turkey and Iran, where humid-sub-tropical arboreal landscapes are present in the Pontic Mountains and Elbrus. The authors of this report share this viewpoint, and hence single out the Caucasus as a separate eco-region among 200 eco-regions existing in the world. This opinion is considered the most substantiated from the geographical and environmental viewpoints.

However, both statistical and other information usually considers the Caucasus in terms of its political and administrative borders. In this respect, there are traditionally three South or Trans-Caucasus countries: Armenia, Azerbaijan and Georgia, and autonomous republics and krays (regions) of the North Caucasus: Krasnodar and Stavropol krays, and the republics: Adigeya, Karachaevo-Cherkessia, Kabardino-Balkaria, North Ossetia, Ingushetia, Chechnya and Dagestan, which are the parts of the Russian Federation. Thus, in the CEO report the Caucasus is treated from this viewpoint.

There are changes recently ongoing in sub-dividing the Caucasus into the "North Caucasus" and "Trans-Caucasus". For specialists from Russia and other northern neighbouring countries who study Caucasus issues, Armenia, Azerbaijan and Georgia are located beyond the Greater Caucasus. That is why the region was traditionally called "Trans-Caucasus". However, after the break-up of the Soviet Union, there appears to be another geographical understanding of the location of these three countries. That is why frequently scientific and political publications refer to the region as the "South Caucasus", involving the territory of three new independent states. The name "Trans-Caucasus" remains only in a physical-geographic sense, and its border is located at the Main Caucasus Range. In this respect, part of the Russian Federation (the Black Sea coastline) is in the Trans-Caucasus and the regions of North Georgia (upstream of the rivers Terek, Assa, Argun and Andian Koisy) and northeast Azerbaijan (the city of Kuba and adjacent to it Mukhtadir, Divichi, Siazan and Kusary regions) belong to the North Caucasus.

Basic Data on the Caucasus

Country		Area thousand km²	Population	Population density person/km²
Total Caucasus		440.4	30 583	69
Armenia		29.8	3 803	128
Azerbaijan		86.6	8 016	93
Georgia		69.7	5 445	78
Russia (N. Caucasus)	Krays	164.2	7 758	47
	Autonomies	90.1	5 561	61

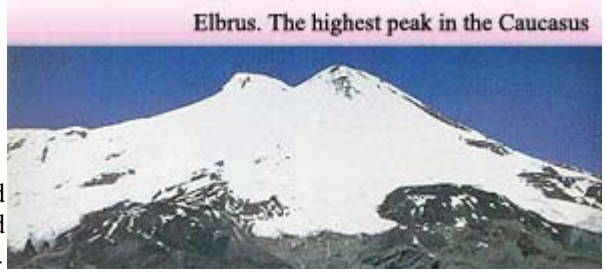
Source: State Statistical Services of Armenia, Azerbaijan and Georgia, Year Books-2000. State Committee for Statistics of the Russian Federation, "Regions of the Russian Federation", 2000

The Russian Federation is now consists of seven federal districts (okrugs). Krays and republics of the North Caucasus are within the South Federal District. Rostov, Astrakhan and Volgograd regions (oblasts) and the Republic of Kalmykia are included in it. If the entire South Federal District of the Russian Federation belonged to the Caucasus, its border would move sharply to the north and the territories added to the Caucasus would have nothing in common with the Caucasus itself, in a physical-geographical and environmental sense.

The North Caucasus involves two completely different parts. The first is represented mainly by pre-Caucasian plains, and in the majority of cases is settled by Russians. There are two krays (regions) of the Russian Federation: Krasnodar and Stavropol. It is one of the richest regions of the Russian Federation, and is characterised by relative political stability.

The other part is connected with the North Caucasus autonomies (Adigeya, Karachaevo-Cherkessia, Kabardino-Balkaria, North Ossetia, Ingushetia, Chechnya and Dagestan), mostly located in the mountains and foothills of the Greater Caucasus. They have diverse ecological and geographic conditions, with their population consisting of local ethnic groups and the regions differing in terms of political stability.

A "backbone" of the Caucasus is the Main Caucasus Range, which extends from the Taman peninsula on the Black Sea, to Absheron peninsula on the Caspian Sea. This range has a direction from northwest to southeast and is 1,500 km. in length. Its highest peak is located in the central part (Mt. Elbrus). Unlike the Alps, the Main Caucasus Range does not have easily accessible passes. The Jvari (Cross) pass is an only motorway laid in the high mountainous part of the Central Greater Caucasus, and thus the Main Caucasus Range remains a difficult barrier to cross.


Elbrus. The highest peak in the Caucasus

It is noteworthy that there are many commonalties in the economic and socio-cultural aspects of its northern and southern slopes. Hence, the Greater Caucasus is often considered a single geographic region.

Source: http://eru.tubankmsk.su/kozylovicau_foto.htm

Geopolitical Location and Ethnic Composition. On the west, the Caucasus is washed by the Black and Azov Seas. The northern border passes the Kuma-Manich depression. Therefore, the North Caucasus joins the rest of the Russian Federation. To the east, there is the Caspian Sea, on the eastern coast of which Kazakhstan and Turkmenistan are located and on the southern coast Iran. On the southern border of the Caucasus lie Iran and Turkey.

The national and religious composition of the neighbouring countries has a great influence on the geo-political situation of the Caucasus.

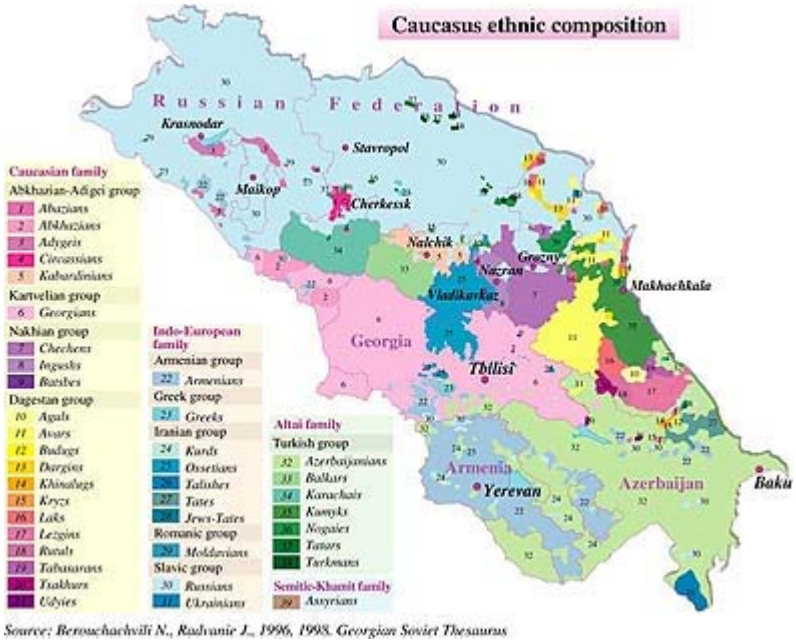
Along with Georgians, the Caucasian language family involves Abkhazs, Chechens, Circassians, Kabardins, and the major ethnic groups of Dagestan.

The Indo-European language family involves Slavs (Russians, Ukrainians, Bulgarians), ethnic Iranian groups (along with Persians, there are Kurds and Ossetians) and Armenians.

The Turkish language group (the majority of population of Turkey, Azerbaijan, Central Asian republics and some minorities of the North Caucasus: Karachais and Balkars) belongs to vast Altai language family.

The Caucasus is located in the geopolitical region where Christian and Moslem worlds are closely inter-related. Religion has a great influence on ongoing political processes in the Caucasus and its surroundings.

Key transport corridors are located in the Caucasus, with the shortest route from Middle and Central Asia to Europe passing through the Caucasus.



Source: Beroutchachvili N., Rudvanie J., 1996, 1998. Georgian Soviet Thesaurus

The transport lines connecting Russia with Turkey and Iran also pass via the Caucasus, and are of great importance as well. Nevertheless, use of the favourable geographical position of the Caucasus for transport is complicated by political and ethnic conflicts. Due to this, many routes traversing the Caucasus remain blocked.

The Caucasus environment is much influenced by existing and planned oil and gas pipelines. The struggle for access to the region's natural resources and adjacent territories considerably influences the political situation in the Caucasus.

Major Physical-Geographic Characteristics. The Caucasus is in the central part of the Alpine-Himalayas mountain chains, starting on the coast of the Atlantic Ocean, embracing the Mediterranean Sea and Middle East, and via the Caucasus leading to the Himalayas.

In terms of climate, the Caucasus is at the junction of sub-tropical and moderate zones. The border between them passes

along the Main Caucasus Range.

Among six floristic worlds globally, the largest area is the Holartic, embracing a greater part of the entire Northern Hemisphere; the Caucasus is located in its southern part. In terms of its vegetation cover as well, the Caucasus is at the junction of the sub-tropical and temperate zones.

In terms of its fauna, the Caucasus belongs to the *Arctoge*, which coincides with the *Holartic* world with some exceptions.

There are eight physical-geographical regions in the Caucasus. The Pre-Caucasus (or North Caucasus plain) is fully located within the Russian Federation and consists of lowlands and lower elevations. The Greater Caucasus is represented by high, difficult to pass mountains. The highest among them Mt. Elbrus reaches 5,642 m. The Trans-Caucasian Depression represented by the humid sub-tropical Colchida and relatively arid East Trans-Caucasus is located to the south. The moderately elevated Likhy (Suram) Range serves a natural divide and is important as a climatic determinant. The Lesser Caucasus consists of relief of medium elevation and generally encloses the arid Armenian Highlands. There are two small, but very specific physical-geographic regions: the North Black Sea (with features of Mediterranean Climate) and Hyrcan (with humid sub-tropical climate and extremely distinct Hyrkan flora) at the northwest and southeast frontiers.

The Place of the Caucasus in the World. Table below presents some important characteristics of the Caucasus. For comparative purposes, average world data and deviations of the Caucasus region from these are given. Analysis of this table enables one to estimate the Caucasus contribution to global processes.

Within the scale of the entire planet, the Caucasus is a medium-sized region. Its total area makes up less than half a percent of the land area of the Northern Hemisphere.

Although the Caucasus is considered a highland region, its average height is 268 m less than the global average. However, if only the Greater and Lesser Caucasus geographical regions are considered, these are 638 m higher than the global average.

In terms of thermal conditions, on average, it is colder in the Caucasus than in other regions of the same latitude. It is as if the Caucasus was actually located several degrees of latitude further northward. It is colder by 4.5 C in January and by 2.8 C in July in the Caucasus. Only in Colchida are the January temperatures close to mid-latitude ones. In the remaining regions, it is relatively colder, with the cooling influence of the powerful Siberian anti-cyclone and results of penetration of cold arctic masses into the Caucasus.

In summer, the temperature of the Caucasus overall is close to mid-latitude values, and in the regions with a relatively continental climate (East Trans-Caucasus), it is 3-5 C higher. The average annual temperature in the Caucasus is 3-5 C lower than that in the same latitudes.

On average, it is drier in the Caucasus than across the globe, with the difference in precipitation reaching nearly 400 mm. If one compares the Caucasus values with mid-latitude precipitation, the Caucasus varies from the global average value by nearly 200mm.

Usually, there is higher humidity in landscapes of Colchida and the Greater and Lesser Caucasus than that in other mid-latitude regions. At the same time, in other Caucasus regions, it is 1.5-2 times more arid.

In terms of thermal and water regimes, the Caucasus overall lags behind average world values, and therefore is like an island of cold and of relative (but not absolute) dryness on our planet.

Some of the Major Physical-Geographical Values for the Caucasus and Globe

Index	Global Value	Value for the Caucasus	Difference
Total area (thousand km²)	510 200	440	0.086%

Total dryland area (thousand km²)	148 100	440	0.30%
Average altitude (m)	870	602	-268 m
Average air temperature in 40° latitude			
January	5.7	-2.8	-8.5°
July	23.2	21.3	-1.9°
Year	14	9.3	-4.7°
Average air temperature in 43° latitude			
January	1.7	-2.8	-4.5°
July	21.2	21.3	0.1°
Average annual amount of precipitation (mm)	1 030	651	-379 mm
in 40° latitude	*850*	*651*	*-199 mm*
Radiation and thermal balance in 40°-45° latitudes (kcal/cm² year)			kcal/cm² year
Total radiation	124	119	-5
Radiation balance	49	46	-3
Heat for evaporation	24	24	0
Turbulent heat exchange	25	22	-3
Annual Water balance in 40°-45° latitude (mm)			
Evaporation	400	399	-1 mm
Water flow	510	259	-251 mm
Biogeocycle (Dryland, t/ha, data of Wetekker,1980)			
Phytomass	123	63	-60 t/ha
Productivity	7.7	7.1	-0.6 t/ha
Mortmass	7.5	1.6	-5.9 t/ha
Zoomass	0.07		

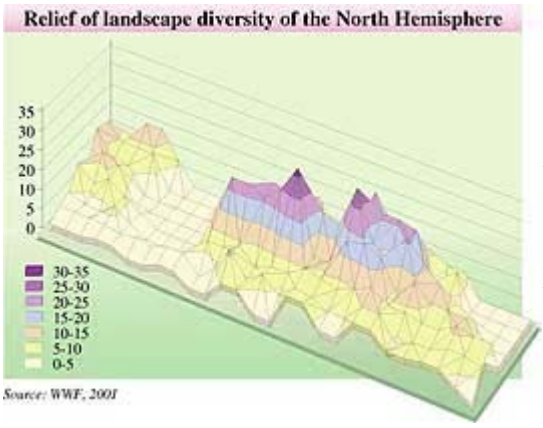
Source: Berschauhvili N., 1995

The Caucasus receives less solar radiation than other mid-latitude regions. However, the difference in this index is less notable than those for thermal and moisture indices. It is noteworthy that lower temperatures compensate for the insufficient amount of precipitation and thus, in the light of the difference in radiation balance, average values of heat for evaporation for the Caucasus and other mid-latitude regions are practically equal to each other.

In terms of radiation balance, only Colchida may be considered a sub-tropical region with landscapes characteristic of such regions (the radiation balance is more than 50 kcal/cm sq.). East Trans-Caucasus and part of the Armenian Highlands are characterised by landscapes ranging from temperate to subtropical.

With values similar to mid-latitude values for evaporation, water flow in the Caucasus is nearly two times lower than average latitude values. Consequently, the heat and water balance is maintained mostly through evaporation, which is close to average latitude indices. Lower values of radiation balance are compensated for by low turbulent heat exchange values. A reduction of water flow, rather than a reduction of evaporation compensate for lower precipitation.

Specific Features and Key Problems. One of the major peculiarities of the Caucasus is high landscape diversity of the region. By this index, the Caucasus occupies one of the highest ranks in the world. A broad spectrum of landscapes is found in the region, starting from humid to arid, from sub-tropical to glacial-nival and from low- to highlands. Based on rough calculations, over 40% of landscape types are existent in the Caucasus, which occupies only 0.5% of the global land area. The Caucasus is thus truly a "landscape laboratory" of the world.



Source: WWF, 2001

Figure "Relief of landscapes diversity of the Northern Hemisphere", or landscape diversity calculated by a five-degree latitude-longitude grid, shows the relief of diversity in the form of a volumetric diagram. On its X and Y-axes, latitudes and longitudes of the Northern Hemisphere are plotted respectively. The height of separate cells corresponds to their landscape diversity, the diversity peaks being easily visible. As it is clear from the figure, the highest level of diversity is characteristic of the Caucasus, the Black Sea region and the north-eastern part of the Himalayas. These regions greatly surpass other parts of the world in terms of landscape diversity, and thus represent "peaks" of landscape diversity globally.

Similarly, the world map of the number of landscapes on a 10 degree-step grid shows that the Caucasus falls into the category of regions with the highest landscape diversity, Georgia being within the group of the first ten countries. By the number of landscapes per unit of area (10,000 km sq.), Georgia appears in first place, far ahead of all other countries.

In terms of biological diversity, the Caucasus lags behind tropical countries, but occupies first place among other regions of the same latitude. The Caucasus is characterised by a high level of endemism: nearly one-fourth of all species are endemic. The Caucasus flora and fauna include many relict species, which have been preserved and inherited from warmer and more humid periods.

Source: WWF, 2000

The high biological diversity of the Caucasus is determined by the region being situated at the junction of temperate and sub-tropical zones, and being affected by both mild Atlantic air masses and the dry continental air of Eurasia. Because of this and its unique natural history, the Caucasus represents a remarkable sub-region in terms of

biodiversity.

One further major peculiarity of the Caucasus is the existence of a comparatively large amount of intact ecosystems and even virgin landscapes. Such landscapes occupy nearly one-tenth of the Caucasian land area.

Overall, the Caucasus is a region, with a relatively clean environment and few environmental “hot spots”.

Finally, one of the specific features of the Caucasus is the high ethno-cultural mosaic of its territory. Many ethnic groups live in the Caucasus, which profess different religions and have quite specific ethno-cultural traditions. In Dagestan alone, in an area of less than 50,000 km sq., there are more than 40 ethnic groups speaking different languages. Very often villages located in neighbouring river gorges do not understand one another, and their populations can only communicate in Russian, which is a state language there.

Among key issues existing in the Caucasus, economic and social ones, connected with the transitional period from a planned to a market economy need to be mentioned. In all the countries of the Caucasus, a general economic decline took place after the collapse of the USSR. Reduced GDP brought about economic and social problems and a “free-fall” in the standard of living. This itself had a two-fold impact on the environment. On the one hand, due to the general economic decline, aggregated pressures from economic sectors (industry, power, agriculture and transport) were reduced. On the other hand, pressures on local environments from both urban and rural communities increased. However, despite the overall reduction in environmental pressures from major economic sectors, per unit pollution increased relative to the 1970s and 1980s, due to the obsolescence or absence of pollution control technologies and the existence of poor compliance monitoring and control systems.

A very important problem for the Caucasus remains armed conflicts. Among them should be mentioned those in Karabakh, Chechnya and Abkhazia. Overall, the Caucasus is characterised by a certain level of geo-political instability. Along with recognised territorial units, there are unrecognised units, often calling themselves “independent states”.

Political conflicts have serious economic, health and environmental implications for the region. On the one hand, military actions themselves cause high casualties, destruction of amenities and environmental degradation in conflict areas. On the other hand, the conflicts create local “hot spots” in terms of refugee camps, where people live under poor sanitary/hygienic conditions and over-exploit nearby natural resources in order to sustain themselves.

Despite relative environmental health, there are nevertheless a number of environmental problems connected with land degradation and soil erosion, desertification, deforestation, unequal distribution of water resources and existence of local pollution “hot spots”.

Specific Features

- High landscape diversity;
- High biological diversity within moderate climate zone;
- Ethnic-religious and cultural diversity;
- Relatively high percent of intact ecosystems and high overall environmental quality with few existing environmental “hot spots”;

Problems

- Economic and social problems specific to countries in transition (overall decline of economic activities, severe budget constraints, high domestic and foreign indebtedness, low GDP growth rate, institutional weakness, etc);
- Geopolitical instability (ethnic wars, political upheavals, etc) and their impact on environment;
- Unequal distribution of water resources;
- Deforestation problems;
- Soil degradation and desertification;
- High occurrence of natural disasters;

Emerging Issues

- Oil spill and biodiversity fragmentation problems related to existing and planned oil and gas pipeline projects;
- Problems with environmental pollution and transit of dangerous goods in TRACECA corridor.

An important problem for the Caucasus is the result of activities related to geo-dynamic processes. In 1988, the Spitak earthquake resulted in about 25,000 deaths. Considerable economic damage was brought about by the Sachkhere earthquake of 1991 and environmental disasters (landslides, mudflows, floods and avalanches) in 1987 and 1989. The Caucasus has always been a region of ongoing major geo-dynamic processes, which seem to have intensified recently, the earthquake of 25 April in Tbilisi being only one example.

In the light of current and future economic trends, the Caucasus may also face the following environmental issues: pollution with oil products and destruction of ecosystems as a result of construction and operation of new oil and gas pipelines; increase in pollution along the transport corridor Europe-Caucasus-Asia (known as TRACECA).

LIMITATIONS

There were several limitations that hindered the CEO report preparation, the majority of these being related to the data problem. Although statistical services in different regions of the Caucasus work with similar methods (at least until the disintegration of the Soviet Union), their data differ in terms of completeness and compatibility. While more-or-less complete historical data exist for Russia, part of these archives is classified.

For the South Caucasus countries, data for the last ten-year period are often lacking or entirely absent, especially for Georgia, where environmental data collection has diminished the most dramatically. Another major issue is the quality of data, with the current system of quality assurance/quality control (QA/QC) malfunctioning.

A final limitation is related to the short time available for the CEO report's preparation and delivery. Within one year, it was necessary to collect data from all four countries, and combine and analyse the same in a coherent way ~ an extremely challenging task.

SOME METHODOLOGICAL CLARIFICATIONS

In this report, data are examined for the Caucasus as a whole and individually for all three South Caucasus states (Armenia, Azerbaijan, Georgia) and the North Caucasus. In general, output data were generated by summarising or averaging raw data for the South Caucasus states and autonomous republics (Adigeya, Karachaevo-Cherkessia, Kabardino-Balkaria, North Ossetia, Ingushetia, Chechnya and Dagestan), and provinces or 'krays' (Krasnodar and Stavropol) of the North Caucasus.

However, some specific difficulties were experienced while working with data for Chechnya and Ingushetia. The problem is that during the Soviet period, they formed a single autonomous republic, which only broke up in the early 1990s. In addition, during the last ten years, Chechnya has been engulfed by conflict, and thus current statistical data on Chechnya either do not exist, or are insufficient.

The data for South Caucasian autonomies are even more incomplete. For those autonomies, currently or previously engaged in military conflicts (e.g. Abkhazia and Karabakh), data are practically absent.

During the Soviet period, republics, autonomies and provinces ("kray") were divided into administrative districts ("raion"). In 1989, there were 390 administrative districts in the Caucasus. Currently, administrative districts still exist in all states except Armenia. Instead of 29 districts, regions have been formed ("oblast"). As to Georgian districts ("raion"), they are further united into bigger provinces ("mkhare" or "kray"). In some cases, data are given by administrative districts and cities.

A specific feature of this report is the so-called "landscape approach". The main idea is that there are as many as 20 distinct landscape types (for a western audience, a more familiar term would be "ecosystem" instead of "landscape") in the Caucasus, as well as 40 sub-types and 152 genera. By using a GIS analytic method, an attempt has been made to compute and design features closely related to natural and social differentiation of an area for these landscape units (population density, number of urban and rural population, area of arable lands, wooded areas, etc.). The reason for using

a “landscape approach” is that first, the Caucasus has extremely distinct and clearly-defined landscape components that make the idea of using administrative units for spatial allocation of some geographical or environmental features very irrational. Secondly, the same landscapes in different Caucasus countries are characterised by similar sets of environmental and geographical features and processes. Thirdly, pollution or other environmental processes do not recognise administrative boundaries and are limited only by natural borders. Finally, what is probably most important, the uniqueness of the Caucasus may only be understood through this natural-ecological mosaic and landscape differentiation.

So-called “hot spots” play a very important role in understanding the mechanisms of pollution and the state of the environment of specific territories, as they have polygonal, linear and point features. Therefore, this study gives much attention to description and analysis of pollution distribution.

However, neither a landscape approach, nor the analysis of smaller administrative districts and hot spots' distribution meets regional requirements, but only covers local features instead. Therefore in this report, the reader will find only maps showing local characteristics and trends for environmental changes in the Caucasus, as description and analysis of these maps and local features would require much time and space.

At the same time, it is perfectly understood that in terms of making real sense the further ideology of the CEO process should focus to the local levels more closely. Or saying in other way, it is necessary to keep moving from Global to Regional, then from Regional to Sub-Regional and finally to Local levels. Only after such in-depth analysis of environmental conditions, it is reasonable to move backward up the chain of synthesis at regional and global levels. Temporal analysis is also very important for the global study. Only such spatial-temporal interpretation of modern processes can address new requirements of forecasting changes in the global environment in our planet. It is hoped this first CEO report will represent a major step in doing so for the Caucasus region.

BACKGROUND ANALYSIS OF REGIONAL SOCIO-ECONOMIC AND HISTORICAL-POLITICAL EVENTS FROM 1972-2002

An analysis of regional environmental and socio-economic trends is impossible without analysing major historical and political changes which have taken place in the world during the last 30 years.

Why does the Caucasus Environmental Outlook (CEO) report focus on the period from 1972 to 2002? In 1972, the first global environmental conference was held in Stockholm. From that time onward, the world community began to pay more attention to environmental issues. During this period, the Caucasus was a part of the Soviet Union, and its industry, agriculture and transport were developed at accelerated rates, increasing pressures on the environment. At the end of the 1970s, some economic contraction occurred, when the rate of industrial growth declined.

Nevertheless, industrial growth continued to increase, though at lower rates, reaching its peak in the late 1980s, and accompanied by greater environmental pollution.

In 1985, Michael Gorbachev and his team of reformers began their rule of the Soviet Union. Their initial intentions were noble, being to improve the situation in the country and initiate the full-scale reform known as “Perestroika”. However, the measures were not planned appropriately and were carried out arbitrarily. As a result, the environmental situation became even worse. A series of ethnic conflicts broke out in Karabakh, Abkhazia and other regions of the Caucasus. The overall situation was aggravated by a series of natural disasters in 1987-1991. The Spitak and Sachkhere earthquakes, and avalanches, landslides and mudflows in Svaneti and Ajara, not only cost thousands of lives, but also resulted in billions of dollars of economic losses. However, industrial and agricultural production nevertheless remained significant.

1991 was a year of a drastic change in the situation of the Caucasus. During this period, the Soviet Union broke up, and three independent states - Armenia, Azerbaijan and Georgia - were established in the South Caucasus.

The late 1980s and early 1990s were marked by a series of political conflicts (Abkhazia, Chechnya, Karabakh, and Former South Ossetia) that significantly worsened the situation in the Caucasus. Traditional economic ties were broken and countries began the transition from planned to market economies, however haltingly. All these factors contributed to the dramatic decline of the Caucasus economy. This was also followed by a decline in population growth, and in some

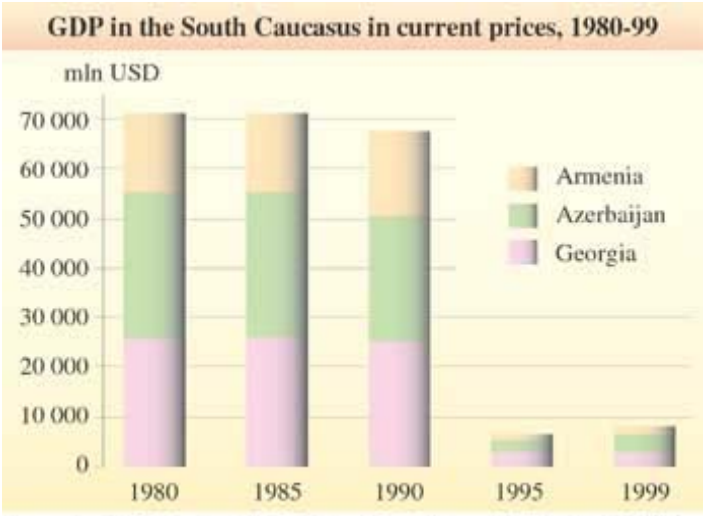
cases even decline in absolute population size in some of the countries and regions of the Caucasus. Consequently, environmental pressures were reduced and the state of the environment improved in terms of some aspects. Since the late 1990s, some signs of stabilisation could be observed, with modest economic growth at the end of the 1990s and beginning of the 21st century. However, the level of growth of the 1980s has not yet been achieved by many economic sectors.

At present, there are four countries (three South Caucasus states and the Russian Federation, represented by the North Caucasus) with transitional economies in the Caucasus, whose major common objective is to build on the current level of democracy and overcome existing economic difficulties.

CHAPTER 1. REGIONAL TRENDS OVERVIEW

1.1 General Information

During the Soviet era, the Caucasus economy was centrally-planned by the Soviet super-state. Management served more to strengthen the economic and political goals of the state rather than meet market demand. All natural resources and means of production were state-owned. The centralised system played the role of stable guarantor of economic relations between the republics, but the economy of the republics was dependent on Russia.

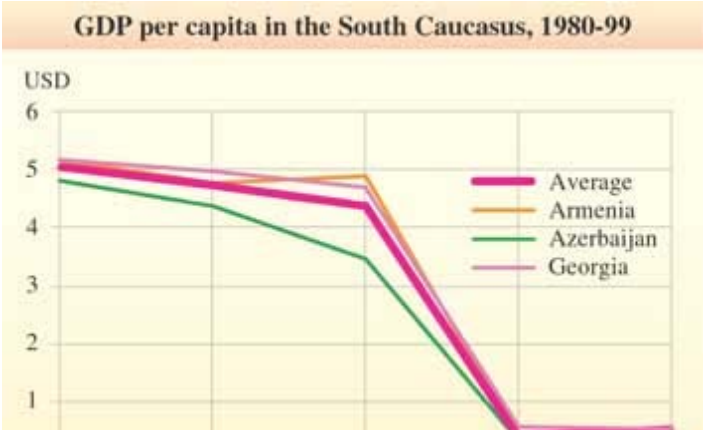


Source: State statistical services of Armenia, Azerbaijan and Georgia, Year Books, 1970-2000

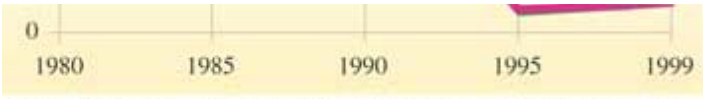
Before the break-up of the Soviet Union, the Caucasus was referred as two economic regions: the North Caucasus (including Rostov region) and the Trans-Caucasus. The latter involved three republics: Armenia, Azerbaijan and Georgia. These economic regions were specialised in several sectors. The tourism sector was also well-developed especially the Black Sea resorts from Anapa to Batumi and the Caucasus Mineralnye Vody (mineral water resorts). In the past, a steady flow of tourists came to the Caucasus, but that flow has been drastically reduced in recent years.

The Soviet economy was more or less stable under the conditions of a planned economy, with growing industrial production and intensive agriculture. A relatively high economic growth rate and standard of living were achieved in the 1970s and 80s, along with a steady growth in GDP. The peak of growth was reached in the late 1980s. The early 1990s, however, were marked by downward trends, explained by overall economic decline. In the South Caucasus, for example, GDP fell to its lowest level in 1992 (1.1$ billion).[1]

Recently, a slight growth of GDP has been observed. However, the growth rate is far below 1970s figures and is unsteady. GDP growth is largely due to the growth in the service, communications and trade sectors. In other sectors, an increase has taken place in mining and oil production. Agriculture is still the most important economic sector for entire region, employing a majority of the adult population. It is noteworthy, that the North Caucasus economy significantly overweighs that of the South Caucasus. By the year 1998, its share of total Caucasus GDP was 77.7%. It was also higher than that the South Caucasus in the 1970s and 80s.



After the collapse of the Soviet Union, economic ties



Source: State statistical services of Armenia, Azerbaijan and Georgia, Year Books, 1970-2000

among the republics were broken, resulting in sharp reductions in production, imports and exports. Trade with other former Soviet republics was suspended. The economies of the newly independent states (NIS) could not compete in western markets. The region was most damaged by its high degree of economic specialisation. Industrial and agricultural production failed to meet the demand for basic consumer goods.

The severe economic crisis of the early 1990s affected nearly all economic sectors. Industrial enterprises stopped functioning and agricultural output declined. Production of fruit, tea, tobacco, cotton and wines declined. Hyperinflation deepened the crisis; as the purchasing power of salaries and pensions declined, the standard of living fell. Political instability aggravated the situation.

The beginning of the 1990s should be considered a transition from a centralised system to a market economy, but a period of economic destruction. The crisis was followed by some political stabilisation, beginning in 1994-95. However, some "hot spots" of political tension still exist in some areas of the Caucasus and continue to impact the region's social and economic life.

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1 - GDP figures expressed in current rates do not reflect the real situation. The Soviet Union practised "imaginary" dollar rate, or saying more precisely, there were several currency rates running at the same time. Therefore, it is very difficult compare data of different periods. It is clear that data on Soviet period is artificially lifted up and data on last half of the 1990s in turn is lowered. Therefore, economic decline is even more obvious.

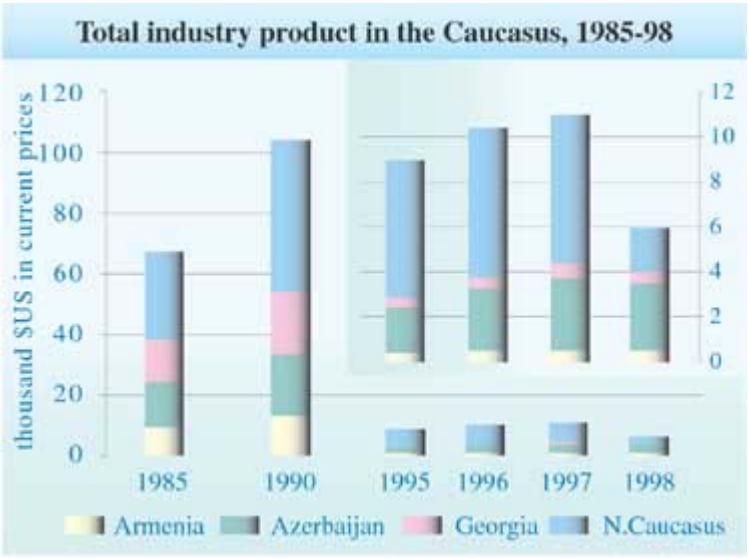
CHAPTER 1. REGIONAL TRENDS OVERVIEW

1.2 Socio-Economic Driving Forces

1.2.1 Economic Driving Forces

1.2.1.1 Industry

General. In the 1970s and 1980s, industry in the Caucasus was well-developed. The major industrial sectors were: oil and gas, chemicals and machinery industries, ferrous and non-ferrous metallurgy, cement, fertiliser, light manufacturing and food processing.



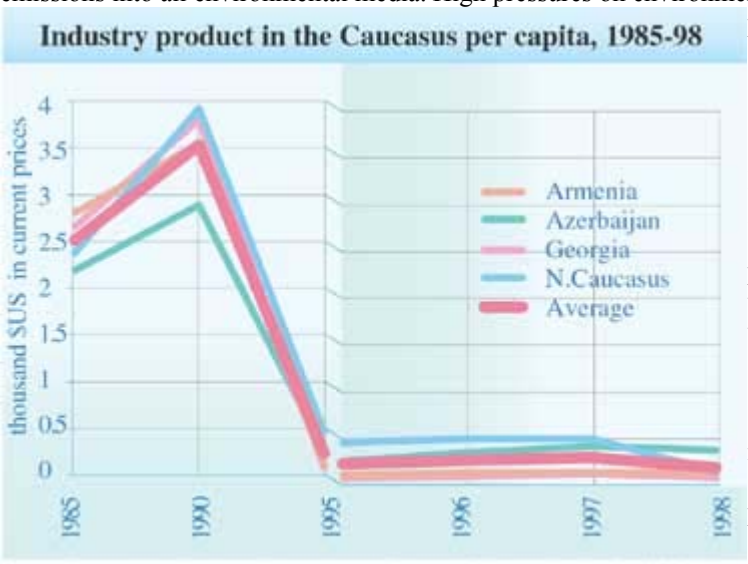
Source: State statistical services of Armenia, Azerbaijan and Georgia, Year Books, 1970-2000
State Committee for Statistics of the Russian Federation, "Regions of Russian Federation", 2000

In the Soviet period, rapid industrial development resulted in increased environmental pressures. From 1970 to 1990 overall production, for example, increased three times in the South Caucasus. However, the level of industrial development was still less the union average value. After the USSR was dismantled, industrial production sharply declined in the Caucasus region, because of the energy crisis and the break of economic ties between the former Soviet republics. Recently, some signs of industrial revival have appeared. However, the growth rate is still insignificant.

In general, industrial activities are not equally distributed across the region. Most industrial centres are located in lowland

zones along the railways, concentrated in large cities.

Manufacturing Sector. Some of the most important environmental problems in the Soviet period were connected with manufacturing industries. The Caucasus was not as heavily industrialised as European Russia, and suffered less environmental pollution, but the impact of industry on the environment was not unimportant. Of the heavy industries, oil processing, chemical, metallurgical, machinery and cement manufacturing plants were built, which created some of the most significant centres of pollution. Beginning from the 1970s until the disintegration of the USSR, the increasing trend of impact on the environment from stationary sources was observed, in spite of the fact that a number of environmental legal acts were adopted and Soviet standards were among the strictest in the world. However, the lack of law enforcement from the government side and pollution controls from industry side contributed significantly to increased emissions into all environmental media. High pressures on environment from industry were traditionally due to extensive power and raw material consumption. Explanations for these can be attributed to many causes, the basic among them being the political-economic arrangement of the Soviet Union.



Source: State statistical services of Armenia, Azerbaijan and Georgia, Year Books, 1970-2000 State Committee for Statistics of the Russian Federation, "Regions of Russian Federation", 2000

In general, the major focus was on economic growth and rapid industrialisation, without proper consideration of environmental issues. In centrally planned socialist systems, all means of production were owned by the state. Practically no attention was paid to the efficiency implications of pricing. State planners set minimal or no prices on inputs in order to promote industrial development. Consequently, the Soviet economy was extremely resource-intensive with economic sectors, including industry, over-utilising natural resources and polluting all environmental media.

Industrial production was significantly reduced in the 1990s. At present, some industrial sectors of industry are not functioning or are in severe crisis (working at 20-25% or less capacity). The fall of industrial production has resulted in some reduction in water and air discharges and industrial waste generation from stationary sources. Nevertheless, the reduction of environmental pressures from industry was not followed by major improvement in the state of the environment. "Old" sources of pollution, toxic industrial wastes, heavy metals accumulated in the ground, obsolete technologies and pollution control equipment remain important factors contributing to environmental pollution and degradation.

Mining Sector. An important factor influencing the environment, both during the Soviet period and today is open-pit mining operations (non-ferrous metals, manganese, coal, gravel, sands, quartz sand extraction), which are common in the Caucasus. Prospects for future development of extensive mining are likely. Therefore, the mining sector will remain an important factor affecting the environment. In many places, open mines are located on household plots and agricultural lands, causing land degradation, creation of badlands and development of geo-dynamic processes. Some of the mines situated at relatively high altitudes impose a direct threat to fragile mountain ecosystems and affect lowland habitats downstream from such mines. There are few land reclamation works, but where they occasionally are, they yield no results in mountainous areas.Of particular concern are tailings from extractive and processing operations. There is a high risk that pollutants from these tailings may leach into water systems. This often occurs in the regions where ores are being extracted. Oil and gas-prospecting companies in the Baku-Sumgayit area and the North Caucasus (Krasnodar, Grozny and Maikop) form important centres of pollution as well. Since the mining sector experienced a lower decline than the manufacturing sector in the 1990s, it is a proportionally larger force in the economy.

- Oil has been of greatest importance for Azerbaijan all through its history. Evidences of oil extraction on the Absheron peninsula have existed since the 5th century AD In 1897-1907, the 833 km long Baku-Batumi oil pipeline was built, which was the largest in the world at that time (one of the first oil pipelines in the world was built in Azerbaijan in 1878). In 1901, Absheron was the largest oil producer in the world (it accounted for over 50% of the world's extraction). Before World War II, Azerbaijan was the greatest oil extracting and supplying region of the USSR, with s share of total oil extraction. However, this was not followed by important rise in socio-economic conditions in the republic. Moreover, the state of the environment has become worse. Current levels of oil production in Azerbaijan are far below the 70s and 80s levels explained by reduced oil reserves, out-of-date technologies, inadequate investments, etc. It is noteworthy to mention that Caspian oil has made the Caucasus a strategic region.

  In the Caspian seashore, the extensive extraction of oil has been conducted for more than a century. Therefore, its influence on sensitive aquatoria and densely populated area is quite high. Near Baku oil has heavily polluted around 10,000 hectares of land. In former USSR the area of Absheron peninsula was considered the region the most polluted by oil products, where pollution was 32 times higher than the background level. In the 1970s, the discharge of polluted water into the sea was prohibited, but that brought about no major changes. Wastes, which were neither buried nor utilised, were disposed of on the shore. Therefore, during storms they returned to the sea. This had negative impact on flora and fauna.

- In Chiatura (Georgia) manganese quarries, thousands of hectares of agriculture lands have been excavated and become useless. As a result, erosion and landslides have become extensive, comprising a high threat to settlements. Tailings formed because of ore enrichment have accumulated in high quantities. Waste-waters with high manganese concentration have been heavily polluting River Kvirila.

- Madneuli (Georgia) non-ferrous metal (copper, lead, zinc and also gold) mine is one of the largest in the Caucasus. It has been exploited since 1970s. The surrounding environment is much degraded and arable lands are useless. Open pit waters of the deposit-based ore processing plant pollute the Kura river tributaries. In 1992, the copper content in the Kazretula River was 220 times higher than legal standard and zinc content was 65 times higher. About 20-30,000 people live in this area. Local agricultural products (mainly vegetables) are supplied to the inhabitants of the city of Tbilisi and its surroundings. Air is also polluted by heavy metals (cobalt, chromium, cadmium, nickel, arsenic, others), where the amount of dust emitted annually amounts to 31 tons.

- In Tyrnyauz (Kabardino-Balkaria, the North Caucasus) tungsten and molybdenum has been extracted and enriched since the Soviet times. After the short break, the industrial activities were re-newed here in 1994, although adequate environmental actions were not undertaken. Consequently 5,527 t suspended substances, 0.1 t of molybdenum and 0.07 t arsenic flow into the Baksan River annually.

Sources: IUCN, 2000; Tvarlchrelidze A. 1998; MoE Documents; Jaoshvili V. 1996; State Committee on Ecology and Control of Natural Resources Utilization 1998, Baku; State Committee of USSR on Nature Protection, 1989; G.Info, 1996.

CHAPTER 1. REGIONAL TRENDS OVERVIEW

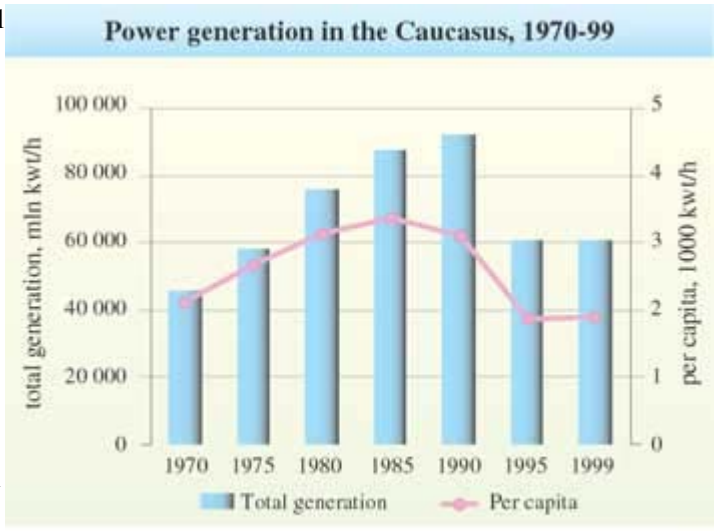
1.2 Socio-Economic Driving Forces

1.2.1 Economic Driving Forces

1.2.1.2 Energy

Two major sources are used in the energy sector of the Caucasus: fuel and hydro power resources. They are not distributed equally across the region, one reason for the chronic power shortage in some parts of the region. A major part of the energy resources comes from hydro resources, comparatively less from fossil fuels.

In the Soviet period, the centralised system of electrical power production provided its non-stop delivery to consumers. Thus, in the region there were no real power shortages despite the fact that in some periods, energy consumption exceeded production. The deficit was filled by electricity imported from other Union republics. In the 1990s, this was more difficult as the centralised system broke-up and fuel prices on the world market were high. Since 1985, power shortages have been a problem for Georgia particularly. It made up in average 2.325-3.64 billion kW/h (Svanidze, 1998).



Source: State statistical services of Armenia, Azerbaijan and Georgia, Year Books, 1970-2000 State Committee for Statistics of the Russian Federation, 1998-2000

Until the end of the 1980s power generation and both industrial and household consumption were steadily increasing. Energy generation increased 2.3 times from 45.9 billion kW/h up to 108.3 billion kW/h. between 1970 and 1990 (Georgia was the only republic where electricity production started to decline from 1985, while its annual consumption increased). At the beginning of the 1990s, power generation declined considerably, falling to 75.7-72.2 billion kW/h from 1995-98. The amount of power generated by hydroelectric plants grew in proportion to all power generated. All this indicates that there has been a reduction of air pollution from power plants. However, in recent years, a slight increase in power generation has occurred.

Considerable changes have occurred in the structure of power consumption as well, with increases in household consumption and decreases in the industry, agriculture and transport sectors.

A considerable number of environmental problems are related to the power sector. This is particularly visible in the surroundings of large power plants, although it should be taken into account that natural gas, which causes less pollution of the atmosphere, is used quite widely in the region. Power plants can have environmental impacts over quite long distances. Water used by thermal power plants pollutes trans-boundary rivers and adjacent areas. Building of hydropower stations can negatively influence coastal zones causing soil erosion and destruction of beaches. In this regard, the Black Sea resort zone has experienced significant damage.

Two large nuclear power sources are the Medzamor nuclear plant, in Armenia and the Rostov nuclear power plant, located in the region adjacent to the Caucasus. These plants are important risk factors for the region. Were an accident to occur at the Medzamor plant, for example, the South Caucasus and much of the Middle East would face particular danger. This risk is increased by the fact that the region is a highly active seismic zone.

CHAPTER 1. REGIONAL TRENDS OVERVIEW

1.2 Socio-Economic Driving Forces

1.2.1 Economic Driving Forces

1.2.1.3 Agriculture

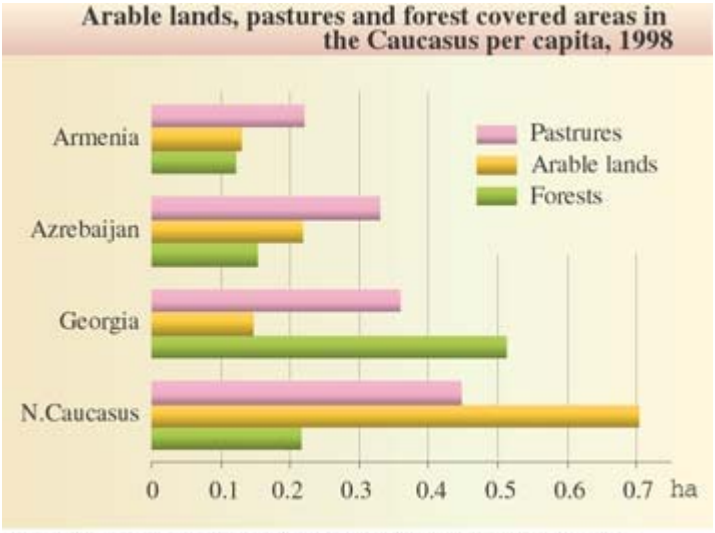
General. During the Soviet era, agriculture was one of the leading sectors of the Caucasus economy. Favourable and diverse climatic conditions and fertile soils promoted the development of comparatively productive agricultural sector there. The Caucasus was an important agricultural region, supplying goods to the entire USSR, including corn, grapes, tobacco, cotton, fruit, tea and citrus. The Caucasus was the only region in the FSU, where tea and citrus were produced. At present agriculture remains the major economic sector in the region, employing a significant amount of the population. Over a certain period, the Caucasus share of the Soviet Union's total output was approximately 20%, while its area was only 2% of the territory of the Soviet Union (WWF, 2001). The abundance of agricultural goods created the basis for developing the food industry (canneries, wine etc).

Despite this, agricultural production failed to satisfy the demands of the Caucasian population for many primary products. The main reason for this was the high specialisation of agriculture, which emphasised the production of technical raw material as a production base for industry over primary food products. That is why a deficit of numerous food products existed and it was necessary to import these products from other countries.

Overall, Soviet agriculture was highly inefficient and had a poorly equipped infrastructure. Losses in agriculture output were high, while the natural fertility of soils fell in most agriculture regions of the country after 1960. Resources were inefficiently allocated within the sector. Even agriculture branches and regions that were not economically viable were subsidised. According to estimates, environmental pressures were more than twice as high as overall land productivity in the Soviet Union. During the period from 1970 to 1980, a 1% growth in agriculture production was achieved by 4% growth in sector expenditures (Ministry of Nature Protection of Russian Federation, 1994). Thus, over time Soviet agriculture became a resource intensive and inefficient sector, with high pressures on the environment. Caucasus agriculture was not unlike that of the entire Soviet Union.

After the USSR's collapse, basic changes took place in the structure of agriculture. The Caucasian republics, which traditionally produced excess agricultural output, began to experience shortages. Numerous plantations and orchards gave way to pastures, arable lands and cornfields.

Agriculture Lands. In the Soviet period, arid lands were irrigated and marshy places drained in order to transform them into agricultural lands. Despite these efforts, there has been a decrease in the amount of arable land, caused basically by unsustainable land use practices. At the same time, pastures increased at the expense of arable lands. This has not had a uniform impact on the economy of the region. In the regions rich in winter pastures, for example in the North Caucasus, the food base for livestock increased.



Source: State statistical services of Armenia, Azerbaijan, Georgia and RF, Year Books, 1998

Land resources are not distributed equally in the Caucasus. At present, the total area of arable land is 12.4 million hectares. Current reduction for land is connected with different factors (land erosion, land salinization and secondary bogging, etc.). This tendency is particularly evident in the North Caucasus. However, the North Caucasus share in the total area of the Caucasus arable lands is 83.1%. Armenia and Georgia experience a lack of arable lands.

Highland summer pastures are the major source of fodder in the region, and they cover vast areas in the Greater and Lesser Caucasus. Summer pastures are particularly abundant in the North Caucasus (Kislar pastures in Dagestan and Checheno-Ingushetia) and Azerbaijan (Kura-Araks lowland). Relatively small areas are found in Georgia (Yeldar lowland, Kvemo (Lower) Kartli plain). Hence, the problem of over-grazing is common to the region. The problem is very acute in sub-alpine and alpine zones, which are affected by intensive erosion processes and have lower bio-productivity.

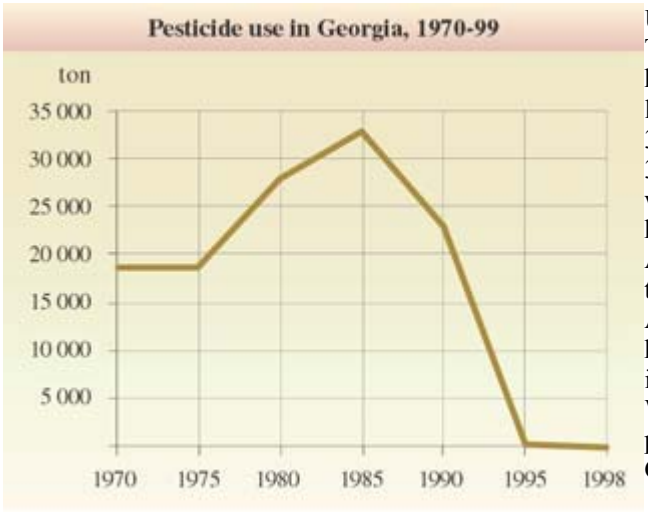
Agriculture lands. Georgia
Source: Soviet Georgia. Tbilisi, 1981

Overall, extensive land cultivation over recent decades has resulted in reduced land productivity and erosion, and has led to the abandonment of some areas on hillsides. Over the last 30 years, there has been increased conversion of semi-desert, steppe and wetland habitats for cultivation, resulting in the loss of some important sites, and increased threats to species. For example, the amphibians and reptiles of the Araks Valley are now threatened because of habitat loss, and the diversity and populations of breeding birds has been reduced as their food sources have decreased. (UNEP/MNP of Armenia, 2000).

Irrigation and Drainage Systems. Irrigation and drainage systems are essential for Caucasus agriculture. Without agricultural irrigation, it is impossible to grow the main agriculture crops in the East Caucasus: Azerbaijan, East Georgia, and the Ararat Valley. It is precisely here that significant amounts of arable lands exist. Cotton, cereals, rice etc. are grown on irrigated lands. Irrigation and drainage systems have been used in the Caucasus since historical times. The intensive development of such systems began in 1920-30s and consequently, a large network was built.

Headwork of Karabakh irrigation channel. Azerbaijan
Source: Efremov I Nature of my country. Moscow 1985

Environmental pressures are high from irrigation systems. On the one hand, irrigation is one of the major water users in the region. Since losses in the systems are high, water resources are both inefficiently used, and over-utilised. On the other hand, unsustainable irrigation practices in the region are leading to a rise in the water table, erosion processes, secondary bogging or salinization of soils, loss of soil fertility, etc. For example, increased salinity is observed in 42,000 ha of land in the Ararat Valley (UNEP/MNP of Armenia, 2000). Water with high salt content (more than 1g/l) is mainly used in the South Caucasus. Therefore, the accumulation of salts and bad soil conditions are frequent. Some arable lands are located on slopes greater than 5 degrees, accelerating the erosion process. This impact is particularly high due to the extensive use of gravitational irrigation and absence of regular canal cleaning.



Source: "Sakagroservisi", JSC

Use of Fertilisers and Pesticides. Traditionally, mineral fertilisers and agro-chemicals were heavily used in the Caucasus region and reached maximum levels in the 1980s. In Armenia, for example, more than 300,000 tons of fertilisers, with usage reaching a height of 369,600 tons in 1986, and 6,000-7,000 tons of pesticides were used in the 1980s. Average pesticide use was about nine kg/ha by public farms (UN-ECE/MNP of Armenia, 2000). In Azerbaijan, this figure amounted to about 33 kg/ha by that time (State Committee of Natural Resources Protection, Azerbaijan, 1997). In Georgia, about 250,000 tons (240 kg/ha) of fertilisers and 29-34,000 tons pesticides were used in the late 1980s (WB/MoA of Georgia, 1996; WB, Washington, 1996). In the USSR, the soils most heavily polluted by DDT are found in Azerbaijan and Armenia (State Committee of Nature Protection of the USSR, 1989).

In general, the Soviet system for distributing and storing agro-chemicals was very inefficient, characterised by high losses, and resulting in water and soil pollution. On the other hand, the system was centralised; hence it was easy to control the distribution and the use of chemicals. There was no media-specific law to regulate the field. Separate institutions were responsible for the handling, storage and use of chemicals, provided they met sanitary requirements, norms or rules established by the central authority.

Since the break-up of the Soviet Union, the use of fertilisers and pesticides has dropped dramatically, reducing some of the environmental pressures from agriculture. For example, in Georgia the use of fertilisers has declined from about 240-

250 kg/ha in the late 1980s to only10 kg/ha in 1994 (WB/MoA of Georgia, 1996). In Armenia, only 10,000-15,000 tons of mineral fertilisers are used at present, which is less than 3% of previous levels (UN-ECE/MNP of Armenia, 2000). Pesticide use has decreased as well.

Although the use of chemicals has significantly declined, soil pollution, has not significantly lessened as a result. Heavy metals used in agro-chemicals are still accumulated in soils in large amounts.

Obsolete fertilisers and pesticides, stored in warehouses not meeting minimal environmental standards, have adverse impacts on soil and water quality. Uncontrolled import and use of chemicals is a common phenomenon for the whole Caucasus (as well as for the entire former Soviet Union). Under such conditions, some chemicals are used (DDT, DDE, etc.) that are banned world-wide. Development of small-scale individual farming has also led to the incorrect use of chemicals. There were cases when the use of unknown pesticides caused destruction of agricultural crops.

CHAPTER 1. REGIONAL TRENDS OVERVIEW

1.2 Socio-Economic Driving Forces

1.2.1 Economic Driving Forces

1.2.1.4 Transport

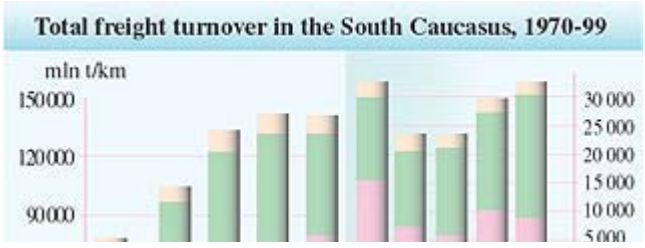
Mountain roads on the Greater Caucasus
Source: Soviet Georgia. Tbilisi, 1981

General. From the viewpoint of transport, the Caucasus has strategic location. On the one hand, it is a "bridge" connecting West Europe with Central Asia (east-west direction) and, on the other hand, Russia with Middle East (north-south direction).

The favourable transport location of the region is caused by two factors: location between economic fuel "extracting" (Central Asia) and " consuming" (Europe) regions; and its coastal location. The Black Sea connects it with Southern European countries, and the Caspian Sea – with Russia, Central Asia, Iran and Volga-Baltic states through navigation canals.

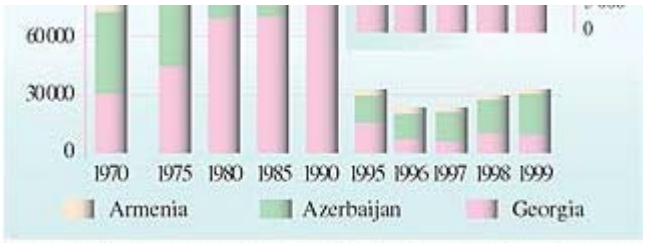
The development of the proposed TRACECA (Transport Corridor Europe-Caucasus-Asia) route connecting the Black and Caspian Seas would be a basis for future development of the region's economy. This, however, may also have some negative impacts on natural environment.

In the Soviet period, the Caucasus was a peripheral region of the USSR, isolated from the rest of the world. Most transport mainly served cargo and passenger shipments within the country. In the 1970s-80s, economic relations among sister republics were mainly implemented by railway and marine transport, and with foreign countries by sea. The harbours of special importance were Baku, Novorossiisk, Tuapse, Poti, Batumi and Makhachkala. In transportation, the main commodities were oil, oil products, manganese, coal, metals, chemical products, timber, grains etc.



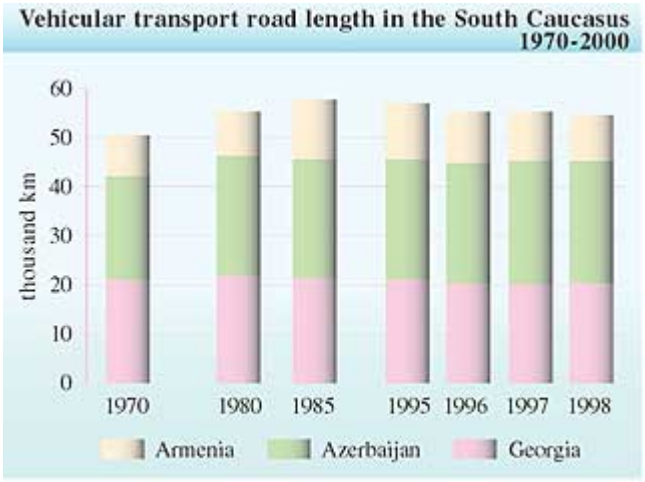
In 1970-88, total freight turnover increased in the entire region. In the South Caucasus, for example, it nearly doubled from 78,2 billion t/km to 154,6 billion t/km. In total value Georgia's specific share was 40-50%. From 1990, in parallel with weakening economic links, the freight turnover sharply weakened reaching a minimum of 23,6 billion t/km in 1996 in the South Caucasus. However,

a tendency of growth in freight turnover has recently been noticed again.



Source: State statistical services of Armenia, Azerbaijan and Georgia, Year Books, 1970-2000

Motor Transport. Similar to other regions of the world, motor transport was an important source of air pollution in the Caucasus over the last decades, and its impact continues to grow. One of the most problematic issues related to transport emissions is ground level ozone, which forms "summer smog." The cities with valley type terrain, poor ventilation and frequent low temperature inversions suffer the most. In the Caucasus, Yerevan, Vanadzor and Tbilisi, etc. are characterised by such natural conditions. However, ground-level ozone problem is not as acute for the Caucasus cities as for large cities of Europe and America.



Source: State statistical services of Armenia, Azerbaijan and Georgia, Year Books, 1970-2000

Passenger cars are the major sources of ambient air pollution in the Caucasus. A significant increase in the amount of passenger cars was observed in the 1980s. The early 1990s were marked by a downward trend, at least for the South Caucasus. Since the mid-1990s, traffic-related pollution has become a more critical issue.

Overall, in the Caucasus, increased pollution from traffic is more related to obsolete car fleet and low quality of fuel used rather than the number of vehicles. Poor vehicle inspection-maintenance systems have led to an increase in "gross polluter" cars.

Oil and Gas Transportation. The Caucasus is a significant region not only for fuel extraction, but also in its transportation. Pipeline construction here dates back to the 19th century, when building of oil pipelines began in this region, with gas pipelines starting later. Over recent decades, the total length of pipelines has increased in the region. Growth has been particularly significant since the 1980s. In the 1970s-80s, the pipeline share of total freight turnover has increased gradually. In Georgia, for instance, from 1970 to 1983 its percentage share increased from 10.4% to 30% (Kverenchkliladze, 1986).

The fuel was transported through pipelines from gas and oil producing regions (Azerbaijan and the North Caucasus). Major oil pipeline routes were Baku-Tbilisi-Batumi, Izberbash-Grozny-Krasnodar/Rostov, and gas pipelines Vladikavkaz/Stavropol-Tbilisi-Yerevan.

In the early 1990s, oil and gas transportation declined dramatically. However, an upward trend is observed again at present, which threatens to increase the risk of oil spills and hence, environmental pollution.

At present, there are large-scale pipeline projects of international importance planned or being currently constructed in the region to develop a transport route for crude oil from Azerbaijan and Central Asia. These may pose high pressures on the environment. It is projected that by 2020 the daily rate of oil extraction will reach approximately 3-5.5 million barrels in the Caspian region, through projects already developed (Utiashvili, 2000).

In general, environmental impacts of pipelines during both the construction and operation phases are significant. Some of the pipelines in the Caucasus cross the protected areas, water recharge regions, archeological sites, etc. In terms of environmental pollution, a high risk is imposed to marine ecosystems from oil loading tanks. Significant impacts can also come from cargo ships carrying crude from Kazakstan to the Dubend terminal in Azerbaijan and from the Supsa Terminal in Georgia to Western countries.

CHAPTER 1. REGIONAL TRENDS OVERVIEW

1.2 Socio-Economic Driving Forces

1.2.1 Economic Driving Forces

1.2.1.5 Forestry

Destruction of forests in different parts of the Caucasus is connected with human activities. Scientists consider that the deforestation on Javakheti Plateau, Shida Kartli plain, northern slopes of the Caucasus and areas between the rivers Zelenchuk and Baksan are due to anthropogenic factors as well as natural ones. Many historical documents indicate that formerly forest-covered areas rich in fauna are now occupied by steppes, shrubs, and degraded and thinned forests or by human settlements.

Destruction of the Caucasian forests became very intensive in the 19th century, when foreign owners exported timber from the region. Extensive logging was particularly noticeable in the first half of the 20th century. In the 1970s-80s, mass woodcuts in the Caucasus were limited due to import of comparatively cheaper timber from Siberia (Russia). That is why mountain forests here remained more or less untouched. Apart from this, most of the Caucasus forests according to adopted forestry codes belonged to the first category forests, where commercial logging was banned. Finally, high attention was also paid to selective cutting and reforestation for forest regeneration purposes.


Strawberry tree (Arbutus andrachne)
Source: Petrov V. Vegetation of my native country

However, non-sustainable wood cutting methods used at that time did not support the regeneration of Caucasus forests. Felling was conducted by extensive use of heavy machinery. Local ecological peculiarities were rarely taken into consideration.

Commercial logging has dropped significantly following the post-Soviet economic crisis. At the same time, reforestation and selective cutting for forest regeneration purposes have declined as well due severe budget constraints.


Albicia (Albizzia julibrissia Durazz). Talish Moun. Azerbaijan
Source: Petrov V. Vegetation of my native country. Moscow, 1991

At present, the increase in population impact on forestry resources is caused by the socio-economic crisis in the Caucasus. Specifically, the energy crisis and fuel shortages have caused an increase in woodcutting to obtain firewood for heating. Forests are being cut both in rural and urban areas. Parks and dendraria have not escaped destruction, either. Forests are mostly damaged on the outskirts of settlements, cities and along roads. Local people near forested regions have been cutting forests in easily accessible areas. Forests are being destroyed, and streambeds and banks damaged by the transport logs by trailing the brushwood. Branches and barks left after cutting fall into lakes and pools turn them into dead systems full of tannin. High corruption and low capacity of law enforcement bodies also result in illegal cutting, especially valuable wood species. This itself causes an overall decline in forest quality. Finally, grazing and hay production in forest areas is not rare. All these factors contribute to decreased productivity and regeneration rate of forests as well as a change in species composition and accelerated erosion. In these conditions, populations of pest species have been increasing, while many bird and mammal species associated with forests are threatened.

Another factor driving logging is the high price of timber in neighbouring countries. This has influenced Georgia,

especially the Adigen-Borjomi and Guria-Ajara regions, where forested areas were considerably damaged during the last decade.

Because of forest destruction in the Caucasus, landslides of catastrophic character have become frequent phenomena since the 1980s. Along with this, the reduction of surface and ground water reserves have been observed in different parts of the Caucasus, which are again connected with intensive wood cutting (UNDP, Georgia, 1996).

CHAPTER 1. REGIONAL TRENDS OVERVIEW

1.2 Socio-Economic Driving Forces

1.2.1 Economic Driving Forces

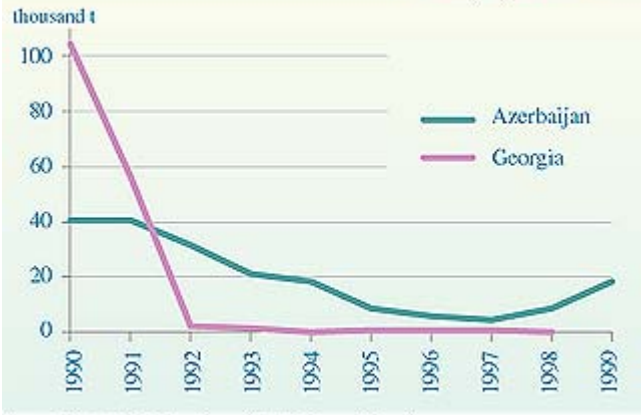
1.2.1.6 Fishery

Over many centuries, humans have fished the Black, Caspian and Azov seas, but this usage was not strong enough to cause the destruction of natural ecosystems. Some thirty years ago, these sea basins were rich in fish stocks. They supplied the Caucasus region, but also Bulgaria, Romania, Ukraine, Turkey, Kazakhstan and Turkmenistan and their food industries. Nevertheless, the situation has changed last decades. High anthropogenic pressures on marine ecosystems have resulted in decreased amounts of commercial fish species and total ichthyic fauna. New settlements, water pollution (with ballast and inflow waters), waste dumpsites located on the coast, building of hydro-technical facilities, over fishing, poaching, etc. have destroyed species habitats, natural breeding grounds and migration routes. Bio-accumulation of chemical substances has been observed among Black Sea fish and mollusks. This itself increased the risks for the food chain and resultant threat to human beings.

The volume of fish catch in the 1970s-80s reached such a big size that this factor significantly affected the water bodies of the region and the ecosystems of the adjacent seas. Deterioration of water quality at the same time caused the reduction of overall volume of bio-organisms and the degradation of ecosystems. Thus, already in the beginning of the 1990s a drastic reduction of commercially exploited fish in the waters of the Caspian, Azov and Black Seas, once very rich in ichtyofauna, was clearly seen. For instance the number of commercial fish in the Black Sea for over past 30-year period was reduced from 24 to 3-4 species by 1990 (G.Info, 1996).

The general economic collapse was followed by a dramatic reduction in the overall volume of fishing. During recent years commercial fishing in the Azov Sea has declined by a factor of 10 times relative to the 1970s and 80s (Grigolia G., 1996). Twenty years ago in coastal area of Dagestan along the Caspian Sea 20-25 thousand tons of sturgeon were caught every year. For the past twenty years, the sturgeon catch has been reduced by 90% (IUCN, 2000). The situation is similar in Azerbaijan, where in 1991-1996 overall fish catch in the Caspian Sea declined from 39.7 thousand to 6.9 thousand tons (IUCN, 2000). Decline in fish catch was particularly acute in Georgia. In 1992, the overall volume of fishing decreased by a factor of 50 compared to 1990.

Total fish catch in marine waters of Azerbaijan and Georgia, 1990-99



Source: State statistical services of Azerbaijan and Georgia "Georgian Agriculture"-2000, State Department for Statistics of Georgia "Agriculture of the USSR", 1970-1988

Nevertheless, illegal fish catch has significantly increased in many places of the Caucasus, particularly the catch of commercial species like sturgeon, salmon, trout and others. Although the catch of valuable fish species is regulated by existing legislation, actual law enforcement is weak.

Logically, the economic collapse of the 1990s should have led to a reduction of negative impacts on ichtyofauna with more favourable conditions for reproduction of their stocks. Unfortunately, this did not happen, due to pollution from oil and oil products through drilling in the Caspian Sea and transportation via the Black Sea. Chemically contaminated

ground water eventually ends up in these waters and thus is still an important factor. Due to the deterioration of social conditions, the impact of the population on water ecosystems has increased. Poaching has become one of the most significant reasons for the reduction of fish stocks. Particular damage to fish stocks is caused by the use of explosives, electric power and chemicals, which are particularly dangerous for young fish, fish spawning grounds and fish-food storehouses.

Aquatic ecosystems, including fish, are also affected by so-called "putting in nets" which are used by poachers. This practice is rather common in the Black Sea. The victims of the nets are frequently big mammals - even dolphins. The problem becomes more severe due to the fact that such nets are very often lost during storms. As a result, fish caught in the net perish and decay. Thus, because of poaching fish stocks have not only declined, but also have lost their quality.

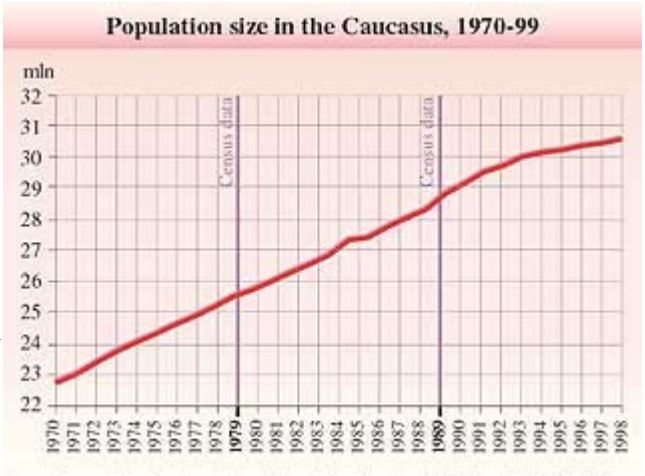
CHAPTER 1. REGIONAL TRENDS OVERVIEW

1.2 Socio-Economic Driving Forces

1.2.2 Social Driving Forces

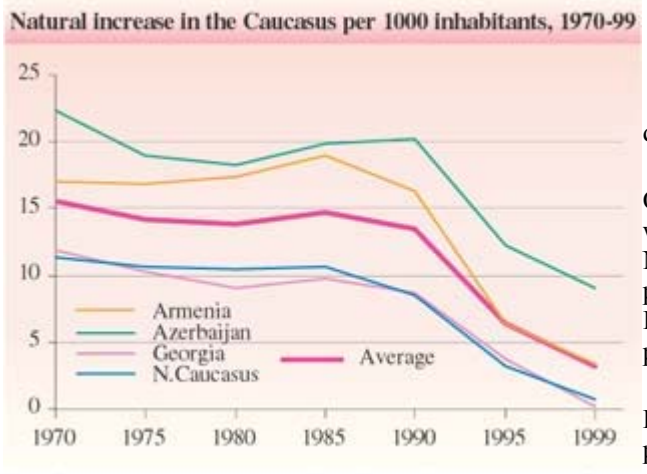
1.2.2.1 Population

Population Size. At present, the population of the Caucasus is over 30 million people. Of this number, 13.32 million live in the North Caucasus and 17.33 million in the South Caucasus. Over the last 30 years, the Caucasus population has been grown steadily, in the beginning of the 1970s being 22.7 million and exceeding 25 million by 1989. By the year 1995, it was already over 30 million.



Source: State statistical services of Armenia, Azerbaijan, Georgia and RF, Year Books, 1970-2000

The Caucasus has far lower growth rates than Asian, African and Latin American countries. Recently, the growth rate has been gradually declining. Thus, environmental pressures from population growth are far less in the Caucasus than in the developing world.



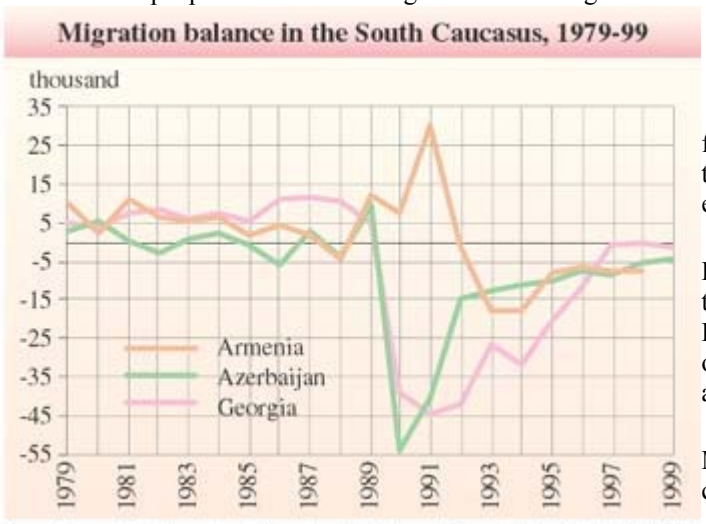
Source: State statistical services of Armenia, Azerbaijan, Georgia and Russia, Year Books, 1970-2000

Over the last 30 years, the growth rate was higher in regions with Moslem traditions (Azerbaijan and a major part of the North Caucasus autonomies) and their share of total population size increased from 41% in 1970 to 45% in 2000. In the period under discussion, there has been some population redistribution in each country.

During the first 20 years (1970-90), the increase in population was caused mainly by the dynamics of birth and death rates. For the last 10 years, migration of the population and a stream of refugees from conflict areas have played an important role. Mortality rates in the South Caucasus for the last 30 years have fluctuated between 5-9 persons per 1000. In the North Caucasus, due to the great number of elderly people along with poor social and economic conditions, the mortality increased from 8 to 13 persons, while at the same time, birth rates have fallen. The mortality rate exceeded the birth rate in this region in the beginning

of the 1990s, leading to a natural population decline.

However, due to an inflow of migrants from the former Soviet Union republics, the population of the North Caucasus keeps growing. From 1990 through 2000, it increased from 12.54 to 13.32 million people. The flow of migrants was the highest in the

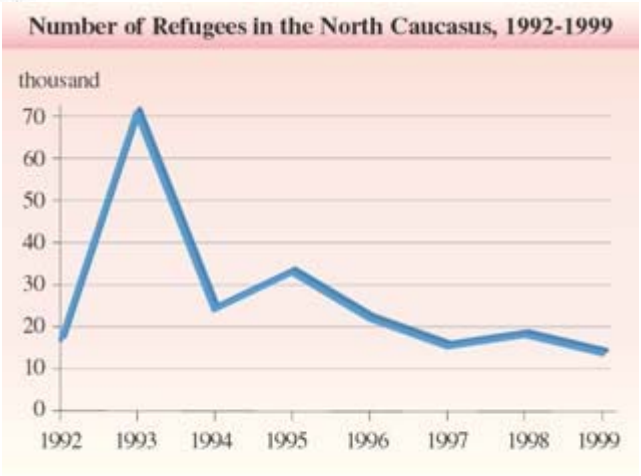


Source: State statistical services of Armenia, Azerbaijan and Georgia, Year Books, 1970-2000

first half of the 1990s. Over that period, 100 to 200 thousand people were arriving in the North Caucasus each year. Since then, the flow of migrants reduced.

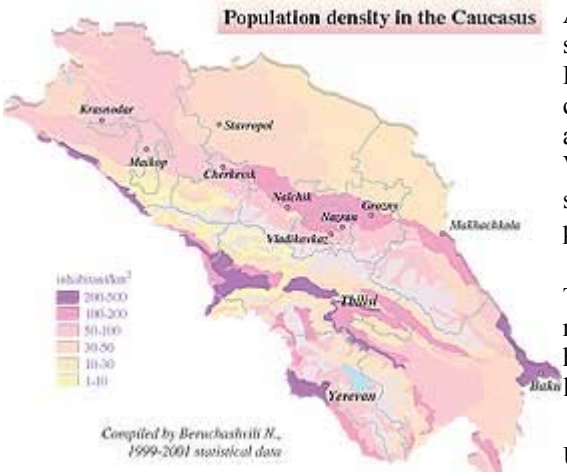
For all three countries of the South Caucasus from 1970 through 1990, the flow of migrants was positive. However, due to dire economic conditions in the 1990s, out-migration of the population occurred, as both native and non-native residents left these countries.

Mass-scale migration of the population is a direct consequence of armed conflicts. A significant number of native citizens migrated to foreign countries. For instance, most of the Russian population left Georgia, Azerbaijan, Armenia and the autonomous republics of the North Caucasus. According to the rough estimates, overall amount of migrants from the Caucasus constitutes 3.5 million people, or about 12% of its population.



Source: State Committee for Statistics of the Russian Federation."Regions of Russian Federation"-2000

Population Density. Population pressures on the Caucasus environment are more related to population distribution rather than to population growth.



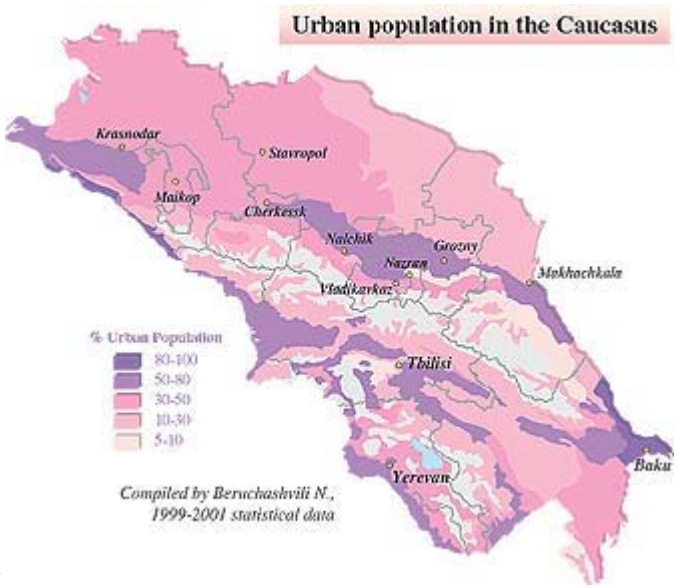
As can be seen from this map, there are three major axes of settlements in the Caucasus. The first axis is connected with the Kuban plain and the South Caucasus foothills. The second axis is connected with the intermountain depression between the Greater and Lesser Caucasus, and the third is connected with the Ararat Valley. In these axes, density of the population exceeds 50 per km sq. and in the regions of urban agglomerations and some densely populated rural regions varies from 100-500 and more persons.

The mountainous territories of the Greater and Lesser Caucasus do not have a high population density (10-30 per km sq.). Some highland landscapes and a many average mountainous and forest landscapes have practically no permanent population.

Urban and Rural Population and Pressures on Environment. The

Caucasus region has three “millionaire” cities with the populations of over 1,000,000. These are the capitals of the South Caucasus: Baku (1,700,000), Tbilisi (1,200,000) and Yerevan (1,200,000). In the North Caucasus, only one town, Krasnodar has a population over 500,000 and four towns: Sochi, Makhachkala, Stavropol and Vladikavkaz have populations ranging from 300,000 to 500,000.

At present, the percentage of urban population in Azerbaijan, Georgia, and the North Caucasus fluctuates between 50-60%. A comparatively high percentage of urbanisation is characteristic of Armenia where it equals to 66.8 %. In all the regions of the Caucasus, the percentage of urban population has been growing, but at low rates.



Urban territories do not occupy large areas in the Caucasus. However, a major part of the population (57.15%) lives in the cities. In this respect, the Caucasus exceeds global average index (41%) and majority of Asian and African countries. However, it is behind West European countries and the USA, which have the highest level of urbanisation in the world.

Cities and industrial centres are the main sources of pollution. There, an important source of pollution is formed by motor transport and obsolete municipal infrastructure, low capacity of water treatment facilities or their absence in general. Unorganised location of parking lots causes traffic jams, creating additional noise and pollution. The location of industrial enterprises against prevailing wind patterns is another important factor.

The environment is influenced by rural settlements in the plain zones. In some places, villages and arable lands form continuous alternating patterns. These includes such areas as the Colchian hilly zone, Alazan-Agrichai plain, Mid-Araks plain, North Caucasus foothills, Lenkoran depression, etc. In such places, there are intensively polluted surface waters, soils and ground waters. Biota are damaged and biodiversity is reduced.

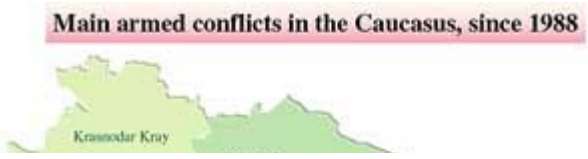
CHAPTER 1. REGIONAL TRENDS OVERVIEW

1.2 Socio-Economic Driving Forces

1.2.2 Social Driving Forces

1.2.2.2 Political Conflicts and Military Actions

Before the break up of the Soviet Union, one never would have imagined that military actions would become significant driving forces for the Caucasus environment. From the end of 1980s they became significant and sometimes determining factors for the state of the



environment of the region.

Beginning in 1988 the Caucasus became an arena for ethnic conflicts and wars. Among these, the most well known is the conflict in Chechnya. Military action continues there to the present. The conflicts in Abkhazia, Karabakh, and Former South Ossetia and between Ossets and Ingush have quieted down but were intensive in the beginning of the 1990s.

Ethnic conflicts and military actions had serious impacts on the Caucasus environment. The intensive bombing of Chechen, Karabakh and Abkhazian territories caused the degradation of topsoil there. Explosions followed by fires damaged local forests and vegetation cover. Apart from this, erosion has intensified. Military actions also resulted in environmental pollution. Environmental pollution and noise had high impacts on local flora and fauna, causing the destruction of species habitats and migration routes (See chapter 3.0 for more detailed analysis).

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.1 Landscape and Biological Diversity

2.1.1. Landscape Diversity

The Caucasus is located at the junction of temperate and subtropical climate zones. The border between them is well-delineated by the Main Caucasus Range, which determines the climatic difference between the North and South Caucasus. Therefore, climatic factors causing latitudinal zonality of the Caucasus landscapes are closely connected with orographic (relief) factors and they should be considered jointly.

In the Caucasus, the first level oroclimatic differentiation of landscapes, connected with the Main Caucasus Range and Trans-Caucasus Sub-meridian upland, is relatively well-known. Less information exists on the second level, in which an essential role is played by relief features, being climate-determining factors of the second order. The "sectoral" differentiation of the Caucasus landscapes, significant difference in regional moisture distribution and a degree of continentality of the climate are connected with them.

Overall, oroclimatic factors and high hypsometric (altitude) peculiarities determine the types and zonality of the Caucasus landscapes.

In the Caucasus, the distribution of landscapes is closely connected with development history. In the Quaternary period, with cooling of the climate two refugiums (shelters): Colchian and Hyrcan were established there. With the warming of the climate, the representatives of Colchian and Hyrcan flora have started to spread. Due to this, the landscapes with the great participation of ancient flora were called Colchian and Hyrcan.

Relief and geological peculiarities determine the distribution of a number of specific landscapes in the Caucasus. First of all, the distribution of karst landscapes, connected with cones of limestone and carbonate rocks should be mentioned.

Volcanic landscapes are most characteristic of the Armenian highlands. Here they occupy considerable areas and high elevation lava plateau and volcanic cones are connected with them. On the Greater Caucasus, volcanic landscapes are met more seldom, presented in the form of isolated volcanic masses, such as Elbrus and Kazbegi.

Caucasus landscape diversity

Country/Region	Landscapes		
	Type	Subtype	Genus
Armenia	8	14	28
Azerbaijan	18	25	53
Georgia	16	22	72
Russia (N. Caucasus)	76	107	149
Krasnodar Kray	12	15	25
Stavropol Kray	6	6	15
Adigea	6	19	13
Chechnya	9	11	17
Dagestan	9	12	21
Ingushetia	9	10	14
Kabardino-Balkaria	8	12	15
Karachai-Cherkessia	8	13	18
North Ossetia	9	9	11
Total Caucasus	**20**	**140**	**152**
Black Sea Region	**19**	**54**	**281**

Source: WWF, 2000

Differentiation of plain, elevated and mountainous landscapes is connected with geological and morphological factors. Thus, separate species of landscapes are of the following types: depression-plain accumulative, pre-mountainous-hilly, denudation-accumulative and denudation-erosive, low mountainous arid-denudation, erosive-denudation, denudation paleo-glacial, and other landscapes.

At present, anthropogenic activities are one of the most important forces driving transformation of landscapes. As a result of human activities new natural-agrarian territorial units are being formed, and the landscapes are connected with selitebic (inhabited) parts, industrial and transport constructions, recreation, etc.

Caucasus Landscapes are described at the level of type. In addition, major sub-types and enumerated numbers of landscape genera according to the Landscape Map of the Caucasus (1979), the monograph "Caucasus: Landscapes, Models, Experiments" (1995) and the Study Report Biodiversity of the Caucasus Ecoregion (2001) are given. In all, there are 2 classes, 20 types, 40 sub-types and 152 genera of landscapes in the Caucasus (see appendix for detailed information on Caucasus landscapes).

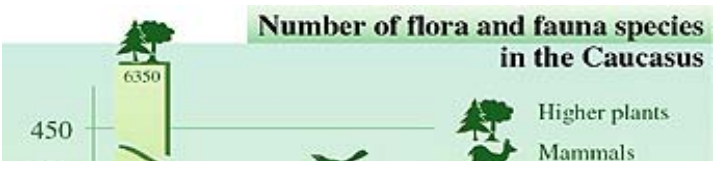
In terms of the number of landscapes, Georgia is distinguished by the greatest diversity at the level of class among other Caucasus countries and the countries of the Black Sea region. In the meantime, Azerbaijan occupies the first place by the amount of landscapes types and sub-types. This is connected with the fact that Azerbaijan, firstly, has a larger territory, and secondly, it involves the Nakhichevan autonomous republic. Thirdly, Azerbaijan better presents a spectrum of arid and moderate landscapes. From the regions of the North Caucasus, the most varied landscapes are presented in Krasnodar kray and Dagestan.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

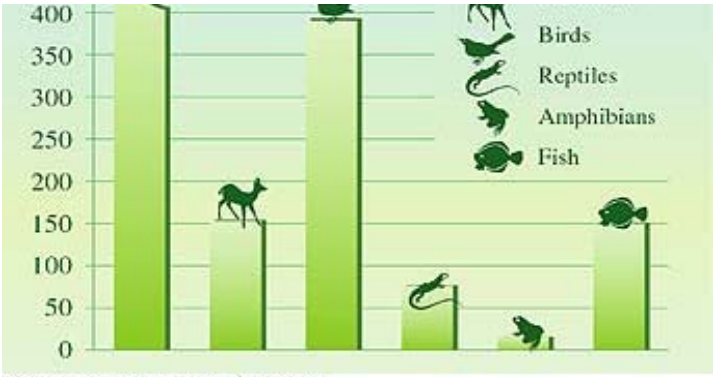
2.1 Landscape and Biological Diversity

2.1.2 Flora and Fauna Diversity

Caucasus Flora. The level of biodiversity in the Caucasus is relatively well-known. Based on recent data, there are 6,300-6,350 plant species in the region. In this regard, the Caucasus is the richest floristic region among the regions of temperate climate zones.



Countries of the tropical climate zone, however, have higher indices of floristic diversity. Milder climate conditions and an abundance of relict plants dated from cretaceous formations may serve as indicators for this. A unique richness in vascular species, with 15 endemic genera, however, makes the Caucasus a centre of global biodiversity (IUCN, 2000).



Source: World Resources, 2000-2001

In terms of endemic species, the Caucasus is between the highly endemic islands and low endemic regions. There are 1,600 endemic species in the region, making up about 25% of the total number of species. Of the total number of plant species, the share of relict species is the largest. All these species are related to two basic refugiums: Colchic and Hyrcan. Many of species of Tertiary flora survived in these refugiums.

Caucasus Fauna. Caucasus fauna is also rich in biodiversity. Total fauna consists of 152 species of mammals, of which 32 are endemic. Birds make up 389 species (3 endemic species), reptiles 76 species (21 endemic species) and amphibians 13 species (WWF, 2001).

Agro-biodiversity. The Caucasus is one of the oldest and richest centres of agro-biodiversity. Agricultural activities here date back to the 5-6th millennium BC, when the first sedentary tribes with farming, animal husbandry and simple infrastructure (adola architecture and irrigation) appeared in the Eastern Tran-Caucasus, on the right bank of the Kura river and the lower courses of the rivers Algeti, Khrami and Debed (UNEP, MoE, NACRES, 1997, Tbilisi). The first farming communities began to grow wheat, barley, oat, rye and grain legumes, e.g., pea, fava bean, etc. and fruit species: plum, cherry, grapes, etc. By the 5th millennium a diverse agricultural economy had already been established with farming and animal husbandry: goats, sheep and cattle breeding. Diverse ecosystems, mild climate and resource abundance enabled small families to populate all zones from lowlands to high mountains. This vertical zonality is preserved in the sub-region to date. More than 300 varieties of grapes together with up to nine major domestic animal breeds are found in the Caucasus (Gokhelashvili at al. 2000).

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.1 Landscape and Biological Diversity

2.1.3 Caucasus Protected Areas

During Soviet times, there was a network of nature reserves ("Zapovednik"). Historically, the Caucasus region contained an unusually number of protected areas in proportion to its relatively small area (only 2% of FSU land area). In 1988, there were 37 nature reserves functioning in the Caucasus (14 of them had two or more components and thus the total number of protected areas consisted of 60). The total area of nature reserves was 898,000 ha, or 2% of the Caucasus area. The number of natural reserves for the North Caucasus in 1998 was five (1.86%), for Georgia - 14 (2.4%), for Azerbaijan - 14 (2.2%), and for Armenia - four (2.3%) (Natural Reserves of the Caucasus, 1990).

The land was first protected in the Caucasus in 1910, when a grove of Eldari Pine on the slopes of Mt. Eldar-Oukhi on the border of Georgia and Azerbaijan was declared preserved. In 1912, the Lagodekhi area and Pitsunda Pine (Pinus Pityuza) grove in Georgia, the Maziani gorge in western Azerbaijan, and a forested lot in Teleti range close to Tbilisi were also declared preserved. In the 1920s - 30s the development of so-called managed nature reserves or sanctuaries ("Zakaznik") was broadly practised. Many reserves were shut-down in 1951. For instance, out of 28 nature reserves in Georgia only one reserve, Lagodekhi survived this campaign. Starting from 1957 Soviet authorities attempted to restore some of the old reserves.

However, many could not satisfy their conservation goals or failed

Caucasus protected areas

to prevent high rates of tourist flow (Pitsunda-Miusera, Ritsa, Sataplia, Gey-Gel, Gobustan, Dilijan). Some of the reserves were located close to traditional cattle breeding areas or densely populated areas, where their preservation was extremely difficult to maintain.

In the 1990s, circumstances became even more complex, when due to economic difficulties many reserves failed. Some were used not only for poaching, but also as illegal pasture zones for local people. What is most unfortunate is that unique woodland areas in some reserves have been used for logging purposes.

However, official records show that the total area and number of nature reserves continued to grow in the 1990s (though many reserves existed on paper only). This is due to the efforts of WWF offices and parliaments of some Caucasian countries, which passed new Laws on Protected Areas increasing the number of types of protected areas. For instance, the Law on Protected Areas passed by the Georgian Parliament in 1996 increased the number of categories to six: National Park, State Nature Reserve, Sanctuary, Nature Monument, Protected Landscape, and Area of Multiple Use.

At present, the number of protected areas in the Caucasus is 43, with a total area of 13,033 km sq. (about 3% of the whole territory) (WWF, 2001; MNP of Armenia, 2002). Of these, three reserves (Strict Nature Reserves) and two National Parks (Sevan, Dilijan) are in Armenia with a total area of 931 km sq. (3.1% of total land resources); 14 reserves are in Azerbaijan (1291 km sq., 1.5% of total land resources); 16 nature reserves and two national parks (Borjomi-Kharagauli and Kolkheti area) are in Georgia. Protected areas there make up 2,466 km sq., which is equal to 3.5% of total land resources.

There are three national parks (Alania, Prielbrusye (Elbrus Foothills), and Sochinsky) and three nature reserves in the North Caucasus. Among them, the Kavkazsky Strict Nature Reserve (Caucasus biosphere reserve) is the largest in the Caucasus, with an area of 2,803 km sq. The total area of protected territories in the North Caucasus is 8,345 km sq. (3.3% of whole region). One should also take into consideration the number of sanctuaries. In Georgia alone, there are five sanctuaries with a total area of 590 km sq.

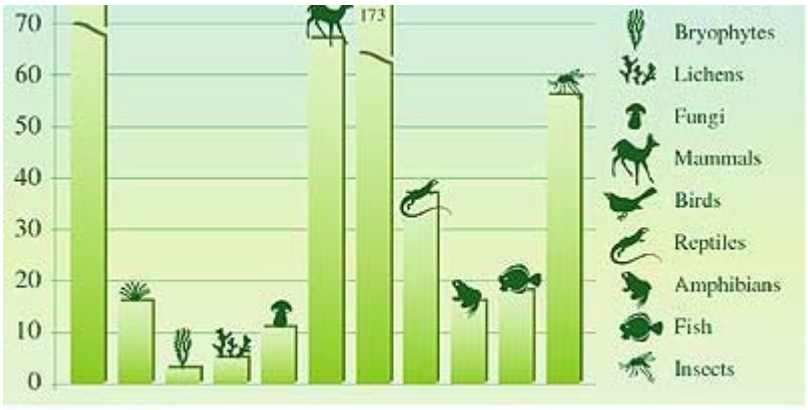
In addition to the network of reserves managed by departments of Protected Areas, there are a number of protected sections managed by other departments. In Georgia, for instance, the Forestry Department owns resort forests (1,185 km sq.), green-zone forests (2,684 km sq.), rocky and steep-slope forests (6,8213 km sq.), sub-alpine forests (322 sq. km), and flood-land forests (127 km sq.) with a total area of 11,131 km sq. If all types of protected areas in Georgia are added together, it amounts to 20% of the whole territory, a rather high ratio. Unfortunately, because of economic difficulties, many protected areas in Georgia and other Caucasian states still exist only on paper, and many kinds of illegal activities (poaching, cattle pasturing logging) flourish there. However, the number and areas of reserved territories in the Caucasus is generally increasing and, importantly public interest in them is also increasing.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.1 Landscape and Biological Diversity

2.1.4 Threats and Current Status of Caucasus Biodiversity

Over the last thirty years, the biodiversity in the Caucasus has been affected by extensive anthropogenic activities. Natural pressure from active geo-dynamic processes is an important factor also.



Source: WWF, 2001

Immediate threats to the Caucasus biodiversity are the loss of species and habitats, as well as habitat fragmentation and modification. Many flora and fauna species have become endangered or threatened and are listed in the IUCN as well as the USSR and National Red Books.

Other threats to biodiversity are as follows:

- Uncontrolled harvesting of flora and fauna;
- Economic development: agriculture, industry, construction, tourism and recreation activities, etc.
- Intrusion of alien species;
- Armed conflicts;
- Climate change

From the above list, the last two threats have emerged only recently. Armed conflicts were never envisioned before the break-up of the Soviet Union. Similarly, climate change has only recently been recognised as a threat to the global environment, including biodiversity. Other factors have existed since the early years of the development of the Soviet Union, although current impacts significantly differ from those of the Soviet era in terms of the impact, extent and type.

Historically, agriculture was the major economic sector in the Caucasus. Because of extensive agricultural development over the last 50 years, many natural ecosystems have been transformed into arable lands, pastures and hay fields, which in turn resulted in:

- Change and even loss of some natural habitats and ecosystems, e.g., semi-desert, steppe, forest and wetland habitats;
- Environmental pollution from extensive usage of fertilisers and agrochemicals: soil and water pollution with heavy metals, POPs and river and lake euthropication from organic materials and biogenic substances, etc;
- Land degradation, erosion, desertification, soil compaction, salinization and bogging and fertility loss;
- Over-grazing, affecting the vegetation cover of pastures.

At present, uncontrolled use of fertilisers and pesticides, over-grazing of forest and lowland areas, especially around settlements, as well as obsolete irrigation infrastructure still pose significant threats to the Caucasus landscape and biological diversity.

Forestry as an economic sector had, historically, some impact on the Caucasus forest ecosystems and biodiversity in the 1970s-80s. Forest problems are discussed in detail in Forestry sub-chapter.

Activities in the fisheries sector have also had significant impacts on Caucasus aquatic species of both fresh and marine waters during the 1970s and 1980s. As a result, many commercial and valuable fish species have declined. Since the break up of the Soviet Union, commercial fishing has reduced. This has not resulted in a significant stabilisation of fish stocks. Currently, poaching is a serious problem, explained by the general economic fall and people's dependence on local resources as well as weak capacity of law enforcement officers and low public awareness. The use of unsustainable methods for catching continues. For example, mussel harvesting frequently is conducted through scrapping the seabed, resulting in not only the over-exploitation of mussel stocks, but also other marine species. In addition to this, game fishing is not regulated, causing over-catching of fish populations.

Historically hunting was strictly regulated in the Caucasus, especially in mountainous zones. Special sanctuaries were established for hunting of certain species. Commercial hunting was not allowed at all and licenses were required for game and sport hunting of many species. At present, although these laws and regulations still exist, they are not enforced due to the lack of a legal and administrative framework and financing for rangers who could detect illegal activities. The population's easy access to weapons makes the situation more uncontrollable. At present, even a tourism industry related

to the harvesting of certain animal species has been emerged. For example, in Azerbaijan a number of cases of illegal hunting of Djeiran by bikers in semi-desert landscapes have been detected (IUCN, 2000). Regarding plant species, the population freely utilises plant and wood resources. Collection of medicinal plants and flowers listed in the Red Data Book is still conducted.

Industry, energy, transport, mining and infrastructure construction activities had serious impacts on the Caucasus biodiversity in the 1970s and 1980s, particularly in the late 80s, which were characterised by highest growth rates in the above sectors. At present, major industrial pressures come from mining operations as well as gas and oil production. The manufacturing sector has lower impact, due to its reduced capacity. In turn, transport impacts have been increasing and will continue to do so in the short to medium term, as freight turnover increases along the TRACECA corridor. Recent developments related to the construction and operation of gas and oil pipelines from Azerbaijan through Georgia pose a threat to sensitive areas such as the Colchian wetlands, which are important sites for many migratory and resident birds as well as endangered mammals. Because of that, contingency plans for potential oil spills and other disasters are of the utmost importance.

Tourism and recreation activities also imposed significant pressures on natural ecosystems of the Caucasus during the 1970s and 80s, when the flow of visitors was high. However, in the late 1980s and early 1990s, due to a series of armed conflicts and economic decline, the tourism infrastructure deteriorated and the tourist flow reduced. Since 1996, a revival of the sector, particularly mountain tourism, has been observed. At present, most recreational activities are not properly managed, imposing a threat to local biodiversity in terms of direct destruction of vegetation, littering and waste dumping, etc.

Alien species were and still are the threats to the Caucasus biodiversity. During the Soviet era, some species were accidentally introduced into the Caucasus; others were intentionally introduced for “enrichment”. Some of the species came from neighbouring countries. Certain introduced species could not survive, while others prove successful. For example, in 1939 American Mink (*Mustela vision*) were brought to Georgia and released in Kvareli region. The species could not survive in the alien environment. However, racoon dog (*Nyctereutes procyonoides*) introduced in different parts of Georgia spread widely and posed a treat to Galliformes species. Racoon introduced in Georgia from Azerbaijan also could spread widely, imposing the threat to Galliformes (UNEP, MoE, NACRES, 1997).

In addition to all above pressures, new threats in the form of armed conflicts emerged in the Caucasus in the late 1980s and early 1990s. The effects of military conflicts are diverse, though there is a lack of basic information on environmental implications for all conflict areas (The effects of military activities are described in more detail in chapter 3.0).

Finally, climate change must be considered a factor that may significantly affect the Caucasus landscapes and biodiversity in the next 30-50 years. Recent studies conducted in the South Caucasus countries under the UNFCCC have shown that climate change, though of non-uniform structure, is already felt in the region. In the case of temperature increase by 1.5-2^{0}C degree, which is expected for the Caucasus region, the following changes may occur: xeropitisation - expansion of vegetation, preferring arid conditions, mostly in Northeast Caucasus, Eastern Georgia, Armenian-Javakheti Highlands, etc; adventisation - expansion of advented or cultivated species, in the passage of Trans-Caucasian depression most of all, in Colchian lowland and relatively elevated parts of the depression; mediterranneasation - expansion and domination of Mediterranean climate elements in the Black Sea Coastal zone and foothills; laurophilisation - invasion and expansion of evergreen broad-leaved species expected in the mountains of Colchida, especially in South Colchida, with dominant number of laurophilous species. These changes in temperature and precipitation may lead to the rapid extinction of flora and fauna with spotty and restricted areas of distribution (UNDP/GEF-Georgian Government, 1999).

There are some other fundamental factors having indirect effects on the biodiversity status, which are listed among six fundamental factors of biodiversity loss in the Global Biodiversity Strategy. These are: the economic and political systems that fail to value natural resources; inequity in ownership and access to natural resources, including the benefits from the use and conservation of biodiversity; inadequate knowledge and inefficient information use and finally, legal and institutional systems, promoting the unsustainable natural resource use.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.1 Landscape and Biological Diversity

2. 1.5 Policy Measures and Responses

In general, while analysing the last 30-year history of policy pertaining to environmental and biodiversity protection in the Caucasus region, two distinct periods should be mentioned: the Soviet and post-Soviet. The Soviet period can be divided into two periods: one longer period – from early 1970s to early 1980s, and a shorter one covering late 1980s. The early 1970s and 1980s were characterised by increased interest in environmental protection, including natural resources/biodiversity protection. Various legal and regulatory documents pertaining to wildlife, forestry, fisheries use and protection were developed and adopted. Designated bodies at the All-union, national and local levels were established. An environmental chapter, with specific sub-chapters covering wildlife, forestry etc. was included into the State Master Plan to be the major policy document for the entire country. Some economic tools such as per unit taxes, deterrent taxes for the use of forestry resources and damage compensation fees were introduced. Traditional activities aiming at conserving natural resources continued. In-situ biodiversity conservation included the enlargement of existing or the establishment of new specially protected areas, e.g. natural reserves: “zapovedniks”, sanctuaries: “zakazniks” and national parks. Ex-situ conservation practices included the establishment and maintenance of botanical gardens, herbaria and zoos. Various scientific institutions extensively conducted studies on Caucasus biodiversity. Data for national and all-union Red books, designed for listing rare and endangered species were collected and regularly updated.

Nevertheless, the 1970s and early 1980s were periods of using sector-based approaches to environmental protection. Sectoral ministries and committees responsible for managing individual resource had no co-operation with each other, and did not take into consideration the interdependence of all the components of environment during the decision-making processes. The major focus for conserving natural resources was on species of special economic value, while the biological value was not taken into consideration. In practice, policies and tools aiming at protection and sustainable use of natural resources were not implemented, even though legislation, though not complete and perfect, existed for this.

In the late 1980s, attempts to introduce a holistic approach to environmental protection were made. The need for developing and adopting a framework law on environmental protection and setting specific environmental body was understood. During this period, the State Committee for Nature Protection with regulatory, managerial and law enforcement functions was established. In addition, a special environmental examination body was set up under the Committee to make environmental valuation of development plans/project/programs. All protected areas previously managed by different agencies were united under the single management of the above-mentioned Committee. This series of actions was a positive step at that time.

It is impossible to talk about national biodiversity protection policies and legal-institutional arrangements for each of the Soviet republics, including the Caucasus countries, since their role was insignificant in decision-making processes during the Soviet era. However, after independence, the South Caucasus countries and the Russian Federation started building up their national capacities and adapting their laws and institutions to those of the EU. New environmental protection laws became the basis for protecting environment, including biodiversity. Environmental media-specific statutes and codes were also adopted aimed at wildlife and forestry resources protection and establishment of protected areas systems, close to IUCN classification. Environmental impact assessments (EIAs) and state ecological examinations (SEEs) became mandatory for large-scale development projects having significant potential impacts, with a right for public participation built into all stages of EIAs. National Environmental Action Plans have been developed in all South Caucasus countries and the Russian Federation. As the Russian NEAP does not have specific regional features, some RF administrative regions located in the North Caucasus have adopted their own (regional level) EAPs. NEAPs have identified biodiversity conservation as one of the priority issues in the environmental and natural resources protection field and set short- to medium goals with appropriate indicators. Licensing systems for the use of natural resources, including wildlife, have also been established and environmental taxes for the use of natural resources introduced in all subjects of the Caucasus. Specific environmental bodies, either ministries or committees, became the key biodiversity policy-making, regulatory and management agencies. For better control and management of protected areas, special Protected Areas Services with local branches have been established in some of the South Caucasus countries, either as separate bodies or as structural units of environmental ministries. However, all these agencies are still in the process of forming their structures and responsibilities. For example, the Azerbaijan State Committee for Nature Protection has recently been transformed into the Environmental and Nature Protection Ministry and has subordinated the previously independent forestry, fisheries and geologic departments and hydro meteorological service for increased efficiency, as well as to avoid overlapping responsibilities and conflicts of interests. In Armenia and Georgia, in turn, there are various parallel structures in the field of biodiversity protection and management, frequently competing, but not co-operating

with each other. In Armenia, for example, six sanctuaries (Managed Protected Areas) are under the responsibility of the Ministry of Agriculture. Others are managed by the Ministry of Nature Protection, which is a key environmental agency in Armenia. In Georgia, apart from the Ministry for Environment, the State Forestry Department, State Department of Protected Areas, Nature Reserves and Hunting Management and the Ministry for Food and Agriculture are all engaged in biodiversity protection and management activities (Gokhelashvili at al. 2000).

In the North Caucasus administrative districts, local and municipal governments carry out biodiversity management and control functions. Federal, republican and local level laws and regulations represent the legal framework here. Apart from federal programs, local authorities have their own programs aiming at local biodiversity protection. In those parts of the North Caucasus specifically, in high mountainous regions where state institutions are practically non-existent, local communities play a key role in biodiversity management. In Chechnya, for instance, there is no state environmental policy and the state has completely withdrawn from nature protection. Traditional practices of natural resource use are based on a subsistence economy controlled by informal groups of rural communities, especially village elders. Shariat courts have also been gaining more power for establishing state order in this republic (IUCN, 2000).

In general, because of financial and technical shortages, the lack of appropriate expertise and presence of inefficient, old-style management, the capacity of all agencies involved in biodiversity protection and management activities is very low, though varying on a country-to-country basis. The high level of corruption found in all FSU countries hinders the effective implementation of appropriate policies. The lack of baseline and current information on biodiversity status also serves as an impediment in the decision-making process. Modern environmental monitoring and information technologies such as GIS and remote sensing techniques are not used by appropriate agencies. Overall, these features are common in all the agencies that are directly or indirectly involved in environmental management.

The role of academic institutions in biodiversity conservation is to support decision-makers with scientific knowledge and data and develop appropriate academic curricula. However, at present these institutions lack financial and technical resources to conduct field studies and collect current data. Only a few individual scientists are engaged in biodiversity conservation activities under different internationally funded programs/projects and co-operate with government agencies on an ad-hoc basis. With regard to curricula, although general courses such as botany, zoology, ecology, etc. are taught at academic institutions and universities, such courses as natural resource conservation and management, environmental economics and policy are of limited use or not taught at all.

Regarding the involvement of NGOs in biodiversity conservation activities, the NGO network is more developed in the South Caucasus than in the North Caucasus. There is very little international support in the North Caucasus, while it is extensive for South Caucasus countries. Many of the NGOs there have been receiving financial and technical assistance from a number of agencies. The only international conservation NGO having a permanent program in the Caucasus is the World Wide Fund for Nature (WWF), operating through its Tbilisi office. WWF-Tbilisi has supported the concept of developing a protected areas system in Georgia and participated actively in the establishment of Borjomi-Kharagauli National Park. The WWF through its Georgian affiliate has invested more than US$4.2 million for conservation activities in Georgia since 1991, including over US$2.5 million for the establishment of Borjomi-Kharagauli National Park (WWF, 2001). Other areas of WWF's interest are sustainable forestry, environmental education, community-based resource management etc. The NGO has recently conducted a biodiversity investment portfolio study for the entire Caucasus. Other NGOs in Georgia are widely involved in all aspects of biodiversity conservation, including endangered species conservation. NGOs in Armenia are more engaged in public advocacy and environmental awareness. Azerbaijan has the least developed NGO sector, including environmental NGOs. These organisations are mostly staffed by concerned scientists who realise the need for an independent voice for environmental protection. In addition, most NGOs in Azerbaijan are focused on Baku's problems and do not cover other areas. In the North Caucasus region, state bodies have established many pseudo-public environmental organisations for supporting certain activities of state bodies. The most powerful NGOs, nevertheless, are: the Social and Ecological Union of the Western Caucasus, operating in Krasnodarsky kray, Adygeya and Karachaevo-Cherkessia; the Azov-Black Sea NGO network, part of the international Black Sea NGO network, based in Krasnodarsky kray, Adygeya and Rostovskaya oblast; and the Independent Ecological Service for the North-Western Caucasus, based in Maikop (IUCN, 2000). WWF also has an office in Russia that carries out species conservation and habitat protection activities, promotes sustainable practices in natural resources management, and works to establish protected areas or strengthen existing ones.

Regional co-operation at the inter-state level in the field of landscape and biodiversity protection is largely limited to occasional consultations and information exchange. Although the South Caucasus countries have signed bilateral agreements on co-operation in the environmental field, there are no national activities and programs supporting such co-operation. An idea for a transboundary protected areas establishment, e.g. between Georgia and Dagestan, has not yet gained significant interest. At the same time, there are several ongoing regional projects between NGOs. Noah's Ark for

the Recovery of Endangered Species (NACRES) has been implementing a transboundary project on conservation of arid and semiarid ecosystems; the Georgian Centre for the Conservation of Wildlife (GCCW) established the Caucasus Environmental NGO Network (CENN) in 1998 that publishes monthly bulletins and arranges regional meetings and workshops. The Regional Environmental Centre (REC) also supports regional co-operation among the South Caucasus countries. United States Agency for International Development (USAID) funded regional water project for Kura-Araks basin. Nevertheless, co-operation among the Caucasus countries, especially between the North and South Caucasus regions is low, caused by poor electronic communications, differences in legal-institutional arrangements and existing political conflicts of interests.

All South Caucasus countries, though at different levels, participate in global processes. The North Caucasus participates in international activities as a part of the Russian Federation. All subjects of the Caucasus are parties to the global Convention on Biological Diversity (CBD) and enabling activities there are supported by the GEF. Biodiversity Country Studies have already been conducted and Biodiversity Strategy and Action Plans (BS-APs) were adopted under the framework of the above convention. In addition, the CBD enables countries to raise funds for major conservation activities defined in BS-APs. Two other major conventions are CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), ratified by Azerbaijan and Georgia and the Russian Federation; and the Ramsar Convention (Convention on Wetlands and International Importance Especially as Waterfowl Habitat), signed and ratified by all Caucasus states. There are some problems with implementing CITES convention, related to the low capacity of national bodies to establish compliance assurance and control systems. Customs offices as the major law enforcement body lack specific knowledge in species diversity. Other conventions related to biodiversity and landscape diversity are the Convention concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention, Paris, 1972), ratified by all South Caucasus countries and the Russian Federation, the UN Convention to Combat Desertification (UNCCD), and the UN Framework Convention on Climate Change (UNFCCC) ratified by all subjects of the Caucasus. Only Georgia has ratified the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979). Georgia also participates in agreements of CMS such as ACCO (2001) and CURL (1994). Azerbaijan is not yet a party to CMS, but participates in the CSM agreement concerning conservation of Siberian Crane (SIBE).

The most active international agencies funding biodiversity conservation activities within the region are the GEF, WB, UNEP, UNDP, FAO, EU/TACIS, USAID, KFW and the Swiss Agency for Development and Cooperation. In addition, various private foundations such as the George Soros Fund, McArthur Foundation, Eurasia Foundation, ISAR, etc. finance different environmental activities, including biodiversity protection, at national and regional levels. The largest investments so far in the Caucasus have come from the WB and GEF. The WB financed the development of a forestry strategy for Georgia and is now assisting in implementing specific programs under this strategy. GEF funded the establishment of Kolkheti National Park and two other parks, and assisted in capacity building for managing protected areas in Georgia. The GEF provided core support to strict nature reserves in the North Caucasus under the project "Conservation of Biodiversity in Russia" (WWF, 2001). However, donor co-ordination remains a problem for the region, leading to duplication and overlapping of activities, and inefficient allocation of financial resources.

Regardless of the positive changes which have occurred at institutional, legal and policy levels, all the Caucasus entities face similar difficulties of financial, technical, legal and institutional character which make it difficult to implement full-scale reforms in the biodiversity protection and management field. Economic systems and policies still fail to reflect resource scarcity into prices. Institutions are weak and lack knowledge in advanced biodiversity conservation study methods, e.g. Gap Analysis, IBA (Important Bird Areas), etc. and management approaches. For example, in all the South Caucasus countries as well as in the North Caucasus krays and autonomies, most existing protected areas used for in-situ conservation are typical Soviet period "zapovedniks", where all human activities are prohibited. These areas are equivalent to "Strict Nature Reserve," a protected areas management category of IUCN. Other types of protected areas, such as reservations and hunting farms are equivalent to IUCN category VI – Managed Resource Protected Areas. Most of these protected areas were established in order to protect one or several species, based on productivity or potential value criteria, and the majority of reserves are aimed at protecting sub-alpine forests and alpine grasslands. Other unique landscapes are under-represented. Frequently, the boundaries of protected areas are set arbitrarily and are not congruent with natural boundaries. Usually, they conform to land use or administrative boundaries, especially in the North Caucasus (IUCN, 2000). Although some efforts have been made to introduce new models for biodiversity conservation, e.g. a protected areas system in Georgia, implying the transformation of several reserves into broadly protected area landscapes with different management regimes, selection criteria still tend to be political (it is easier to enlarge an existing reserve rather than to establish new one) and economic (donor's preference and aesthetic value). Criteria such as species rarity, richness, endemism, habitat uniqueness or vulnerability are not taken into consideration. Additionally, very little attention is paid to wildlife management and sustainable use of natural resources outside protected areas.

In general, there is a lack of baseline information on species and their relation to different land use management practices. Because of that, there are no systematic approaches for prioritising national conservation efforts (selection of conservation areas, identification of species conservation status, development of management guidelines for vulnerable species and habitats, policies for sustainable resource use, recovery plans for endangered species, etc.) (Gokhelashvili, Scott, Millington, 2000). The general public is mostly unaware of biodiversity protection issues and public involvement in decision-making processes is very low. There are no incentives for local communities to manage local resources in an environmentally sound manner. Because of that, community-based management practices together with environmentally sound traditional economies have to be encouraged. Finally, regional co-operation has to be strengthened through information exchange, study tours, regular consultations and bi- or multi-lateral agreements.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.2 Land Resources

2.2.1 Land Estate and Land Uses

Agricultural Land Use. The total land area of the Caucasus consists of 44,019,400 ha. Agriculture is a major land use in the Caucasus, amounting to about 54% of total land area. The majority of such lands are located in plain areas. These lands produce almost the entire agricultural output in the Caucasus. The shortage of agricultural lands is particularly acute in mountainous regions.

The largest agricultural areas are spread in the Kuban-Azov plain, Stavropol plateau in the North Caucasus, and in the Alazani-Agrichay Valley and Lenkoran lowland in the South Caucasus. There, more than 80% of lands are cultivated. Large agricultural areas are also located in other parts of the Caucasus such as the Kura-Araks lowland, Caspian coastline, the Ararat Valley, Colchian lowlands and foothills of the Greater and Lesser Caucasus.

Most of arable lands in the Caucasus are located in the Kuban-Azov plain, the Stavropol Plateau in the North Caucasus, and the Kura-Araks lowland and the Ararat Valley in the South Caucasus.

Traditionally, cultivation of cereals, fodder, fruit, tea, tobacco production and vegetable gardening were major agricultural sectors. Perennial crops occupied the large areas in the South Caucasus: Colchian foothill, Shida Kartli Plain, Alazani-Agrichay Valley, Lenkoran lowland and Ararat Valley.

Historically, summer pastures were located in high mountains of the Greater and the Lesser Caucasus and winter pastures mostly in plains of East Caucasus: the Terek-Kuma plain and the Kura-Araks lowland.

In the 1970s and 80s, highly subsidised large-scale collective farms, either for livestock raising or land cultivation, produced the total agricultural output. Increased productivity was achieved

by the use of huge quantities of foodstuff for livestock raising, and the intensive use of fertilisers and other agricultural chemicals for crop production.

Since the break-up of the Soviet Union, land use, agricultural production and trade patterns have dramatically changed in the Caucasus region, as in other FSU regions. The breakdown of traditional economic ties among the Soviet republics caused the loss of markets for both agricultural inputs (chemicals, food grain for livestock, fuel, machinery and spare parts) and outputs, leading to reduced amounts of arable lands and livestock and hence, a general fall in agricultural output. Large-scale collective farms were no longer sustainable and began to disappear. Individual farmers gradually became the main producers of agriculture output, changing land uses, agriculture practices and adapting to local markets. The natural (subsistence) economy has become stronger in agriculture and brought about increased grazing and hay production. In the South Caucasus countries, almost all collective livestock farms have stopped functioning. This had a detrimental effect on pastures near villages, promoting erosion and land degradation of lowlands (IUCN, 2001). It is worth noting that publicly owned large-scale farms have proven to be more long lasting in some North Caucasus republics (Dagestan, etc.) compared to the South Caucasus, where the land privatisation process has fostered the establishment of private enterprises and small farms.

Urban Land Use. In the Caucasus, urban land development is not the major land uses. Urban territories occupy small areas in the region. Major concentrations are the Baku-Sumgayit agglomeration and along the Black Sea coastline from Sochi to Tuapse, where urban areas vary from 10 to 25% of total landscape areas. Urban territories also are Yerevan, Ganja, Tbilisi-Rustavi agglomeration, Kutaisi-Zestaphoni agglomeration, Nalchik, Vladikavkaz, Grozny and Makhachkala and Derbend.

Historically, many environmental problems of the 1970s-80s in urban areas were related to poor town planning/town-building and land zoning system. Environmental considerations were largely neglected during the planning and construction processes. An even less controlled situation exists now. Illegal construction of residential blocks and commercial buildings, even in green zones, are not rare in the cities.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.2 Land Resources

2.2.2 Land Degradation and Soil Erosion

Degradation and pollution of land resources rank high among the major environmental issues in the Caucasus region. These priorities are underlined in National Environmental Action Plans (NEAPs) of each country. At present, it remains very difficult to take preventive or corrective measures, since severe budgetary constraints do not allow for planning and/or taking large-scale land

reclamation and soil protection measures.

Soil erosion in the alpine zone
Source: Sunny Georgia

Both natural and anthropogenic pressures contribute to land degradation. Among the natural factors, wind and water erosion, landslides, mudflows, flooding, etc. are important driving forces in the region, since the whole region is prone to active geo-dynamic processes. Among anthropogenic factors, bad agricultural practices (intensive land cultivation, over-use of agricultural chemicals, slope ploughing, intensive irrigation, over-grazing) as well as unsustainable forestry practices, urbanisation and other activities affect land resources.

Soil erosion is one of the most widespread natural phenomena in the Caucasus and is the most dangerous for the republics short in arable lands, such as Georgia and Armenia. Erosion here is connected with climate and relief peculiarities as well as anthropogenic factors: irregular woodcutting, unsustainable irrigation and drainage practices, open-pit mining, intensive grazing, land cultivation (especially on steep slopes), etc. Erosion results in reduction of land fertility and degradation of vast land areas, which not only reduces crop production but also worsens the environment condition.

Erosion is also dangerous for highland meadows and steppes, where surface wash out is intensively expressed. It may be presumed that erosion processes are one of the reasons for the degradation of environment in highland zones, where a considerable number of pastures and hayfields are concentrated.

Wind erosion is especially prevalent in the East Caucasus, where the climate is relatively dry strong winds during cold periods form favourable conditions for wind erosion. It incurs great damage to agricultural lands because in the recent years many windbreaks were cut-down. In East Georgia about 1,000 km sq. of land area is prone to wind erosion (Beruchashvili, 1996).

The total area of eroded lands has been increasing since the 1980s. In Armenia, for example, a 1.9% increase in total eroded area was observed during the last 20 years and the damage from land erosion amounted to 7.5% of the gross agriculture product (UN-ECE/MNP of Armenia, 2000). At present, about 45% of total area is affected by erosion in the country, and of these, agricultural lands account for about 60% (UN-ECE/MNP of Armenia, 2000). Annual loss of fertile lands makes up 8 million tons and more than 80% of arable lands experience erosion of different types (MNP of Armenia, 2001; UNDP, Armenia 1999).

In Azerbaijan, about half of the total land area is affected by erosion (State Committee of the Azerbaijan Republic on Nature Protection, 1993). Nearly 35% of agricultural lands are susceptible to water and wind erosion in the country. (UNDP, Azerbaijan, 1999). In result of water activity over 516 m^3 of land per each hectare is influenced by erosion annually (UNDP, Azerbaijan, 1998).

In Georgia, over 20-year period, the area of eroded lands reached 1 million hectares, 33% of the entire area of the republic (Tsereteli, 1987). At present, there are more than one million ha of eroded lands in Georgia, 380,000 ha are arable lands and 547,000 ha are pastures and hayfields. In the 1980s it was only 300,000 hectares, from which 200,000 hectares experienced water erosion, and 100,000 hectares wind erosion. About 87,000 ha along the Black Sea coastal zone have been eroded by rivers, where the riverbanks are not protected (MoA of Georgia, 1998). Soil erosion is a very serious problem in the North Caucasus as well. In Kabardino-Balkaria, for example, about 56% of agricultural lands are subject to wind and water-induced erosion, and during last 15-17 years, the area of eroded lands has more than doubled (IUCN, 2000). Geo-dynamic processes together with bad agricultural practices (slope ploughing and over-grazing) and intensive logging are underlying reasons for severe land erosion in the region. The problem is aggravated by the fact that protective measures against wind and water erosion, like the construction of windbreaks, are not taken due to the lack of finances.

Technogenic activities such as open-pit mining operations also have adverse effects on land resources, causing land degradation and depletion. For example, in Krasnodarsky Kray, according to 1999 data, about 2,801 ha of degraded mountain land and 1,498 ha depleted land were registered, brought about by extraction of different types of construction materials, facing and coloured stones, as well as gas and oil operations (IUCN, 2000).

Soil salinization is another major issue pertaining to land resources in the Caucasus region. Soils in dry steppe and semi-desert zones in the region are naturally saline. Hence, cultivated soils in such zones need intensive irrigation and drainage. Unfortunately, since the break-up of the Soviet Union the total area of irrigated lands has been declining in the region. For example, in Armenia, irrigated areas have declined from 311,000 ha in 1985 to 280,000 ha in 1995 and 217,000 ha in 2000 (UN-ECE/MNP of Armenia, 2000).

In the region, most irrigation systems are inadequately lined. In addition, they are not properly maintained and need major repairs and/or replacement. Water losses are high, although it is impossible to give exact numbers, and contribute to an increase in the water table and hence, soil salinization. Regretfully, the countries lack finances to rehabilitate the systems or plan for new irrigation projects. Irrigation systems need in proper drainage as well, without which water logging and secondary soil salinization can occur. Many irrigation systems in the Caucasus region do not have drainage systems or have inefficiently operating ones. The systems were destroyed during the last decade and there is a lack of funds to repair or rehabilitate them. Thereby, the secondary salinization of soils is a serious problem at present. In Armenia, for example, salinised soils occupy approx. 42,000 ha in the Ararat Valley. According to the Azerbaijan NEAP, for example, about 1.2 million ha are affected by salinazation (State Committee on Ecology and Control of Natural Resources Utilization, Baku, 1998; UNDP, 2000). About 8.8% of the total area in Krasnodarsy Kray suffers from salinization (IUCN, 2000).

Construction of large dams and reservoirs without due consideration for physico-geographic and environmental characteristics, also causes soil salinization and flooding. For example, the building of Krasnodarsky reservoir resulted in the water table rise and hence, salinization and flooding of large territories in Krasnodarsky Kray (Ministry of Environment and Natural Resources Protection, 1998).

The problem of salinization is also very acute in Caspian Sea coastal areas as well. Sea-level rise in recent years, for example, caused a rise in mineralised ground water above the critical level and the flooding of thousands of ha of agricultural lands in coastal areas of Dagestan (IUCN, 2000)

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.2 Land Resources

2.2.3 Soil Pollution

Soil pollution is a serious concern for the Caucasus. During the Soviet era, such pressures as intensive use of mineral fertilisers and agricultural chemicals together with industrial activities, mining, oil and gas operations, traffic emissions, and the dumping of municipal and toxic solid wastes affected the soil quality in both urban and rural areas.

Presently, despite the general decline in use of agro-chemicals, the problem of topsoil pollution still exists. First, agro-chemicals do not easily degrade and heavy metals are still accumulated in soils. Second, the uncontrolled import and use of fertilisers and chemicals by individual farmers pose a threat to environmental quality, along with obsolete pesticides stored in inadequate warehouses. In Georgia, for example, about 400 tons of obsolete pesticides and 3,500 tons of mineral fertilisers are stored in warehouses that do not meet health and environment requirements (TACIS/MoE of Georgia, 1998). In Krasnodarsky kray up to 1,000 tons of obsolete pesticides are stored (Ministry of Environment and Natural Resources Protection of the Russian Federation, 1998).

There are limited data on soil pollution by agrochemicals. Historically, the Hydro-meteorological Services (HMSs) in the Republics conducted soil sampling and analysis. Measurements were sporadic and the methods of sampling and analysis employed by HMSs might include unacceptable errors. For example, in Armenia, 3,560 soil samples were taken in 1977-1983 from arable lands and orchards, and only 21 samples showed high pesticide concentrations. High concentrations of DDT and DDE were found in 20% of soil samples taken from arable lands of the Ararat Valley (UN-ECE/MNP of Armenia, 2000, UNEP/MNP of Armenia, 2000). Similar studies conducted in Georgia have not revealed an excess of allowable concentrations (TACIS/MoE of Georgia, 1998). In Azerbaijan, the State Sanitary and Hygienic Service

toxicological laboratory studied approximately 2,819 food and soil samples from 1988-91. The residual quantity of pesticides was found in 7% (184) of these samples and of these, limits were exceeded in 96 cases (State Committee of the Azerbaijan Republic on Nature Protection, 1993). Studies conducted in Krasnodarsky kray show that nitrates pollute about 4.1% of Kray's territory, and pesticides at a level from "moderately dangerous" to "dangerous" (IUCN, 2000).

Soil pollution by heavy metals and oil products is a concern in urban and industrial areas. Heavy metals and oil products released into all environmental media from specific industrial activities, mining operations and fuel combustion, pose a high threat to environmental quality. Before the transition, road traffic accounted for about 60% of soil pollution in urban areas. At present, this figure exceeds 85%, since industries work at a minimum level. In Georgia the cities of Tbilisi, Rustavi, Kutaisi, Zestaphoni, Chiatura and Batumi, which have a high concentration of heavy industry, steel, manganese, ferro-alloys, machinery manufacturing and oil refinery plants, etc. and heavy traffic were mostly affected. Additionally, copper and gold mining operations in Kvemo Kartli region were heavily polluting soils. In Armenia, about 30,000 ha of land is polluted by copper, lead and molybdenum due to mining operations in Northeast Armenia. The city of Yerevan is heavily contaminated. USAID studied soil samples from the area surrounding a thermopower utility and found contamination by polychlorinated biphenyls (UN-ECE/MNP of Armenia, 2000). In Azerbaijan, urban lands in Sumgayit, Baku, Ganja, Alybairamly and Mingachevir are the most polluted. Sumgayit is severely polluted by mercury used in chlorine-alkalin production. During the Soviet period, the mercury loss amounted to approx. 1-2 kg/ton per unit output. At present, the figure is about 300 kg/ton of chlorine produced. The soil is heavily contaminated through toxic waste dumping and air deposition (State Committee on Ecology and Control of Nature Resources Utilization, Azerbaijan, 1998). In addition, copper, lead and zinc mines in Azerbaijan cause soil pollution with heavy metals. Intensive oil and gas operations pollute the soil with oil products. The North Caucasus republics and Azerbaijan, with well-developed oil production and petrochemical industries, suffer the most. Soil contamination with oil products, for example, is extremely high in the Absheron peninsula. There, in the 1980s and 90s average soil oil content in the 0-5 centimetre gradient regularly exceeded background levels (100 ppm) up to 56 times (Ministry of Environment and Natural Resources Protection, Russian Federation, 1994). Overall, about 10,000 ha of land are heavily contaminated with oil products (State Committee on Ecology and Control of Nature Resources Utilisation, Azerbaijan, Baku 1998). In Grozny, Chechnya, soil oil content in the 20-centimeter gradient was varying from 1,200 ppm in 1986 to 2,470 ppm in 1990, with 50-ppm trace level (Ministry of Environment and Natural Resources Protection, Russian Federation, 1994). At present, in Chechnya many unlicensed and uncontrolled firms extract small quantities of oil and sell it to neighbouring countries, completely neglecting environmental considerations during mining operations.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.2 Land Resources

2.2.4. Policy Measures

During the Soviet era, all the lands were public property and belonged to the "United State Land Fund." The Land Fund was divided into several categories based on land use: agriculture, state forestry farms, state land fund, non-agricultural lands (industrial areas, resorts and urban areas, etc).

Many of land-related problems of the 1970s and 1980s were caused by poor land use planning. Land use planning was a part of central planning system consisting of strictly centralised territorial and sector planning. The planning was conducted at all-union (central) and national levels. State Planning and Building Committees ("Gosplan" and "Gosstroy" respectively) with subordinated branches in the Soviet republics, were the responsible bodies at the central level. In addition, similar national bodies operated in the sister republics. The State Planning Committee developed master plans for the entire Soviet Union and provided the major territorial planning guidance for national republics. This agency also worked out short to long-term sector development and industry distribution plans for the entire Soviet Union. Based on these plans, similar national bodies developed national branch development plans.

In essence, the Soviet planning system was ineffective. There was no co-ordination between industrial and land use planning, local conditions were ignored, and many plans were infeasible. Master plans for urban development were based on uniform approaches and characterised by under-valuation of land, lowland development at the expense of agriculture lands and green zones, intensive industrialisation, monotonous housing projects etc.

Following their independence, all of the NIS countries, including South Caucasus states and the RF, began developing national legal-institutional capacities. In the land resources management field, new land codes, providing land classification according to planned uses, and rules and procedures for land ownership, etc. were adopted. Environmental media-specific statutes on soil protection were also passed in some of these countries.

At present, land resources management and protection responsibilities are widely spread among different agencies and the scope of work of these agencies varies on a country-by-country basis. In Armenia for example, the Ministry of Nature Protection is responsible for land resources protection. The Ministry of Agriculture is responsible for planning and management of agricultural land resources. At the same time, the State Committee of the Real Property Cadastre under the Government of Armenia is responsible for the planning and management of all lands other than agricultural. These three agencies are all responsible for some aspect of land resources planning and management. They develop regulations and general policies for land resources planning and management. The Ministry for Environment conducts monitoring of land use and is responsible for inventory of lands affected by geo-dynamic processes. In Georgia, the State Department for Land Resources Management and the Ministry for Environment, specifically the Department for Waste Management and Land Resources Protection, are the key agencies in land planning and management. Both of these agencies are engaged in the development of regulations and general policies pertaining to land use; soil protection from erosion and contamination, etc. Whereas the MoE is responsible for the inventory of degraded and contaminated lands, the State Department for Land Resources Management is responsible for the control over privatised and leased lands and land tenure, etc. Agriculture Ministries also play key roles in protecting and monitoring of agricultural lands. Other agencies (health ministries and their sanitary-hygiene oversight services, hydro-meteorological services, forestry departments, etc.) are also involved in land-related activities in all the South Caucasus countries. City planning is conducted by the Ministries/Departments of Urbanisation and Construction and the managerial functions are the responsibility of city municipalities. In the North Caucasus autonomies, federal, republican and local authorities carry out land-use planning and management activities. In krays, kray-level administrations are the key authorities. In some of the parts of the Caucasus, where the state legal-institutional system is weak or absent and where a long tradition of nature use exists, local communities play a significant part in land resources management.

Overall, all agencies in the land planning and management field experience similar financial and institutional difficulties, as do others involved in environmental and natural resources management. Current legislation is imperfect, especially in the field of land ownership, spatial planning and zoning, etc. Town planning practices are still based on Soviet approaches and do not reflect modern urban concepts or the special nature of transitional economies. Whereas various state plans, programs and projects pertaining to land resources management do exist, financial and implementation mechanisms are lacking or absent.

The South Caucasus and Russian NEAPs identify priority issues pertaining to all environmental fields, including land resources, and suggest legal-institutional and investment measures for solving these issues. Some of these activities are currently being implemented. For example, Armenia has developed the Agro-biodiversity Program aimed at conserving and using wild species, analogous to cultivated ones. The country also has a Program for Land Restoration as well as a National Agrarian Policy. In Georgia, GTZ, WB, UNDP, etc. funded the land estate registration project, aimed at establishing a modern user-oriented state system of land tenure by using advanced remote sensing and GIS technologies. All South Caucasus countries are parties to the UN Convention to Combat Desertification, and the first national reports have been delivered under the Convention. Currently, the countries are in the process of developing national programs against desertification and building up institutions under that framework.

Nevertheless, there are some concerns that the funded programs/projects will never be carried through, since most of them do not include sustainability components for further financial and technical resources. In addition, each of the donor organisations uses its own criteria and methodologies and has little co-ordination with other donors. For example, several donors implementing land registration programs in Georgia use different methodologies and data collection protocols that may lead to the establishment of inconsistent and incompatible land information systems within the country.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.3 Forestry Resources

2.3.1 Caucasus Forests

The Caucasus is rich in forests. The total area of forests comprises more than 73,100 km sq., or 17% of the total land area. From the total area of forests, one should distinguish the area of the "State Forestry Fund (Estate)". It occupies a vast territory and amounts to 87,100 km sq. Apart from forestlands, it also consists of glades, small arable lands, hayfields, pastures, transport and communication right-of-ways, etc.

General data on the Caucasus forests

Country/Region	Total area Thousand ha	Percentage share	Timber volume mln m^3	Registered woodcuts mln m^3
Armenia	450	15.1	45	0.054
Azerbaijan	1 214	14.0	113	0.045
Georgia	2 773	39.8	452	0.423
Russia (N. Caucasus)	2 883	11.4	520	-
Total Caucasus	**7 320**	**20.1**	**1 130**	-

Source: Statistical services of Armenia, Azerbaijan, Georgia and Russian Federation, 2000

Most Caucasus forests are located in mid-mountain zones at altitudes of about 500-2,000 metres and grow on steep slopes. There are also lowland and riparian forests. Broad-leaved forests dominate the region, representing 93% of Armenian forests, 83% of Georgian forests and 98% of Azerbaijani forests. The most important are the relic forests of the Tertiary era, located in the Caspian Sea coastal zone and Tallish Mountains, and the coastal temperate rain forests in south-western Georgia. Well-expressed vertical zonality and climate variations determine the existence of several types of forests, such as oak forests, beech forests, horn-beam forests, birch forests, dry scrub juniferous forests and coniferous forests, with dominating species of fir, spruce and pine. Riparian forests consist of alder, lowland oaks, wing nut, etc.

Georgia has a relatively high percentage of forestlands, though it significantly lags behind other countries rich in forests. Forests cover is nearly 40% of Georgian territory. The North Caucasus exceeds Georgia in total area of forests (28,800 sq. km), but has very low percent of forestland at 11.4%. Azerbaijan has forests 14-15% of its territory. In Armenia only 10% of total land area is covered by forests, while the State Forest Fund is almost 15%.

The total supply of timber makes up 1.130 million m^3. The overwhelming part of the supply (86%) comes from Georgia (40%) and the North Caucasus (46%). Azerbaijan supplies about 10% and Armenia only 4%.

Both timber supply and forestlands within the countries vary largely depending on physical and geographical conditions, agricultural development, and proximity to urban centres. In the North Caucasus, for example, forestlands vary from 6% in Stavropol kray to 23% in North Ossetia.

In the South Caucasus, much of the forest area is characteristic of the regions of the Greater and Lesser Caucasus. A small amount of forestland is in intermountain depressions, connected with the intensity of agricultural activities in the west and central part or with semiarid and arid conditions in the east. The Javakheti-Armenian highlands, due to continental conditions, relative aridity of the climate and relatively high altitudes, has little forest cover.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.3 Forestry Resources

2.3.2 Dynamics of Forest Cutting

Pine forests. Georgia
Source: Sunny Georgia

Analysing the dynamics of forestry estate over the last 30 years is difficult. The statistics allow one to analyse only the change in total area of the State Forestry Estate. This area changed not so much due to logging, but due the transfer of territories from one agency to another in the former Soviet Union. In addition, different criteria for designating territories as forests were set in the countries of the South Caucasus following the dissolution of the Soviet Union. In Armenia and Azerbaijan, the area of the Forest Estate increased because some territories with shrubs were added to it.

Thus, data on forest estate area dynamics do not express the real picture. Neither does official data on timber supply dynamics.

Statistical yearbooks contain data on woodcuts. These data, however, are very tentative, since after the dissolution of the USSR illegal woodcutting has sharply increased. There are practically no data on the amount of this woodcutting.

Reforestation activities were conducted during Soviet times. Annually, trees were planted in the forests of the 50-60 thousand ha area. In the 90s, this was halted. However, the area of forests in some regions (e.g. in Racha, Georgia) began to increase naturally in connection with the depopulation of these regions. Pines and other aggressive, rapidly growing timber species occupied the places of former arable lands, increasing forested lands in such areas by 5% to 6%.

The World Bank (2001) attempted to find out the dynamics of the forest cover in the central part of the Caucasus based on comparing aerial photos made from Landsat in 1989 and 2000. The results of comparing these pictures showed that changes in the forest-covered area are not high. The most intensive cutting was noticed in the Bakuriani, Adigen and Khaishi regions. On the rest of the territories, the data on forest cover are not essential. Do the data of the aerial photos reflect a real situation? Usually, most of Caucasus forests according to Soviet regulations belonged to the I and II categories and woodcutting was fully or partially banned there. These regulations still exist even now on the countries of the South Caucasus. If now any woodcutting is conducted, it is illegal. Aerial photos show just these territories.

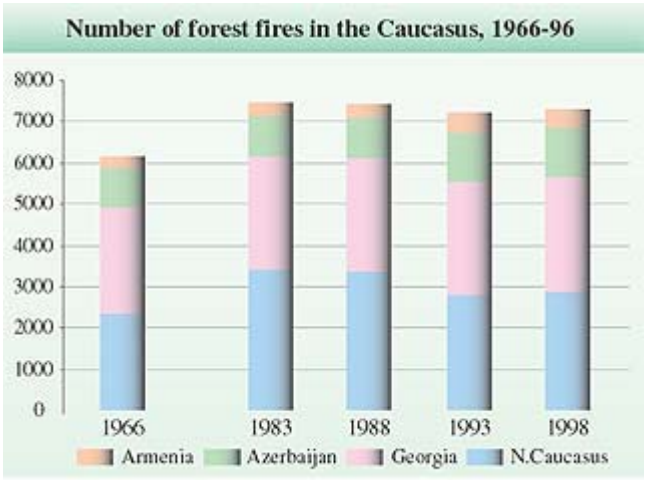
In recent years, selective cutting occurred in the Caucasus, when the highest quality trees were cut. During the last ten years cutting was extensive on the Saguramo-Yalon range (East Georgia), and on the outskirts of Tbilisi and Yerevan. In the forests of the state forest fund, there were no significant changes in the total forest cover, but all valuable specimens of beech and some other species have been cut. This resulted in a drastic reduction in forest quality. For example, it is estimated that over the past ten years 26% of beech forests were converted to coppice forests and only about 10% of the beech forests left have high density in Armenia. Oak forests are in the most critical condition. Mature and over-mature trees accounted for 31.3% of oak forests. The current age structure of forests (average age - 90 years, pre-mature trees amount only for 6.5% of total) also has a negative impact on the future development of forest resources (UNEP/MNP of Armenia, 2000). In Georgia, as a result selective logging, forest density has been significantly reduced: 0.5 and lower density groves occupy 1149.8 thousand hectares (53%); groves of average (0.6-0.7) density occupy 932.8 thousand hectares (43.0%) and groves of high density (0.8 and more) occupy only 86.8 thousand hectares (4%). It is quite clear that the area of high-density forests have been considerably reduced (WB/State Forestry Department, Georgia, 1997).

For the last ten years, the largest amount of cutting has taken place on former collective farms that had no owners following privatisation. The situation in these regions is critical. Cutting of green zones was particularly severe around urban areas of Armenia and Georgia in the early 1990s, where population was forced to use forests for fuel wood because of an energy crisis. Consequently, environmental situation in these settlements has substantially worsened. In Yerevan, for instance, about 60-80 thousand trees were cut down, though they could have significantly improved the ambient air quality by absorbing and neutralising air emissions (UNEP/MNP of Armenia, 2000).

Uncontrolled grazing in forest areas is also common practice at present. This itself causes the destruction of biodiversity of underbrush woods, endemic and relic species being the most vulnerable among them. As a result, underbrush fauna

migrated from their habitats and less valuable brushes began to expand.

During recent military conflicts in Chechnya, Georgia and Azerbaijan, bombing, forest fires, clear-cutting for heavy military equipment have damaged the forest cover. Out flows of refugees and depopulation of the regions have reduced human pressures and created good conditions for forest regeneration.



Source: State statistical services of Armenia, Azerbaijan, Georgia and RF, Year Books, 1970-2001

To sum up, the problem of deforestation has not been so acute for the Caucasus as in some tropical countries, where over the last thirty years the forest cover has been considerably reduced. Overall, the area of forest cover in the Caucasus has been more or less preserved during the past 30-year period. Nevertheless, in recent years the territories near urban areas or where forest exploitation is promoted either by natural factors (easy access) or good opportunity for illegal timber export (e.g. in the Lesser Caucasus near the customs with Turkey) the forest cover structure has changed significantly. Valuable specimens of timber have been cut, and forest quality reduced.

In addition to anthropogenic activities, fires have a considerable influence on the forest cover. Nevertheless, in case of the Caucasus, the forest fires are not so common as in Siberia and Far East, for example.

Do the changes in forest cover have serious environmental impacts? Where full-scale cutting is going on there is a danger of erosion. However, still, the area of re-eroded slopes within the scale of the entire Caucasus is not so large, though in some individual cases it is of critical importance. Forest estate of the Caucasus, over last 30 years was subject to moderate changes and, thus its ecological function as the "natural lungs of atmosphere" has been preserved overall. This cannot be said of its aesthetic value, which has been sharply reduced due to unsustainable woodcutting practices.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.3 Forestry Resources

2.3.3 Forestry Policy

Before the break up of the Soviet Union, uniform forestry policy was conducted in the Caucasus. All forests were public property and belonged to the “State Forest Fund” (estate). Forests were divided into various categories. Those of national importance were managed by central and local branches of the Ministry for Forest Management (“Minleskhoz”), while city forests were managed by different sectoral bodies. Other categories included forests of reserves and sanctuaries and forests of collective farms.

According to Soviet legislation, the forests fell under three categories based on their location and function. The first category forests had water regulation, soil protection, sanitary-hygiene and recreational functions. Forests of special importance, such as national parks, state reserves, reservations, etc. also belonged to this category. The second category consisted of the forests located in densely populated areas with protective and some commercial value, along with forests belonging to collective farms. The third category included the forests designed purely for commercial cutting, which served as a state forest stock. Different regimes of resource use and management were applied to these three categories of forests.

Forest cutting was usually conducted for general use (commercial cutting) and regeneration purposes (sanitary cutting). Commercial cutting was conducted when trees reached certain levels of maturity and three types of felling were used: clear-cutting, selective and rotational. Sanitary cutting, on the contrary, was conducted at any growth stage.

Commercial logging was not so extensive in the Caucasus, because the most forests there were managed for conservation and protection purposes and were classified as first category forests, where commercial logging was prohibited. Significant stocks of forests in Siberia and central and northern parts of the USSR were used to export timber to the Caucasus.

According to forestry regulations, all high forests were subject to natural regeneration. Reforestation was conducted annually. Special large-scale reforestation programs were implemented resulting in thousands of hectares of land area planted with new trees. For example, large quantities of trees, predominantly pines, were planted around the city of Tbilisi. These areas were practically bare at the beginning of the 20th century.

However, practices such as selective and unsustainable cutting have led to degradation of forest resources in the Caucasus. In addition, weak legal-institutional frameworks for enforcing existing legislation has hindered the effective implementation of existing rules and regulations on the use and protection of forestry resources.

In the early 1990s, each of the South Caucasus countries began to develop and implement independent national policies. Although some efforts have been made to introduce new policies and management practices, traditional forestry practices remain widely in use. New forestry codes and national strategies have been developed and adopted. Grant programs and projects have been implemented through financing by donor organisations, the World Bank being the major donor. The main goals of these projects are to establish forestry systems similar to those of western countries.

Despite this, the forestry sector in the Caucasus countries faces serious economic, institutional and technical problems. Frequently forest management and protection efforts are duplicated by different agencies. Law enforcement officers lack the capacity to detect violations and act appropriately. Most importantly, there is a lack of current data on forest resources and thus, a forest inventory needs to be conducted and modern resource monitoring and inventory systems established.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.4 Fresh Waters

2.4.1 Water Balance

Caucasus rivers belong to the basins of the Black, Azov and Caspian seas. In 70% the territory of the Caucasus, water drains into the Caspian Sea. In terms of flow volume, the first place (56%) is occupied by the Black-Azov basin, located in the western part of the Caucasus where precipitation is more plentiful. The major data on main rivers of the Caucasus are given in the table.

General data of the Caucasus major rivers

	River	Lenght km	Basin drainage area, m^2	Average discharge m^3/sec	Basin height m
Caspian Sea Basin	Araks	1 072	102 000	210	3 400
	Kura	1 364	188 000	575	2 100
	Sulak	332	13 400		3 580
	Terek	600	43 700	302	3 199
Black Sea Basin	Chorokhi	438	22 130	307	1 800
	Enguri	213	4 060	170	3 050
	Kuban	906	57 800	425	3 080
	Rioni	327	13 400	405	2 800

Source: Caucasus Water Balance, 1991. Water Resources of the Trans-Caucasus, 1988

The annual average flow of the Caucasus rivers fluctuates between 1,000-2,000 mm (Ajara and the Greater Caucasus) to 50 mm and lower. A small amount of flow is characteristic of the Kura-Araks lowland, the Caspian lowland, the Stavropol upland and northern part of the Kuban plain. The middle mountains have a flow from 600 to 1,000 mm and low mountains from 200 to 600 mm.

The outflow is connected with evaporation. The amount of aggregate evaporation depends on evaporation and amount of precipitation. The amount of precipitation in the Caucasus fluctuates from 1,000 to 100 mm. The

Water balance in the South Caucasus

greatest amount of evaporation occurs in places with a humid and warm climate. Insignificant amounts of evaporation are found either on the territories with arid climate or in highland regions with low air temperature. The table shows elements of water balance in three South Caucasus countries.

Country	Precipitatio km³	Total flow km³	Surface flo km³	Evaporatio km³	Undergrou flow km³	Infiltration km³
Armenia	17.4	6.24	2.34	3.9	11.2	9.77
Azerbaijan	35.1	7.81	4.81	3.0	27.3	14.8
Georgia	93.3	52.8	31.1	21.7	40.5	45.6

Source: Caucasus Water Balance, 1991. Water Resources of the Trans-Caucasus, 1958

Overall, the Caucasus is not rich in lakes. Sevan is the largest lake in the Caucasus with an area of 1,416 sq. km. It is followed by Manich-Gudilo (800 km sq.) and a few coastal salt lakes of the Azov Sea. Wetlands in the Caucasus are found in the Colchian lowland and in the deltas and floodplains of large rivers, where hydrophilic conditions prevail.

Water resources of the South Caucasus

Country	Area of water collection 1000 km²	Country area 1000 km²	Local flow km³	Inflow km³	Total resources km³	Outflow km³
Armenia	59.2	29.8	5.63	2.08	8.32	7.71
Azerbaijan	217.9	86.6	7.72	19.4	28.1	19.7
Georgia	99.3	69.7	51.9	8.67	61.45	60.61

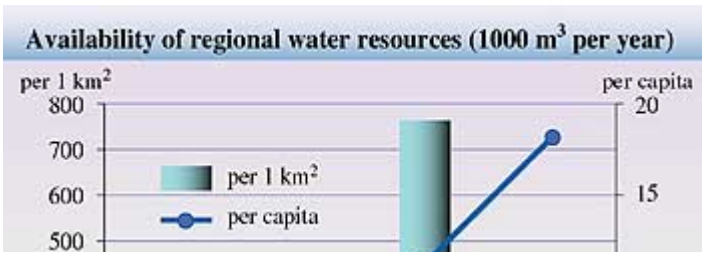
Source: Caucasus Water Balance, 1991. Water Resources of the Trans-Caucasus, 1958

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.4 Fresh Waters

2.4.2 Water Availability and Use

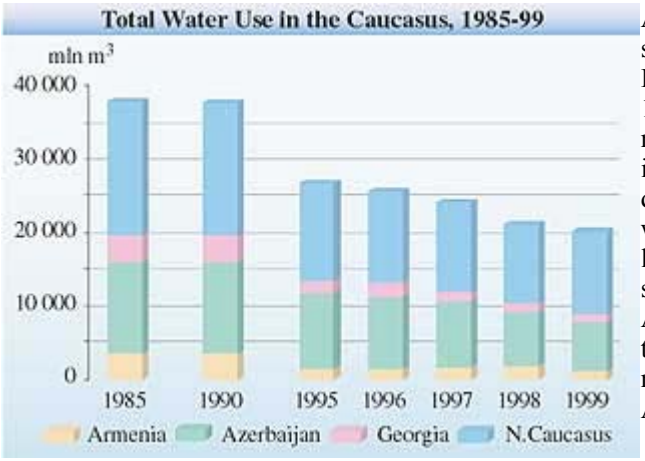
The unequal distribution of regional water resources in the Caucasus causes problems with water allocation in the region, especially in the Kura-Araks river basin. In the future, this problem may become the source of regional conflict. For example, while Georgia is the richest country in water resources among the South Caucasian countries, Azerbaijan suffers from water shortages the most.



Historically, major users of fresh water resources were agriculture, industry and households in the Caucasus region. Usage for hydropower generation and recreation was also significant. Agriculture's share of total use was higher than that of households and industry. The industrial sector used the least amount in most parts of the regions.

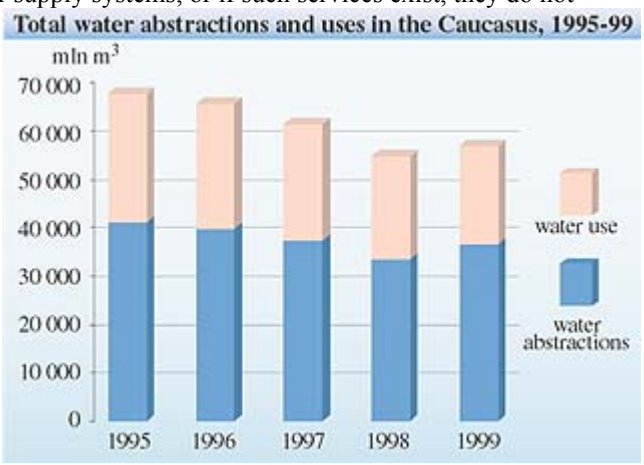
Source: HDR, Azerbaijan, 1999

Inefficient water use practices were common to the region. Only a small percentage of water was recycled and/or reused. Water losses in irrigation and water supply systems were high in the 1980s. In Georgia and Azerbaijan, for example, losses in irrigation systems amounted to 29% and 33% in 1988 respectively (State Committee of the USSR of Nature Protection, 1989). Regardless of legal water quantity limits set for each enterprise, water over-consumption was frequently detected. In Azerbaijan, for example, 14 out of 17 enterprises for which the legal limits were set exceeded these limits by 18 million cubic metres; in Armenia 14 out 25 enterprises exceeded existing limits by 16 million cubic metres; and in Georgia 14 out of 22 enterprises exceeded their limits by 15 million cubic metres in 1988. Reportedly, regular water over-consumption was related to the lack of water metres (State Committee of the USSR on Nature Protection, 1989).

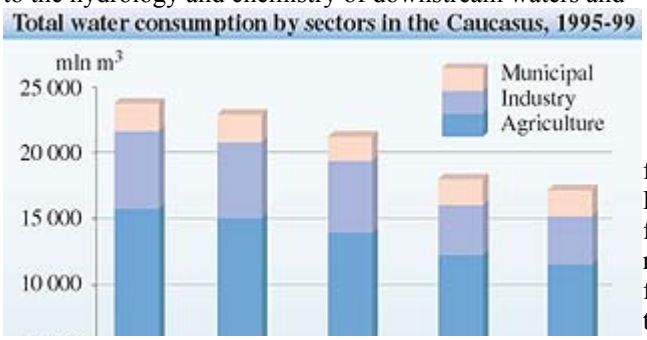


After the break-up of the Soviet Union, total water use has significantly decreased due to the general economic decline. In Azerbaijan, for example, water abstractions declined from 16,176 million cubic metres in 1990 to 11,968 million cubic metres in 1999 (UNDP, Azerbaijan, 2000). Of the major uses, industrial usage has dropped the most dramatically and the domestic usage the least. The fall in industrial water usage was more drastic in Armenia and Georgia, where due to the loss of markets for industry inputs and auxiliary parts, the sector has virtually collapsed. In the Russian Federation and Azerbaijan many industries continue to function. Therefore, the patterns of water usage have not changed very much in most of the North Caucasus republics and krays as well as in Azerbaijan.

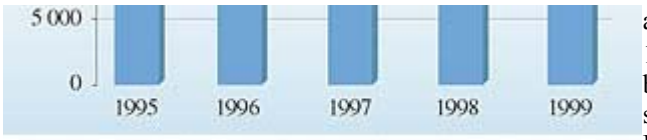
For the last decade, the Caucasus countries have faced problems related to potable water supply. This was underlined in all NEAPs. Although almost all major cities of the Caucasus have centralised water supply systems, existing water supply volumes do not meet the demands of rapidly growing urban populations. The systems themselves are inefficient, having high losses. Many rural areas do not have central water supply systems, or if such services exist, they do not operate. Hence, the rural population is urged to use water from rivers or artesian wells that might be contaminated. Existing water supply systems and intake facilities are out of date and insufficient to satisfy current demands. Lack of funds precludes repairing and expanding existing facilities or building new ones.



Over decades, uncoordinated sector-based uses of water resources, traditionally practised in the region, posed a threat to the hydrology and chemistry of downstream waters and



foster the degradation of biota, nurtured in these waters. Building of large-scale dams, without providing paths for fish, had a negative impact on fish populations, greatly reducing fish stocks. For example, intensive water abstraction from the Terek River for irrigation uses, the lack of paths for the sturgeon populations in Kargalinsky dam, and non-



Source: State statistical services of Armenia, Azerbaijan, Georgia and RF, Year Books, 1970-2001

attainment of minimum required discharges amounting to 80-100 m^3/s for fish population in spring times affected fish breeding and has led to a significant reduction in Dagestan's sturgeon population (Ministry of Environment and Nature Resources Protection, Russian Federation 1996). A similar situation exists in the Azov and Black Sea basins.

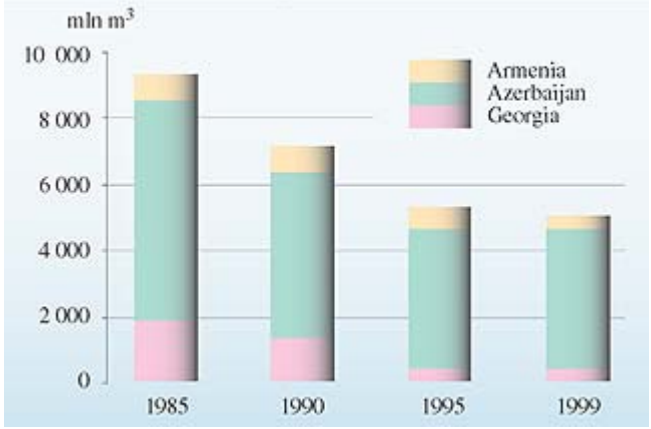
CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.4 Fresh Waters

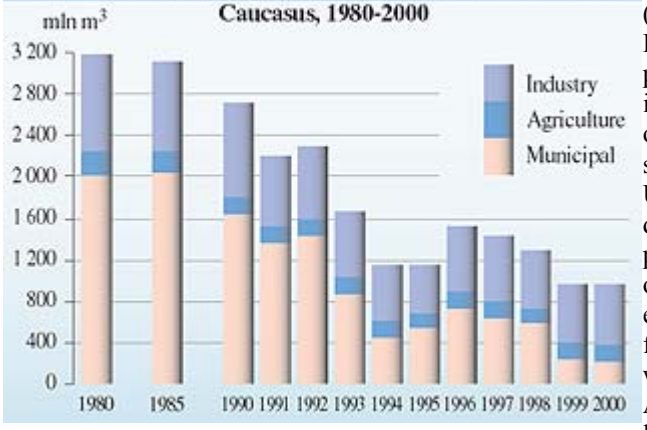
2.4.3 Surface and Ground Water Quality

Water quality is one of the major environmental concerns in the Caucasus. During the Soviet era, large volumes of effluents were discharged into surface water bodies from municipal, industrial and agriculture sources, causing pollution of both surface and ground waters. The largest sources of point source pollution were municipal waste-waters, which polluted rivers downstream of large cities with organic matter, suspended solids, surfactants, etc. Industrial waste-water discharges also were high, polluting surface waters with heavy metals, oil products, phenols and other hazardous substances. In Georgia, for example, large industrial facilities producing manganese, ammonia, machinery, etc. together with arsenic, copper and gold mining and processing plants, oil refineries and power plants polluted the river bodies of the Black and the Caspian Sea basins with heavy metals, oil products, phenols and other toxic substances. In Armenia and Azerbaijan, different industries also discharged high loads of pollutants into the Kura and Araks Rivers and their tributaries. In the North Caucasus, one of the major concerns was the contamination of the Terek River and its tributaries from non-ferrous industries (Ministry of Environment and Nature Resources Protection, Russian Federation 1996). Heavy metals, oil products and phenols also heavily polluted the Kuban River. For example, in the late 1980s in the Kuban River, ambient concentrations of oil products and copper were 5-7 times as high as existing surface water quality standards (State Committee of the USSR on Nature Protection, 1989). Agriculture run-off discharged heavy loads of nutrients, suspended solids and pesticides into surface water bodies, causing eutrophication of rivers and lakes and the loss of biota. Lake Sevan, for example, suffered seriously from heavy loads of nutrients from agriculture. About 800,000 tons of 34 types of fertilisers were used in the 1980s in the Lake basin (UN-ECE/MNP of Armenia, 2000). Agricultural run-off from nearby arable lands and livestock farms discharged heavy loads of P and N and organic matter into the lake, changing its status from tropic to almost eutrophic. Therefore, its physical-chemical balance was destroyed, leading to eutrophication and the loss of valuable trout populations. In the North Caucasus, the River Kuban was also highly polluted by biogenic substances (Ministry of Environment and Nature Resources Protection, Russian Federation 1996).

Total waste-water discharges in the South Caucasus, 1985-99

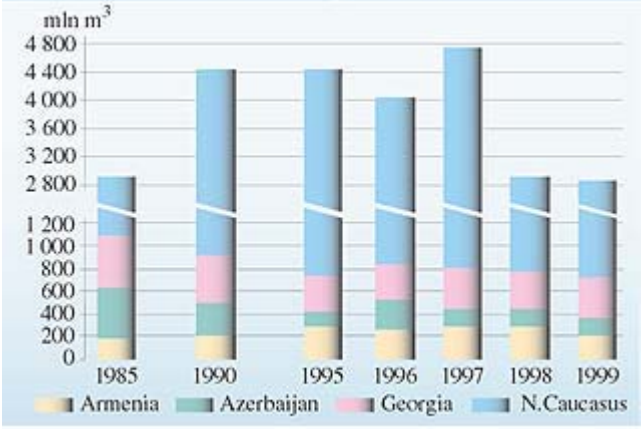


Waste-water discharges from major sectors in the South Caucasus, 1980-2000



Diffused sources of pollution, other than agriculture runoff, drainage waters from legal landfills and illegal dumpsites and open-pit mining operations, etc. as well as urban run-off also posed high threat to surface and ground waters. In Armenia, for example, the Debed River, a tributary of the Kura River was highly polluted with copper and zinc discharged from the Alaverdi mine in Northeast Armenia. In Georgia, waste-waters from copper mining operations heavily polluted the Kazretula River (Kura River basin) with heavy metals. In the North Caucasus, the contamination of Terek-Kuma artesian aquifer with arsenic was and still is a problem (Ministry of Environment and Nature Resources Protection, Russian Federation 1996).

Untreated waste-water discharges in the Caucasus, 1985-99



Source: State statistical srvices of Armenia, Azerbaijan, Georgia and RF, Year Books, 1970-2001

Historically, the coverage rate of the Caucasus region by sewage systems was high, amounting to about 50-60% of the urban population. The majority of the rural populations however, were not covered by sewage services and they at large relied on septic tanks. Water treatment facilities usually received more waste-water than they could treat. In many cases, industrial waste-waters were discharged directly into municipal sewage collectors. In addition, frequently rain water sewers and domestic sewage systems were connected to each other, causing overloading during heavy rainfalls.

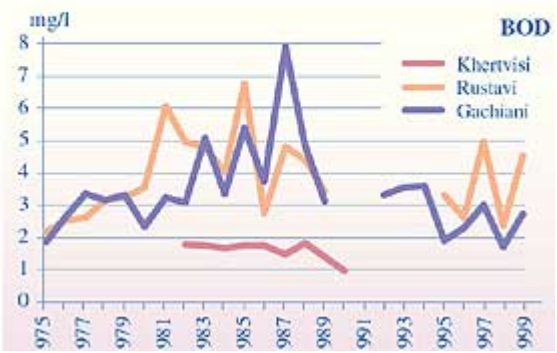
The most polluted rivers in the Caucasus, 1999

Since the break-up of the Soviet Union, contamination of surface waters has decreased. This could have resulted in the temporary improvement of water quality. However, this is off-set by the fact that the majority of waste-water treatment facilities ceased to function or work at very low levels of efficiency, causing the discharge of larger quantities of untreated waste-water directly into water bodies. The problem of industrial accidents and gulp releases is still acute in the region. For example, during 1998 in North Dagestan gulp discharges from industries located in Chechnya caused heavy contamination of the Terek River and other small river bodies with oil products, exceeding the existing water quality standards 200 to 600 times (Ministry of Environment and Nature Resources Protection, Russian Federation, 1998).

Overall, most of rivers of both the Black and Caspian Sea basins are considered polluted. However, the Kura river, being the major waterway in the South Caucasus region, has a high degree of international importance, in terms of both quantity and quality of water, since its basin covers five countries: Armenia, Azerbaijan, Georgia, Turkey and Iran and the rivers and their tributaries there are abstracted for essential uses. Whereas they are less crucial, at a national level, to Iran and Turkey, they are nevertheless important to the economy and communities living in the riparian corridors.

Kura-Araks River Basin, including its two main rivers, the Kura and the Araks and their tributaries, covers three countries: Armenia, Azerbaijan, Georgia, and parts of Turkey and Iran. The total area of the basin is more than 200,000 square kilometres, with about 188,000 km sq. of catchment area for the Kura river basin and 102,000 km sq. of catchment area for the Araks river basin. The Kura River originates in Northeast Turkey, passes through Georgia and flows into the Caspian Sea in Azerbaijan. Some of its tributaries flow from Armenia to Georgia and Azerbaijan. The Araks River originates in eastern Turkey and flows along the border of Turkey, Armenia, Iran and Azerbaijan. One branch of the Araks flows directly into the Caspian Sea. The total length of the Kura River is about 1,515 km and its main tributary, the Araks River, is

Concentrations of selected components in the Kura River*

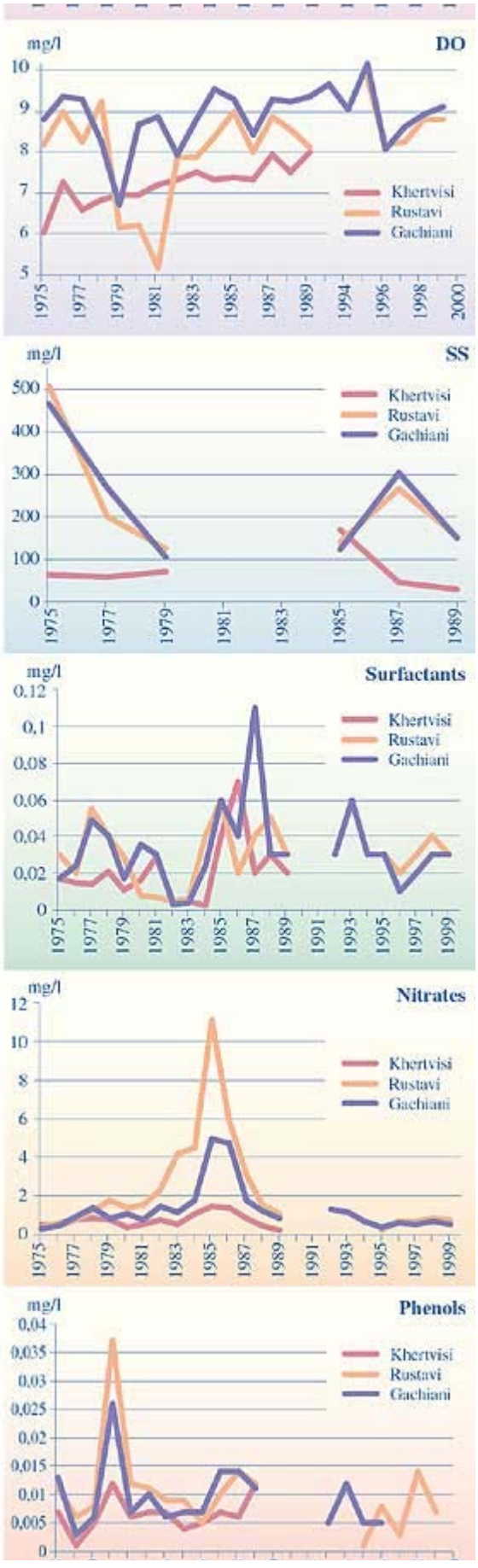


approximately 1,072 km. The basin is rich in biodiversity, unique riparian forests along the Kura, and many important wetlands.

The rivers of the Kura basin are used for agriculture, domestic, industrial, and hydropower generation and recreation purposes. Whereas Armenia and Georgia have abundant underground water reserves, which are used as a major source of drinking water, Azerbaijan is almost entirely reliant on the Kura River for all types of water uses. The problems existing in the basin are related to both quantity and quality of water. Water shortage is acute for Georgia and Azerbaijan, since rainfall disappears from west to east of the basin. The average annual precipitation in Central Georgia, where the Kura enters Georgia from Turkey, is 500 mm but is 200 mm in Azerbaijan, where the river flows into the Caspian Sea. Similarly, evaporation rates soar from west to east. Drought periods in the Kura Basin are very common. This has seriously affected the economies of Georgia and Azerbaijan. Overall, despite the efforts to manage river flow the region faces both floods and shortages. Water quality is deteriorated by raw municipal and industrial waste-waters and return flow from agriculture, imposing health, ecological and aesthetic threats. Additionally, improperly designed solid waste landfills and illegal dumpsites, drainage waters from open pit mines and urban run-off degrade the water quality. Municipal sewage contributes the highest share in pollution. The Kura River downstream of such large cities like Tbilisi and Rustavi is heavily polluted with organic matter and other pollutants. Thus, when the river crosses the border of Azerbaijan it is already heavily polluted. For example, in 1992-94, average annual concentrations of phenols and oil products exceeded existing water quality standards about 13-14 and 2.5-3 times respectively in the vicinity of village Shikhly, Azerbaijan near the border with Georgia.

At present, most waste-water is left untreated. Existing treatment facilities are out of date and work with low efficiency. Mostly, only mechanical treatment is conducted. Recently, experts from Sandia Laboratory made cost estimations for raw sewage discharges downstream of Tbilisi. Modelling results have showed that potential costs for discharging municipal sewage in Tbilisi with current discharge rates exceed US$ 100,000 at Rustavi and further fall below US$ 300 downstream the river due to self-purification capacity of the river. This means that Rustavi population would gain the most if the waste-water were properly treated.

Sources: Phase I Report, Draft, USAID/DAI, 2000; Sandia Sandia Report, 2001; Concept Paper UNDP, 2001, UNEP/GRID-Arendal, 1995



1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000

Source: State Department for Meteorology of Georgia

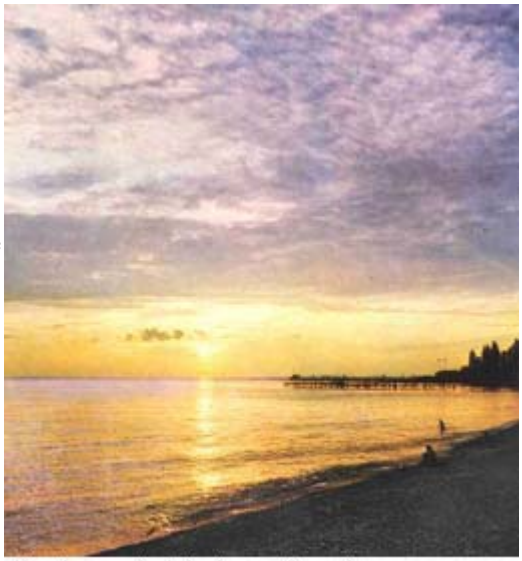
**note: Khertvisi is the most upstream and Gachiani - the most downstream river gouging site*

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.5 Coastal and Marine Waters

2.5.1 Black and Azov Seas

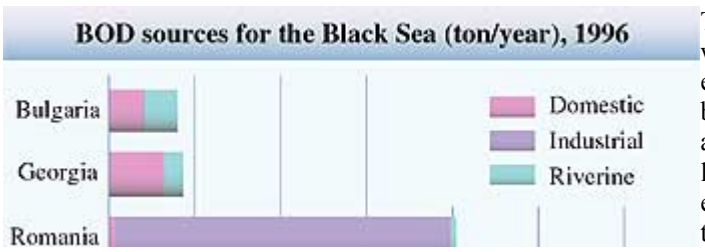
During the last decades, the Black and Azov Seas, which represent the one system of interconnected waters, suffered greatly from environmental degradation and pollution. Intensive anthropogenic pressures on the seas' ecosystems, resulted in serious and sometimes irreversible environmental effects.



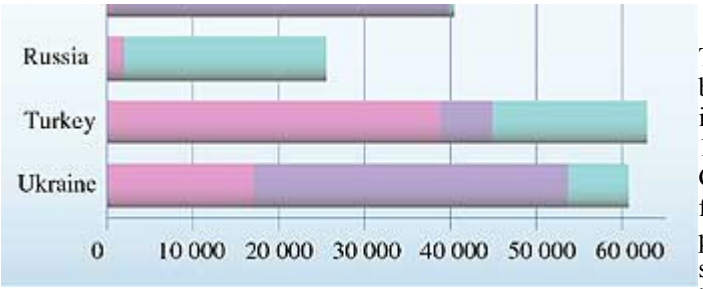
Sunrise on the Black sea. Georgia
Source: Sunny Georgia

During the Soviet era, the Azov Sea was polluted from multiple sources. Heavy volumes of waste-water from industry, households and agriculture were regularly discharged into the Sea and the rivers of its basin. Waste-waters mostly were carrying heavy metals, chlororganic chemicals, phosphates and pesticides. In the late 1980s, the sea encountered the problem of intrusion of alien species: jellyfish *Mnemiopsis*, which inhabits Atlantic Ocean coastal waters in USA. The species was introduced in the Azov Sea in 1989. The jellyfish eats almost entire zooplancton, causing the change in biota. Non-sustainable use and pollution of Kuban River, which drains into the Azov Sea, destroy the natural balance of ecosystems in the basin, including marine ecosystems. Regular non-returnable water abstractions from the Kuban, without taking into consideration the minimum ecological flow hinder the natural breeding of major commercial fish species. Building of large-scale hydro projects on these two rivers also result in the loss of natural breeding grounds for many valuable fish.

Overall, 10-fold decline in fish productivity has been reported for major fish breeding grounds. According to 1995 data, annual commercial catch in Azov Sea, which in the past was one of the most productive Seas, amounts about 5 thousand tons annually, while the figure was 120-160,000 tons annually in 1935-36 years. Seal catch has been almost zero since 1992 (Ministry of Environment and Nature Resources Protection, Russian Federation 1996). Although, Russia and Ukraine take some measures to retain existing fish stocks, without joint measures by these countries to regulate fresh water discharge and control pollution, it will not be possible to recover the fish stock to traditional levels.

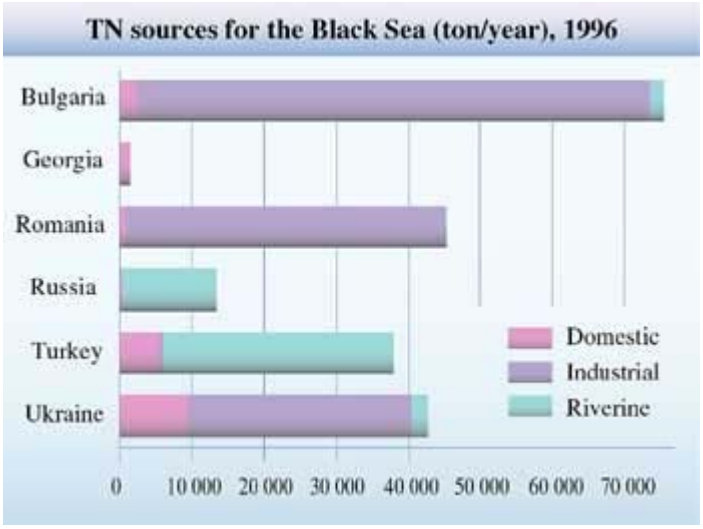


The Black Sea has an international importance, since it washes several countries and is rich in unique ecosystems. The number of total population within its basin is about 170 million. In the Caucasus, Georgian and Krasnodar kray's share the coastline of the Sea. Sea level rising together with degradation of unique marine ecosystems and water pollution is the major issue for the Sea.



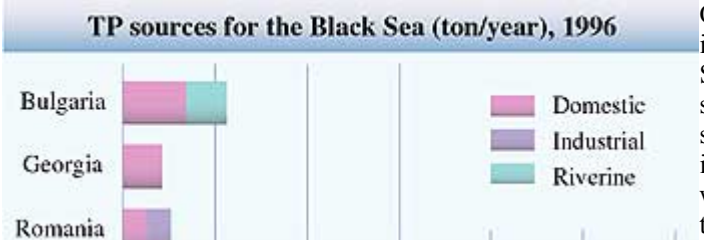
The Black Sea, as a part of the World Ocean, is affected by global warming. Long-term sea level observations indicate that the Black Sea level rising has begun since 1923-1925 with a rate of 2.5 mm per year (UNDP/GEF-Government of Georgia, 1999). Sea level rise created following vulnerability to the sea coastlines: increased probability of catastrophic floods on some rivers; salinization and bogging of pastures and washing out of beaches; and damage to amenities: communications, municipal buildings and facilities. In Georgia, the most vulnerable places are Poti and Rioni delta regions. The regions have receded since the beginning of this century by up to 0.52 m relative to the sea and it is assumed the process will continue in the future. In addition to above phenomena, the trend of cooling of the Black Sea surface has been observed, which reached 1^0C for the last 50-70 years at the coastal zone of Georgia. This itself will result in the decline of recreation and tourism periods as well as vegetation spell for subtropical crops, such as citrus and tea, hence reducing the revenues for local population (UNDP/GEF-Government of Georgia, 1999).

The part of the Caucasus washed by the sea has serious environmental impacts on the Black Sea in terms of seawater pollution. Some of the major resorts, harbours and industrial centres are located there and have a significant impact on the sea.

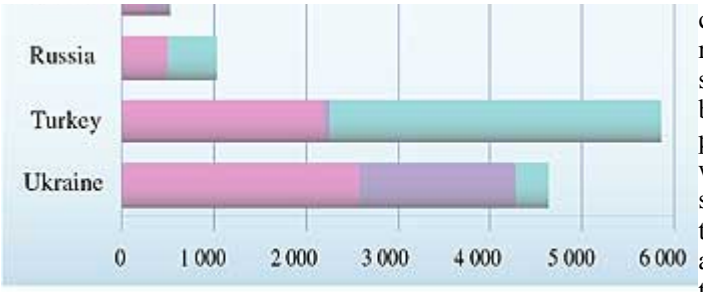


In the 1970s and 1980s, millions of cubic metres of domestic and industrial waste-waters were discharged into the sea from large cities, resorts and industries. During tourist seasons, the concentrations of BOD, COD, and surfactants were exceeding existing water quality standards several times. Water pollution by coliform bacteria was common as well. Water oil content was also high along coastal line, where large harbours: Novorossiisk, Tuaphse, Poti, Batumi, Sukhumi, etc. were located. Different industries were developed within the basin. Waste-waters from ferrous, chemical, mechanical plants, oil refineries and mines were discharged into the rivers or directly into the sea. Batumi oil refinery alone, for example, discharged more than 500 tons of oil wastes into the sea annually in 1980s. Gulp discharges from the plant also were not rare, bringing about 115 km sq. water surface pollution on average annually (State Committee of the USSR on Nature Protection, 1989). Agriculture also had significant impact on coastal waters. Georgia produced almost the entire citrus and tea crops of the FSU and about 90% of these products were exported to other republics of the FSU. Tea and citrus plantations were concentrated along the coastline and agriculture run-off from these areas discharged significant amounts of fertilisers and pesticides into the sea. Return agricultural flow from ploughed fields, fodder fields and perennial crops in Krasnodarsky kray also contributed highly to the pollution of surface and coastal waters.

The demise of the Soviet Union was followed by economic decline. At present, the problem of seawater pollution is mainly related to domestic sewage and oil spills from cargo ships and storage tanks. Although, industries continue working at low loads, resulting in reduced industrial waste-water loads, non-optimal operation regimes, out of date technologies and reduced control from law enforcement officers may offset the situation.



Oil products were one of the major seawater pollutants in the 1970s and 1980s and remain such at present. Studies conducted by Georgian scientists in 1993-95 showed that oil products significantly polluted the seawater in Batumi and Poti harbours. Water oil content in water samples varied from 1 to 24 times the existing water quality standard (0.05 mg/l) in Batumi and from 1 to 14 times the standard in Poti. The highest



Source: BSEP, 1996

concentrations were recorded in days with high sun radiation. Phenol concentrations also were high in warm seasons and they were not only discharged from rivers, but also formed in the seawater as an intermediate product of the degradation of oil products. Sediments were also polluted by oil products and might cause the secondary pollution during high turbulence. In addition to oil products, trace levels of chlororganic pesticides and surfactant, sometimes exceeding existing limits 2-5 times, were detected. (Institute of Hydro-meteorology, Georgian Academy of Science, 1998).

In the past, the Black Sea was rich in fish stocks. Over the last 30 years, the maximum catch was in 1976 and amounted to about 315,000 tons (Ministry of Environment and Nature Resources Protection, the Russian Federation, 1995). Over-catching and water pollution has significantly reduced fish populations. Currently the bulk of the commercial fishing consists of hamsa and *Sprattus*. The industrial catch of sturgeon has extremely reduced, while carp and bream stocks are more stable. Shamaya, pilengas and rybets became very rare (IUCN, 2000).

The problem with invasion of alien species is common to the Black Sea. In the mid 1980s, a jelly-fish-like species (*Mnemiopsis leidyi*), which was accidentally introduced to the Black Sea from the eastern seaboard of America in the ballast water of a ship, invaded the Black Sea. It quickly reached a total mass of 900 million tons. Though declining, *Mnemiopsis* continues to nourish in the Black Sea.

Finally, recent large-scale development projects for the Caspian oil transportation and the expansion of the Black Sea harbours within TRACECA project may significantly affect the Black Sea in the near future. Thus, environmental considerations should be taken into account during construction and operation phases.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.5 Coastal and Marine Waters

2.5.2 Caspian Sea

The Caspian Sea is the largest inland body of water in the world. It washes five countries: Azerbaijan, Iran, Kazakhstan, Russia and Turkmenistan. A significant part of it is located in the Caucasus, shared by Azerbaijan and Dagestan.

The water level of the Caspian Sea is currently about 26.5-27 metres below the Baltic Sea level. The level has fluctuated from 6 to 7 metres during the past few centuries and about 13 metres over last 500 years. Historically, the sea accounted more than 90% of world's sturgeon and caviar output. Additionally, it has abundant oil and gas deposits and they are exploited both on- and off-shore. Major environmental issues related to the Caspian Sea are the impact of water level fluctuation on coastal settlements, decline in sturgeon populations and water pollution from oil and gas operations, industry, households and agriculture.

The water level rose over four metres between 1978-95, causing severe damage to nearby territories, populations and infrastructure. About 807 km^2 of land was inundated in Azerbaijan. An additional 460 km^2 will be flooded if the sea level rise to -25 m (State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan Republic, 1998).

The sea level rise has resulted in significant economic, health and environmental damage to Azerbaijan and Dagestan. Communities in affected areas have suffered from increased humidity and dampness; drinking water quality has deteriorated due the salt water intrusion; communications infrastructure has been significantly damaged; flooded agricultural lands and damage to sturgeon hatcheries and fish processing industries have deepened unemployment and poverty. The rising sea has also caused the secondary pollution of marine water from oil fields either through direct flooding or water table rise and ground water seepage.

While in recent years the sea level has slightly declined, it is forecast to continue rising over the next two decades. The reasons for sea level fluctuations are not well understood. Presumably both natural and anthropogenic factors affect it. Change in water cycle and climate within the watershed have a high impact on the sea level. At the same time, non-sustainable agricultural practices, especially on the river Volga, and human-induced change in water regime contribute greatly to the sea level rise too.

Historically, the Caspian Sea water was affected by polluted river flow and direct discharges from households, industries, oil and gas operations and oil transportation through marine routes. From the territory of Azerbaijan alone more than 300 million cubic metres of waste-water were discharged into the sea in 1980s, polluting it with suspended solids, organic matter, surfactants, oil products, sulphates, chlorides, phenols and other harmful substances (State Committee of the Azerbaijan Republic on Nature Protection, 1993). From the industry sector, the oil and gas industry contributed the highest share. During the Soviet era, existing water quality standards for oil products and phenols were significantly exceeded in coastal waters of Dagestan and Azerbaijan. For example, in 1988 in Dagestan water quality standards for oil products and phenols were exceeded four to six times and in Azerbaijan about 5-16 times (State Committee of the USSR on Nature Protection, 1989). Agricultural run-off also was a significant source of the Caspian Sea pollution during 1970s and 1980s. In the early 1980s, the intensive use of fertilisers and pesticides polluted the fresh and coastal waters with nitrogen, phosphorus, chlororganic compounds, etc. However, the use of agrochemicals has significantly declined during last ten years, due to the overall economic decline. At present, oil extraction and municipal sector are the major sources for seawater pollution. Although industrial discharges have reduced due to the fall in economy, pollution from such activities as oil and gas extraction, oil refining and transportation, and power generation are high. Obsolete production and pollution control technologies or lack of pollution controls aggravates the situation. Inefficient and obsolete waste-water treatment facilities add to the problem.

In the past, about 11.4 billion cubic metres of waste-water were discharged annually into the Caspian Sea (State Committee of the Azerbaijan Republic on Nature Protection, 1993). Among the rivers of the Caspian Sea basin, the Volga River's share of total pollution was and still stays more than 80%. Currently, about 2.5 billion m^3 of raw sewage and 7 billion m^3 treated sewage is discharged into the river annually (Ministry of Environment and nature Resources Protection, Russian Federation, 1996). The Kura and Araks rivers are also historical polluters of the Caspian Sea, discharging about 522 million cubic metres annually during Soviet era, from which about 497 came from Georgia and Armenia (State Committee of the Azerbaijan Republic on Nature Protection, 1993).

At present, seawater oil pollution remains a major concern for the Caspian Sea, as it was in the past decades. Among coastal waters, waters off Absheron peninsula, where intensive oil operations are conducted and Sumgayit with concentration of petroleum, petrochemical and chemical industries were and still are the most affected. A recent baseline study of the total oil in sediments off Absheron peninsula in and around the Chirag field revealed that in the area of the oil field (contact area) the level was 19-3,860 mg/kg, near the shore sediments in Baku Bay were 270-2,100 mg/kg. One station just south of Oily Rocks showed 5,800 mg/kg. Sediment concentrations of petroleum hydrocarbons were analysed at ten stations 60-80 km off Absheron Peninsula. Levels of 4.7 to 128.5 mg/kg were recorded. An analysis of the individual hydrocarbons of the samples indicated contamination with heavily degraded crude oil, which is also seen in natural seeps (TACIS, 2000). The levels of mercury and phenols are high too, amounting to over 0.2-1.0 and 5.0-140 g/kg of sediment in Baku Bay respectively. Concentrations of oil products and phenols are also high in water column, exceeding the standards 10-30 times (State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan, 1998). The sediment concentration off Kura River is reported to contain 500-1,500 mg/kg even though it is far from any offshore installations. Also, at the Lenkoran coastal zone the level of petroleum hydrocarbons in sediment

reach 200-1,500 mg/kg. As comparison the level of petroleum hydrocarbons in the Baltic Sea reached 4,100 mg/kg, and in one case close to an oil refinery 16,000 mg/kg.

In general, environmental impacts of water oil pollution are related to the loss of benthic fauna, and fish populations, using benthos as a food. In the case of the Caspian Sea, the open water surface and eastern coast of the northern Caspian Sea is polluted, and the benthic communities have lost their stability and are in a transition state. The Dagestan coast is heavily polluted. Azerbaijan coast from Russian border to Sumgayit is polluted, and the benthic fauna varies between a stable and a transition state. The Absheron peninsula, the Baku Bay and the Sumgayit coast are extremely polluted, and the state of the benthic fauna communities ranges from a transition to a critical to a disastrous situation. The open waters of the whole Caspian Sea are heavily polluted. The fish fauna has decreased in the strongly polluted areas in Baku Bay, Sumgayit Coast and Neftyanye Kamny and they are considered "dead zones" mainly due to oil pollution. However, the very same area contains a long series of industries that discharge or did discharge numerous other contaminants into that coastal area. The disappearance of the zander in the southern part of the Caspian nevertheless, is directly related to oil pollution. The disastrous situation of the Caspian herring (shad) stocks is also the result of oil pollution. The migration routes of sturgeons have been affected by oil pollution in Azerbaijani territorial water. Earlier the sturgeons moved from the southern part of the Caspian to its middle part and back along the western and eastern coasts. Now they come across a barrier of highly polluted water near the Absheron Peninsula and have to migrate particularly along the eastern coast. The grey mullet stocks have been reduced, too, and a great number of crawfish have disappeared (TACIS, 2000).

Overall, intensive anthropogenic pressures, such as: industrial and municipal waste-water discharges and developments of large-scale hydro schemes have detrimental impacts on natural ecosystems of the Caspian Sea. A sharp decrease in the diversity of the benthic fauna of the Caspian Sea has been reported. In the northern part the diversity has decreased from 78 to 46 species, and in the southern and central part the number of species has decreased by one third. In Baku Bay and off Sumgayit crustaceans and some species of mollusks have drastically declined. Bulk stocks of commercial fish species have significantly reduced in last decades. The sturgeon population has suffered especially. Twenty years ago, about 20-25,000 tons of sturgeons were harvested in the Caspian Sea annually. Over the last 20 years, the total catch has decreased by 90% and in the last three years by factor three. In 1998, for example only 1,465 tons were harvested (IUCN, 2000).

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.6 Policy Measures in Water Resources Protection Field

Until the break-up of the USSR, Caucasus states had no national bodies responsible for environmental protection, including water resources protection and management, with real power at both: local and national levels. In general, the Soviet managerial system was arranged from the top down, and all the issues at national/local levels were solved based on decrees and directives issued from Moscow. The central Ministry for Melioration and Water Management ("Minvodkhoz") with similar national structures in sister republics was the major body responsible for water resources protection and rational use. Several other agencies also carried out water-related activities. Central and national HMSs were responsible for water quantity and quality data collection; standards departments developed and set surface water quality standards; health ministries set drinking water quality standards and enforced them via sanitary-hygiene services; geologic agencies conducted the geologic surveys over ground water reserves. Historically, there was little or no co-ordination among these agencies, because only a sector-based approach to environmental and natural resources management was conducted in the 1970s and 1980s. In 1988, in order to improve co-ordination among different agencies, the Nature Protection Committee was established, later transformed to the Ministry for Environment, to be responsible for the protection of all environmental media. However, the committee had no long-term record due to the break up of the Soviet Union in 1991.

The first Soviet water law was adopted in 1970, immediately followed by the development and adoption of similar national laws and regulations. For enforcement purposes, the codes of civil and criminal violations were developed during the period from 1970 to 1990. In order to implement existing legislation, Soviet regulators mostly used command and control approaches. In 1976-90, source-specific and general (activity or river basin based) water abstraction and use standards (quotas) were developed and set for major water user economic sectors, taking into consideration the quality of the water used. In the 1960s and 1970s, surface water quality standards (GOSTs) for a broad spectrum of substances were established as well. Water bodies were divided into several categories, based on some of the basic functional water

uses: municipal-domestic, recreational, fisheries, etc. In order to achieve desirable water quality, in 1979 source specific effluent limitations were introduced for point sources, based on dilution effect and self-purification capacity of the river. Domestic sewage was required to enter water treatment facilities and undergo both mechanical and biological treatment. In essence, Soviet point source discharge standards were based on ambient quality and did not require a certain type of technology for pollution control, hence promoting end-off pipe pollution control approaches. Meanwhile, no standards, guidelines or management practices existed for controlling diffused source pollution.

The state statistical reporting system, introduced in the late 1980s, obliged all water users to conduct water use and discharge inventories at source, using either measurement or estimation methods and regularly report to responsible authorities. After water use and discharge data were submitted they were then aggregated and published in statistical yearbooks. The validity of reported data was checked through regular inspections. However, water inventory data were not precise, because the majority of industries lacked water metering and effluent monitoring equipment, and largely employed estimation methods.

Regardless of legal requirements, existing laws, regulations, and standards were frequently ignored or violated, because of their strictness and unfeasibility. Besides, rent-seeking systems based on bribery and mutual services hindered the compliance assurance monitoring and control.

The Soviet Union had little experience with using economic tools in environmental fields, including water resources management. Until 1991, there were no taxes on water pollution. Only water use fees were employed. Per unit water use fees were first introduced in 1982. In essence, they served more to finance state water protection programs rather than to give an incentive to water users to conserve a resource. In addition to water use fees, environmental damage compensation fees were employed in the country. Effluent charges have been in effect since 1991. The first charge system was introduced at the all-union level. The charge rate under this program was different within and above the legal limit. In addition, the type of pollutant as well as socio-economic and environmental conditions for specific regions was taken into consideration while calculating the base charge rate. After the disintegration of the Soviet Union, national authorities introduced “polluter pays” principles in their environmental legislations and established effluent charge systems. These systems are similar to their Soviet ancestor. Charge programs are very complicated and cover a wide range of pollutants, which cannot possibly be monitored fully. At present, these countries only have the capacities to monitor several voluminous pollutants. This partly explains low tax revenues. Tax rates themselves are low, not reflecting marginal damage and benefit costs and hence not affecting environmental behaviour. Even if the taxes were set at appropriate levels, industries have little option for reducing their emissions, due to the thin market for environmental services and goods. Increased inflation also erodes the real tax rate. Finally, taxes are not earmarked for environmental purposes. Water use fees employed by the countries are also set at lower levels and do not generate an incentive to conserve the resource. Water charges, employed for potable water consumption also are low, not allowing for recovery of O/M costs. At least, the number of pollutants has to be reduced, tax base rate set at appropriate level and revenues earmarked for environmental expenditures or for maintaining the tax system.

In the 1970s and 1980s, national HMSs maintained extensive hydro-meteorological and ambient environmental quality networks, conducting observations over surface water quantity and quality. Water quality networks were based on manual sampling. For sample analysis, the combination of both wet chemistry and automated methods was employed. After collection, the raw data were processed and stored in paper formats or non-user oriented PC-based databases. HMS published data in annual yearbooks or multi-year summaries. Usually, sister republics did not share or exchange data. Although Soviet monitoring networks provided baseline river flow and quality data, these networks were not designed for daily resource management.

The period from 1991 up to now can be considered one that for established and strengthened national environmental institutions in the FSU, including the South Caucasus countries. At present, national environmental ministries have major environmental protection and management responsibilities in South Caucasus states. In the North Caucasus autonomies, similar structures are subordinated to republican and federal governments the latter has the right to veto a republican decisions. In the kray level administrations, local governments manage environment and natural resources. Environmental ministries develop water regulations, general policies/programs, permit new developments or major modifications, issue licenses over water use and waste-water discharges and conduct compliance assurance control either through their regional branches or special environmental inspectorates. Other agencies: HMS, health, agriculture, fuel and energy ministries, geologic services, etc. are engaged in water-related activities as well. However, the duties and powers of all these agencies vary from country to country.

Presently, most water-related agencies lack financial and technical resources to implement their policies and enforce existing laws. Public financing is very poor and only allows for minimum performance. The wide distribution of

environment related tasks in the government results in scattered and inefficient budgetary expenses for environment. Regarding non-public finances, environmental taxes employed are not earmarked in general. The countries lack field-financing strategies to set specific and realistic targets and implementation schedules; make cost assessments; and identify potential financial sources. However, some limited activities in this direction have already been conducted in some of the South Caucasus countries. In 1998-2000, Georgia, for example, together with some other selected NIS countries, participated into the project called “Environmental Financing Strategies, Environmental Expenditure and Use of Economic Instruments in NIS Countries". The environmental financing strategy focused on bringing the water supply and sewage sector in line with NEAP priorities was developed by COWI.

In general, there is a little co-operation among the agencies engaged in water resources management. They do not share or exchange information due to the lack of legally binding data flow requirements. The sector-based approach to water resources management is still widely used and integrated river basin-based water management principles are not entertained region wide. However, currently there are some efforts to introduce these approaches as well as to establish specific water authorities for co-ordinated water resources management and improved performance in some of the countries of the Caucasus region. In Armenia, for example, specific water authority was established under the WB funded national water project. An ongoing USAID/DAI South Caucasus Water project also aims at strengthening the co-operation among water-related agencies at all local, national and regional levels and demonstrate integrated water resources management.

The post-soviet era can be considered a productive period for drafting environmental legislation in the FSU states including the South Caucasus countries. The majority of them have adopted framework environmental protection acts. Laws/regulations on state environmental examinations and environmental permitting, requiring permits for new developments or/and major modifications after environmental impact assessment and state environmental examination have been conducted, also were developed and passed. In the water protection field, media-specific water laws/codes have been passed, setting water protection objectives and goals, duties and powers of responsible authorities, record-keeping and reporting requirements, etc. Although new principles such as: precautionary, stand still, polluter pays, etc. have been introduced by some of the Caucasus countries, the appropriate regulatory basis has not been developed yet. Existing regulations are still based on Soviet approaches. There is no application of BAT/BAP standards. Ambient standards also need review and revision.

Regarding water quantity and quality monitoring, data collection and flow have declined greatly because of the regional financial crisis. Apart from this, existing monitoring technologies are out of date and do not meet international standards. Quality of current data is not guaranteed, due to the malfunctioning of existing QA/QC systems. Finally, there is practically little or no application of remote sensing and GIS technologies for water resources monitoring and management. Though limited, there are some such national capacities, concentrated largely in scientific and academic institutions.

At present, Georgia and Russian Federation are parties to International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) and International Convention on Liability for Oil Pollution Damage (CLC 1969). Azerbaijan and the RF are parties to London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters (LDC 1972), and Georgia has ratified its protocol of 1996. Georgia and Russia are parties to UN Convention on the Protection of the Black Sea Against Pollution (Bucharest, 1992). These countries also ratified the GEF Black Sea Protection Program. Under this program, for example, Black Sea Environmental Action Plan and Black Sea Program for Integrated Coastal Zone Management have been developed and launched in Georgia with GEF financial assistance. Azerbaijan participates in Caspian Sea Environmental Program, operated since the late 1990s. UNDP, TACIS, WB and USAID fund the Program. The significant output of this program is the establishment of Caspian Centre for Pollution Control and the development of GIS-friendly database.

The CITES convention, ratified by Azerbaijan, Georgia and the RF, among others concerns protection of sturgeon populations. Since 1998, international trade in all sturgeon species has been regulated under the convention, since unsustainable harvesting and illegal trade in sturgeon has a high impact on sturgeon stocks. Under the convention all littoral countries of the Caspian Sea that engage in international trade in sturgeon, their parts or their derivatives, are required to hold CITES permit or certificate. The situation in the Caspian Sea is particularly troubling. Special focus is on the protection of Caspian sturgeon, and specific regional annual quotas of catch and trade in each specimen of sturgeon are set for littoral countries, including Azerbaijan and the Russian Federation. In addition, parties are required to report to the Secretariat on the progress made to fulfil commitments taken under the convention. Azerbaijan and the Russian Federation closely co-operate at bi- and multi-lateral levels in joint assessment of fish stocks, deriving total allowable catch (TAC) and implementing measures to enhance fish stocks. Recent assessments made by five littoral countries have shown that sturgeon populations in the Caspian have stabilised or are beginning to increase and that the age structure of

the stocks is biased to younger age classes, due to the introduction of tens of millions of juvenile sturgeon over the past two decades. These results were achieved by implementing long-term fisheries re-stocking programme and drastically cutting catch limits (Management Authority for Sturgeon of the Russian Federation, 2001).

Armenia, Azerbaijan and Georgia participate in the activities within the framework of the UN Convention on Transboundary Water Courses. However, only Azerbaijan is a party to this Convention, while all South Caucasus countries ratified the protocol concerning health protection. The WB jointly with Finland, the Netherlands, Sweden and Switzerland has financed the implementation of the Lake Sevan Environmental Action Plan in Armenia, aiming to establish sustainable and integrated water management practices there. During the period from 1999-2001, the WB funded the development of Integrated Water Resources Management Plan for Armenia. USAID also is one of the active donors financing integrated water resources management activities within the Caucasus region. For example, it financed the national project for Sustainable Water Resources Management in Armenia. Currently, it implements the South Caucasus Water project to strengthen water resources management in the Kura-Araks basin, based on integrated river-basin water resources management principles. In parallel to this, TACIS launched the Joint River Management Program on Monitoring and Assessment of Water Quality on Transboundary Rivers, aimed at the prevention, control and reduction of trans-boundary pollution impact. The program covers four basins, including Kura river basin. In addition, regional organisations such as REC, Eurasia Foundation etc. and numerous local foundations promote the national and regional activities in the field of water resources management and protection. Recently, the Georgian office of UNDP has prepared the concept paper for large-scale regional partnership program for Kura-Araks basin to be presented to GEF. The project aims at the strengthening regional partnership and security through preventing trans-boundary pollution of the waters of Kura-Araks basin. The project is expected to develop institutional and legal framework for the use and protection of shared resources. The project is currently waiting approval.

Along with this, some large-scale investment projects for infrastructure rehabilitation, which were identified as priorities in NEAPs, are being implemented within the region. For example, the WB finances long-term irrigation-drainage system rehabilitation projects in Georgia and Azerbaijan, together with investment components, including capacity building for sound management of the systems, specifically, the establishment of local community-based water use associations. Similarly, the investment project on primary and secondary canal rehabilitation has been prepared in Armenia. In addition to this, the WB and other lending organisations funded or plan to invest in the rehabilitation of municipal water supply and sewage networks in many cities of the South Caucasus. Rebuilding of water treatment facilities is also among the planned investment activities.

Thus, there is a hope that all above activities will strengthen the national and regional capacities to manage shared water resources in a sustainable and integrated manner and protect them from environmental pollution.

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.7 Atmospheric Air

2.7.1 Global and Regional Atmospheric Problems

The Caucasus' contribution to global and regional environmental processes, such as climate change, stratospheric ozone depletion and acid rain, etc. is presumably insignificant, taking into account its small scale economy and the medium to low development index of its countries by the UN human development scale. The World Resources Institute's estimates show that the South Caucasus share of global and Europe's CO_2 emissions from 1950 to 1999 was only about 0.38% and 0.85% respectively **(see appendix for detailed information).**

A downward trend in emissions of pollutants contributing to global and regional atmospheric problems can be seen in the 1990s relative to the late 1970s and 1980s. This fact is explained by the post-Soviet regional economic crisis. In Armenia, for example, a 12-fold drop and three-fold drop were reported for SO_2 and NO_x emissions, respectively (TACIS/MNP of Armenia, 1998). In Georgia in 1994, sulphur dioxide emissions were eleven times less and NO_x emissions seven times less relative to 1988 (TACIS-MoE of Georgia, 1998). In the late 1990s, some signs of economic stability were observed, which were reflected in slightly increased emissions, including those of GHGs, SO_2, NO_x, etc.

From an environmental standpoint, the impact of global and regional atmospheric processes on the Caucasus environment is of much interest. Whereas more or less complete information on climate change phenomena is available for the Caucasus, there is practically no information on acid deposition and its effects on ecosystems in the region. Little is known about regional background levels of pollutants and their long-range movements as well.

For climate change, national studies on climate change have been conducted under the UNFCCC in the South Caucasus countries and the trends of climate warming have been revealed. Studies for Georgia, for example, have revealed noticeable warming of up to 0.5^0C in Eastern Georgia and slight cooling up to 0.3^0C in Western Georgia, especially in the cold period of the year. These trends match well with global studies conducted under IPCC in 1995 that revealed the trend of warming in the Central Asian and Caspian Sea regions and cooling over the Black Sea region. Similarly, changes have been found in precipitation levels. Specifically, plain regions have seen an increase in precipitation of up to 15% and conversely, mountainous areas of the Greater Caucasus, especially the eastern slopes have seen a decrease of up to 20%. Climate specialists, based on available data, predict that a 1.5-2^0C increase in mean air temperature in the South Caucasus. However, sea surface cooling by another 0.5-07^0C will continue along Georgia's coastal zone (UNDP/GEF-Georgian Government, 1999).

It is assumed that as the economies of FSU countries, including Caucasus states, begin to recover, both production and consumption levels will go up, accompanied by increased contribution to global and regional atmospheric problems. However, whether or not they will below or above the late 1980s levels depends on the macroeconomic development scenarios and the implementation of commitments taken under relevant international treaties and conventions.

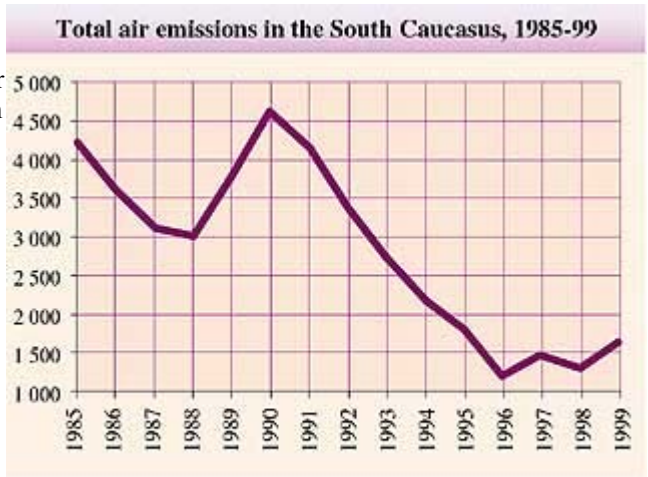
CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.7 Atmospheric Air

2.7.2 Atmospheric Air Pollution

Major Sources of Air Pollution and their Emissions. During the 1970s and 1980s, transport and industry were the major sources for air pollution in the Caucasus region. Total emissions reached their peaks in the late 1980s and fell in the early 1990s due to the general economic decline. Currently, some signs of economic stabilisation can be observed in the region as reflected in slightly increased emissions. However, the increase is irregular character and far below the 1980s' levels. At present, the significant share, apart from mobile and stationary sources, is from domestic heaters in many parts of the region.

Mobile Sources. Historically, the percentage of emissions from transport, with some exceptions, was higher than stationary source emissions in most of parts of the region. For example, whereas in Georgia, Armenia and most of the North Caucasus republics and krays mobile sources contributed over 60% of total emissions, in Azerbaijan, Chechen-Ingushetia, etc. with large industrial capacities, the figure varied from 30% to 40%.



Source: Complex Scheme of Environment Protection of Azerbaijan, 1987. State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan, 1993. MoE of Georgia, 1996. State statistical services of Armenia, Azerbaijan and Georgia, 1985-2000

Vehicular transport was a major concern. The early 1970s were marked by a significant growth in the Soviet car fleet. Although a higher priority was always given to public transport, the number of passenger cars significantly increased. By 1980 the annual vehicle output of existing vehicle manufacturing plants increased from 916,000 to over 2.1 million vehicles and the car fleet expanded by 3.5 times relative to 1970 (State Committee of the USSR on Nature Protection, 1989). This aggravated ambient air quality in

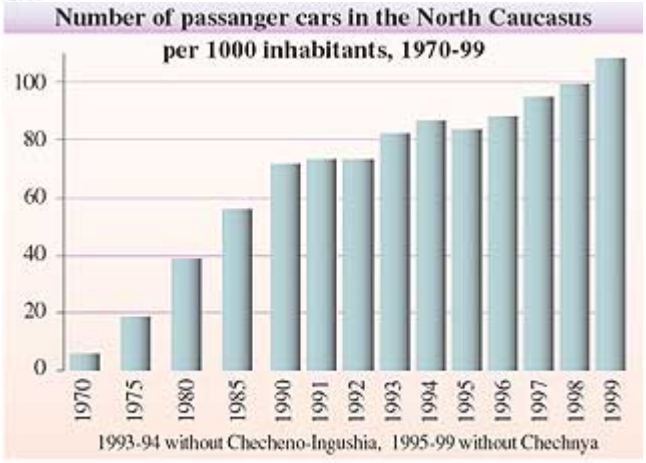
most of parts of the country. Air quality was particularly poor in urban areas with dense populations and heavy traffic. The reasons for high vehicle emissions were heavy traffic in urban areas and high emissions from cars lacking pollution control devices.

Source: Complex Scheme of Environment Protection of Azerbaijan, 1987. State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan, 1993. MoE of Georgia, 1996. State statistical services of Armenia, Azerbaijan and Georgia, 1986-2000

Vehicle emissions reached their peaks in the late 1980s in the Caucasus region, in line with general trends for the Soviet Union. Gross emissions were particularly high in large cities such as Baku, Yerevan, Tbilisi, where they varied from 150,000 to 300,000 tons per year, some of the highest figures in the Soviet Union (State Committee of the USSR on Nature Protection, 1989).

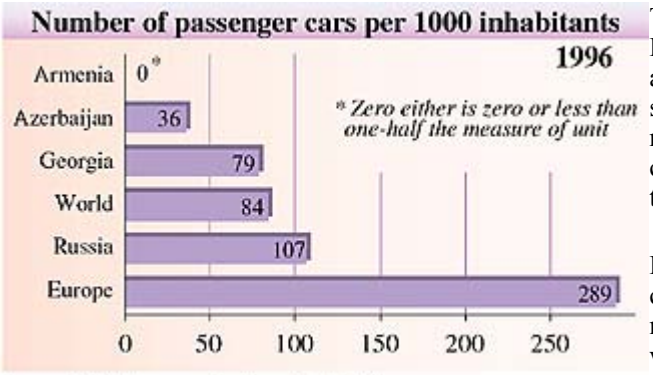
In the early 1990s, aggregated vehicle emissions declined in the region. Industrial emissions declined even more dramatically, increasing the transport share of total emissions to 80%.

The number of vehicles in the South Caucasus slightly declined in the early 1990s, but this (CAID, 1998) trend was not observed in the North Caucasus. At present, an upward trend is reported for both the South and the North Caucasus. However, the countries of the region still lag behind European countries and the US in terms of number of vehicles per capita.



Source: State Committee for Statistics of the Russian Federation."Regions of Russian Federation", 2000. "Statistical Yearbook of Russian Federation", 2000

The current problems of vehicle emissions are more related to high emissions per vehicle rather than high vehicle numbers. Increased per vehicle emissions are mainly related to obsolete car fleet, in which more than 90% of all vehicles are more than five years old. The average age of vehicles is around 15 years. Most vehicles are of Soviet made. The share of foreign models, used cars, has been increasing recently. Soviet models do not have catalytic converters and are higher polluters than foreign models. However, the owners of foreign models frequently use gasoline with lead additives, since there is no differentiation between the pumps for leaded and unleaded gasoline in gasoline stations. This causes the poisoning of catalytic converters and increases the vehicle emissions.



Source: World Resources Institute, 2000-2001

The system of vehicle inspection/ maintenance is very poor. Responsible authorities lack finances, technical equipment and qualified staff to properly check vehicle emissions. Low salaries of inspectors lead to bribe-taking and falsification of records. The proper maintenance and repair of vehicles cannot be guaranteed under such conditions, which promotes the increase in the volume of gross polluters.

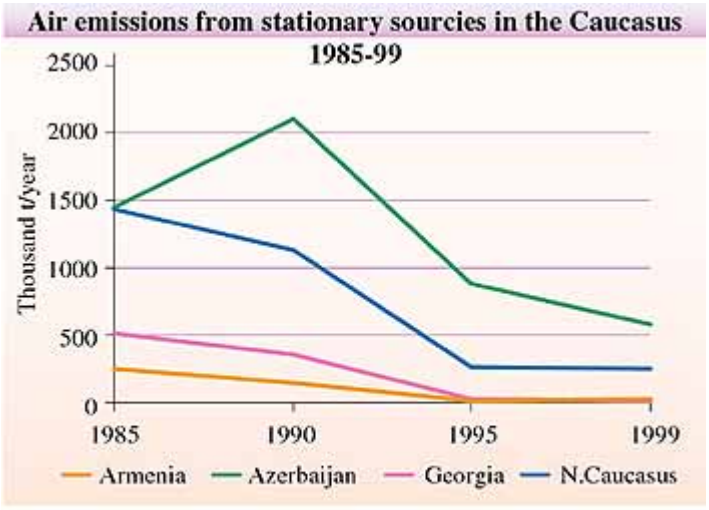
Fuel quality is a concern as well. Lead is needed for Soviet cars in order to reduce wearing of "soft" seat valves that most of these cars have. Hence, leaded gasoline is still widely used in the region. Although the use of lead is banned in some of the countries of the Caucasus, frequently wholesalers and retailers illegally add lead additives to the low octane gasoline in order to enhance the octane rating and generate extra revenues. For example, a study conducted by

NORCE consultants in the city of Tbilisi in 1999 revealed that the average lead level in gasoline pool was about 52 mg/l, while the legal lead content is 13 mg/l (NORCE & MoE of Georgia, 1999). There are limited studies on other components of fuel, such as sulphur and hydrocarbon.

Heavy traffic and poor road conditions also contribute to increased vehicle emissions. Lack of bypasses in most cities causes a deterioration of urban air quality there.

Stationary Sources. In the 1970s-80s, stationary sources were significant polluters of ambient air in the Caucasus, with the percentage share of total emissions depending on the level of industrialisation. In Azerbaijan and Chechnya in the 1980s, for example, stationary source share of total emissions was more than 60%, predominantly due to the emissions from large stationary sources located in Baku and Sumgayit in Azerbaijan and Grozny in Chechnya. In most of other parts of the region, stationary sources' share was lower than 50%.

Stationary source emissions, similar to mobile source emissions, reached their maximum levels in the late 1980s. The break-up of the Soviet Union was followed by the mass shut-down of industry in the region, resulting in a significant fall in industrial emissions. However, the extent of the fall was different for the countries of the region. In addition, there were temporal differences in the peaks of fall between the North and the South Caucasus as well as within these very regions. In the early 1990s, Armenia and Georgia, facing a power crisis, suffered the most. Stationary source share of total emissions dropped to almost 5% there. Whereas the pressures from economic sectors have fallen, those from households have increased in these countries. Due to the loss of fuel markets and disintegration of central heating systems people were forced to use alternative fuels for domestic heaters and micro-generators. This has resulted in increased low temperature emissions. Most of the North Caucasus states and Azerbaijan have retained their industrial capacities and power sector at higher levels.



Source: Complex Scheme of Environment Protection Azerbaijan, 1987. State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan, 1993. MoE of Georgia, 1996. State statistical services of Armenia, Azerbaijan and Georgia, 1986-2000

Air Pollution from stationary sources Azerbaijan
Source: HDR Azerbaijan 1999

Stationary source emissions have been slightly increasing since 1995. However, they are far below the 1980s' levels, as existing facilities still work at low capacities (about 15-20%) and there are few new industrial developments in the region. Currently, major pollution is from gas and oil industries, power plants and small to medium size enterprises. Although gross emissions are reduced, current per unit emissions are believed to be higher than that of the 1980s, since existing production and pollution control technologies are out-of-date and inefficient. Besides, current compliance assurance monitoring and control systems do not guarantee compliance with existing standards.

Industrial "Hot-spots". Large urban areas were targets for intensive industrial development, and gradually became environmental "hot-spots" with a broad spectrum of environmental problems. For example, the cities of Baku, Tbilisi, Yerevan, etc. became large industrial centres with diverse industries of local, regional or all-union importance. In the late 1950s, many new mono-functional cities were developed around specific industries. For example, the city of Rustavi was built around the steel manufacturing industry. The city of Sumgayit was also built as a typical Soviet industrial centre. Populations of such cities were mainly employed by the various industries there.

Current environmental problems in industrial centres are mostly related to out of date technologies, low efficiency or lack of pollution controls and the disposal/treatment of industrial wastes accumulated around the industries. The territories of many facilities have become practically “brown fields" whose clean up costs could be millions of US dollars. Among industrial centres, the city of Sumgayit can be considered an extreme case of an industrial “hot-spot”.

Sumgayit was founded in the 1950s as a centre for the chemical and petrochemical industries. Soon after it became one of the largest industrial centres of the USSR. Industrial areas occupied over 34% of the city. About 88 large facilities were built, of which 10 became heavy air polluters. Annual air emissions were about 100,000 tons. Emissions per square kilometre amounted to 1,200 tons in 1990-91, while the average value for Azerbaijan was about 24 t/km^2. Apart from criteria pollutants, toxic substances, mercury, chlorine, hydrogen fluoride, heavy metals, etc., were released into the ambient air, affecting the local population especially sensitive groups. Persistent organic compounds, such as dioxins and dibenzofuranes were released from petrochemical industries. The city had one of the highest morbidity rates during Soviet era. In 1992, the city of Sumgayit was declared as environmental disaster zone, although air emissions have been declined since 1990. The city was later designated a free economic zone, in order to foster economic growth and the introduction of new technologies there. However, the problems of uncontrolled emissions, persistent pollutants and the liability for past pollution remain unsolved.

Source: State Committee for Nature Protection, Azerbaijan, 1998; UNEP/State Committee for Nature Protection, Azerbaijan, 1996

Urban Air Quality. In the Caucasus, urban areas with dense population, high concentration of industries and traffic are environmental “hot-spots.” Existing National Environmental Action Plans (NEAPs) identify urban air quality protection as one of the national priorities.

Industrialisation and urbanisation over the past 30 years have resulted in the deterioration of ambient air quality in urban areas of the Caucasus region. In large urban areas, existing air quality standards for SO_2, Dust, NO_x, CO were regularly exceeded. Ambient air quality standards were exceeded for wide range of substances, linked to specific industrial activities. Cities of the region such as Baku, Sumgayit, Yerevan, Alaverdi, Tbilisi, Rustavi, Zestaphoni, Grozny, etc. were included in the list of the most polluted cities of the FSU.

Although there is limited information on ambient air quality for the last 10 years, due to decline in baseline data collection, it is assumed that in the early 1990s, ambient air quality temporarily improved in the cities of the region. Since 1996, slight increase in emissions has been observed that might become the reason for air quality deterioration.

At present, vehicular transport is a major concern in urban areas. High ambient concentrations of CO, NO_x, phenol and formaldehyde indicate a significant impact from traffic. The problem with ground level ozone is a concern. Cities such as Tbilisi, Yerevan, Vanadzor, Ararat, etc. with valley type terrain or/and poor ventilation may suffer the most. However, there are practically no data on ground level ozone. Of ozone's precursors, only NO_x is monitored regularly. There are no regular measurements of VOCs. Lead is a problem, as most cars run on leaded gasoline. However, lead background measurements are very rare and irregular.

Indoor Air Quality. Historically, little attention was paid to indoor air quality in the Caucasus region. Very little is known about the indoor concentrations of asbestos and other man-made fibrous materials, used as building materials or insulation. Building materials and furnishings also may be the sources of such substances as formaldehyde from chipboard and hydrocarbons from paintings, cleaners, adhesives, timber and furnishing. Levels of flue gases from domestic cooking, the products of incomplete combustion, POPs, or cigarette smoke are usually significant in indoor environments. However, there is no information for the Caucasus. Neither human health impacts nor cost estimations have been made. At present, the problem of indoor air quality may be acute for some of the parts of the region, people use domestic heaters with alternative fuels and without proper fuel combustion devices.

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2.7 Atmospheric Air

2.7.3 Policy Measures and Responses

In the early 1970s, in the USSR there were three key agencies with atmospheric air protection and management responsibilities at both the all-union and national levels. The State Inspection was responsible for inspecting stationary source pollution control equipment, the State Sanitary-Hygienic Service for setting ambient air quality standards and the hydro-meteorological service for ambient air quality data collection. However, none of these agencies had regulatory functions. There was no special environmental protection body, with broad spectrum of managerial and regulatory responsibilities. In 1988 State Nature Protection Committee, with national branches was established, in order to improve environmental performance and enhance the co-ordination of activities within the field. Although, Soviet republics and autonomies had legal right for implementing independent policies in theory, in practice they had no real autonomy and were strictly dependent on the central government.

The first Soviet Atmospheric Air Protection Act was passed in 1980 followed by the adoption of national laws and regulations. However, the Soviet Union had long experience in developing health and technical standards, regulations and methodologies. For example, in 1951 health-based air quality standards were set for up to 10 pollutants. By 1972, standards existed for 98 and by 1991 for 479 substances. These standards were based on toxicological studies and were believed to be set at levels, below which no health effects were observed. Two sets of standards were applied for all substances: 20-minute and 24-averages based on dose-response effects.

At the beginning of the 1980s, source-specific emission limits were introduced for stationary sources in order to achieve ambient air quality standards. Those were ambient, but not technology-based standards, and did not promote pollution prevention and the introduction of cleaner technologies, but rather the use of passive methods of pollution control (end-off-pipe approach). Regular statistical reporting requirement was introduced for all large stationary sources in the late 1970s. Facilities were required to report on their annual emissions using either direct stack measurements or engineering calculations. Emission calculation methodologies were based on source-category emission factors or mass balance methods.

Regardless of legally binding requirements to comply with existing standards, the standards were ignored to fulfil five-year production plans. Environmental protection was considered a low priority at the government level. As environmental protection was of lower priority than economic growth, little was spent on enforcement and monitoring, or in developing pollution control technologies and technological innovations. Industries themselves had no incentive to lower their emissions below legally binding emission levels and introduce technological breakthroughs. Therefore, there was no market for environmental services and goods.

Concerning the mobile source pollution control, in 1970, emission standard (GOST) was set on carbon monoxide emissions for gasoline-powered engines. In 1975, the standard on diesel soot content was introduced. In 1974-80, vehicle design and technical standards were developed and introduced. Standards were also developed for fuel quality. Specifically, they were set on diesel sulphur and hydrocarbon content, gasoline lead content, etc. However, between 1970 and 1990 practically nothing was done to update existing standards. Additionally, the entire system of vehicle inspection was weak and corrupted.

In the 1970s-80s, there were no economic tools for environmental pollution, including atmospheric air pollution. Only in 1991 were emission taxes were introduced for a broad spectrum of substances countrywide.

During the Soviet era, national hydro-meteorological services maintained ambient air quality monitoring networks. Almost all the stations were concentrated in densely populated and highly industrialised cities. The monitoring was based on manual sampling. There were no automated monitors. According to standard methodologies, the following criteria pollutants were monitored at all monitoring stations: TSP; SO_2, CO and NO_x. A broad spectrum of specific substances

was measured at some of monitoring sites of several major cities. There were no regular measurements of O_3, Pb and VOCs. There also were no stations measuring fine particles with aerodynamic diameters of less than 10 microns. Ambient air quality data were recorded in paper formats not computerised databases. Data were reported in paper format on daily, monthly and annual basis. In general, these ambient monitoring systems were more designed to detect longer-term pollution trends, rather than high pollution peaks and thus, did not assist in the daily air quality management.

Since 1991, national environmental ministries or committees with regulatory and some managerial functions have been established in the independent states of the Caucasus. However, these agencies are still in the process of developing their organisational structures and during last ten years have been expanded or cut several times. North Caucasus republics and krays do not have independent environmental bodies. Existing governmental institutions there are subordinated to the federal agency. In the air protection field, media-specific departments/divisions under environmental ministries deal with air protection. They have regulatory functions to issue operation permits for stationary sources. They also are responsible for developing general policies, programs, regulations, and methodologies in the air protection field. Compliance assurance monitoring and law enforcement is conducted either by regional/district/local environmental authorities or special inspection bodies. Health ministries are responsible for developing and setting health-based ambient air quality standards. Road Police Departments are responsible for inspecting and monitoring mobile sources. Either hydro-meteorological services or environmental ministries carry out air quality monitoring responsibilities within the Caucasus countries.

After independence, all the South Caucasus countries and the Russian Federation adopted framework laws on environmental protection. Although these laws introduce new approaches, principles and standards: “polluter pays”, “risk minimisation”, “access to information”, “critical loads”, BAT, IPPC, EMAS, etc. they are only statements, and require the development of detailed legislation. Existing air protection laws are still based on the Soviet principles and approaches. According to these laws, source specific ambient-based standards are applied for stationary sources. There is no differentiated approach for existing and new facilities. For mobile sources, emission standards cut from Soviet models are employed. There is no differentiated approach for old and new models. Only CO and soot content in exhaust gases are regulated. There are no standards for NO_x and -HC-emissions. Additionally, there are no regulations covering the vaporised (fugitive) emissions. Similarly, Soviet ambient air quality standards are used in the region. These are only health-based standards and do not take into consideration protection of ecosystems and amenities. Although some of the Caucasus countries, Georgia for example, attempted to adopt EU standards there are no finances and implementation mechanisms to undertake appropriate measures. The standards need not only change in quantitative values, but also change in the whole data collection, processing and analysis systems, which is a resource and time consuming process.

Even if the legislation were perfect, poor enforcement system would preclude compliance of existing laws and regulations. At present, the countries lack finances to develop modern compliance assurance monitoring and control systems. Environmental law enforcement officers are untrained and poorly equipped with measuring devices and there is no legal basis for the frequency and quality of inspections and emission measurements. Administrative penalties imposed on violators, including permit conditions, are symbolic, encouraging illegal activities. On a whole, the Caucasus countries lack legislation and practical experience related to environmental damage, liability and compensation issues, and public court suits.

Emission taxes currently employed in the region do not perform well. Although there is insufficient empirical evidence, it is doubtful that charges have any effect on environmental behaviour. First, charge rates are set at low levels, not taking into consideration marginal abatement costs of industries. Second, real charge rates are low due to the growing inflation and there is no frequent tax adjustment. The criteria for calculating base charge rate is unclear and somehow arbitrary. Although relative human health effects are used for the calculation of base charge rate, it is still unclear how closely they are related to marginal damages. Pollution charge system is very complex itself, covering hundreds of pollutants that are infeasible to monitor. Real revenues fall short of estimates due to the lax enforcement and monitoring. Economic difficulties that the industries undergo today contribute greatly to the low level of revenues from pollution charges. Many marginal enterprises are not capable of paying charges. Frequently, charge deductions and even exemptions are made for prioritised enterprises. The revenue generation is a major driver for regulators. Receipts from charge/taxes are not earmarked and there is no transparency on how much is spent on environmental purposes. However, the inertia of the political system and non-existence of a functional market are core reasons for the low performances of existing tax programs. “Predatory” rent-extracting systems are everywhere in the region. Although privatised, the same ministries, local authorities, and plant managers hold the firms. All of them are linked with each other by bureaucratic connections and mutual services. In practice, existing laws are not enforceable equally for all the parties. High authorities as well as prioritised sectors remain untouchable.

A current problem related to ambient air quality monitoring is the drastic decline in data collection due to shortage of financial resources and technical equipment. In general, existing monitoring networks do not meet international requirements in terms of number and location of sites, data collection, storage, processing and reporting methods, etc. In addition, the current economic situation requires the change in monitoring network design as well as gradual network automatisation, in order to reflect the current status of ambient air and the major pressures as well as conduct daily resource management and make short to medium-term forecasts. At present, the traffic related pollution is a major concern and will continue to exist as such in the future. Hence, particular attention should be paid to ground level ozone, CO, VOCs, NO_x and $PM_{10/2.5}$ measurements. In addition, considerable attention should be paid to ambient lead measurements, since leaded gasoline consists of significant share in total gasoline pool. Modelling capabilities have to be strengthened as well, since modelling, though imprecise, is one of the cost-effective ways for ambient air quality monitoring. Hence, it can be used as complement for real measurements.

During the period from 1972 to 1991, the USSR became signatory and party to the 1979 European Convention on Long-range Transboundary Air Pollution and some of its protocols, 1985 Vienna Convention for the Protection of Ozone Layer and 1987 Montreal Protocol on the Substances that Deplete Ozone Layer. Soviet experts participated also in the development of the UN Convention on Climate Change. After independence, the Russian Federation automatically became an inheritor of the Soviet legacy. The South Caucasus countries started participating in international treaties and agreements individually. They became parties to the Vienna Convention and Montreal Protocol. At present, Georgia is ahead from other South Caucasus countries in terms of participation in Montreal Protocol. She has already acceded to London (1990), Copenhagen (1992) and Montreal (1997) Amendments. South Caucasus Countries and the Russian Federation became also parties to the UNFCCC. Later, Armenia and Georgia have signed the Kyoto protocols. Georgia, Armenia and Russia are also the parties to EC Convention on Long-range Transboundary Air Pollution and actively participate in negotiations and development of relevant protocols. The countries also participate in the London Charter on Transport and Environment and Program of Joint Action (POJA) processes. Georgia together with some of the NIS countries participates in EU approximation processes funded by European Union. With financial assistance of different international institutions and donors, UNDP, UNEP, WB, GEF, Multilateral Fund, EU-TACIS, etc. various national activities have been implemented under the above treaties and agreements. Country programs and first National Communications under UNFCCC have been prepared in all these countries and National Climate Centres have been established in some of them. Ozone Country Programs and action plans have been prepared or are currently under preparation. Ozone Units have been established in some of these countries and several technical assistance and investment projects have been implemented.

Whereas the co-operation at the global level is high, there is practically no co-operation at the regional level to address trans-boundary air pollution issues. Although, in the past some of the ambient monitoring stations within the region were measuring regional background pollution levels, at present, there is practically no information on trans-boundary movements of pollutants.

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2.8 Wastes and Hazardous Chemicals

Traditionally, there was no state system of integrated waste management in the FSU including the Caucasus region. No specific management agency existed. Separate sector-specific institutions and organisations were responsible for waste disposal generated under their auspices. There was no specific law regulating wastes. Only sanitary-hygienic rules and technical requirements existed. Whereas the system of state inventory and regular reporting was established for air and water discharges in the late 1970s, there was no such system for wastes. Therefore, there are practically no historical data on them. Limited data are scattered among different organisations. Whereas in 1986 an effort to introduce the state system of inventory and statistical reporting for industrial wastes was made by the Soviet central government, the system was never introduced widely.

Consequently, wastes were frequently disposed without due consideration of environmental issues. Legal landfills were not planned in an environmentally friendly manner either. Frequently, municipal wastes were disposed together with industrial and hazardous wastes from hospitals, military camps, etc. An even more uncontrolled situation exists at

present.

2.8.1 Municipal Wastes

Population growth and urbanisation have resulted in increased generation of municipal wastes over the last 30 years in all the regions of the FSU, including the Caucasus, although this trend slowed somewhat following the collapse of the Soviet Union. In Armenia, for example, per capita solid municipal waste generation amounted to about 370-430 kg annually in 1985-90, while the figure was about 247-285 kg in 1997 (UN-ECE/MNP of Armenia, 2000). The figures are similar to those in all transition countries. At present, annual municipal waste generation has been increasing with slight upturn of economy. As the studies in selected cities show, the largest share of solid domestic waste is due to the household wastes and the rest is harmless industrial waste. The studies for selected cities of Armenia show that the content of food residues has decreased by 9 per cent and that of soil, silt and debris increased by 12% since 1990. The percent share of paper and polymeric materials has been increasing as well. The study for the city of Tbilisi has showed increased plastic component in municipal waste (WB, 1996).

Historically, solid waste was taken to a landfill and covered with soil. Some was burnt and/or processed. There used to be some recovery of organic wastes. In separate cases food wastes were collected separately and used as animal foodstuff. Usually, legal landfills were built without special planning and due consideration of environmental issues.

Solid waste composition for the cities Yerevan and Hrazdan

Constituents	Hrazdan	Yerevan	
		Before 1990	*After 1990*
Paper, corrugated paper	11.85	11.6	18.0
Food residues	32.67	40.9	30.0
Wood, leaves	5.95	6.7	2.0
Textile	2.72	2.8	2.0
Resinous substances, leather	1.74	2.0	1.0
Polymeric substances	2.41	2.0	2.0
Bones	1.69	1.8	1.5
Ferric metals	1.77	1.9	0.2
Non-ferrous metals	1.31	1.2	0.1
Glass	5.49	5.4	4.0
Rocks, glass	16.20	7.6	11.2
Soil, silt, etc.	16.20	16.1	28.0

Source: UNEP/MNP of Armenia, 2000

At present, existing municipal waste landfills are overloaded, improperly operated and maintained and do not meet minimum health and environmental requirements. Illegal waste dumping is common as well. There is a very limited practice of waste separation and recycling. Only glass bottles are recycled in some urban areas. Wastes are disposed by private sector without any state control. Consequently, industrial wastes and even hazardous wastes are dumped into the municipal waste disposal sites. In rural areas, garbage is directly dumped on riverbanks, hence threatening surface and ground waters.

The absence of controlled landfills for environmentally sound municipal waste disposal or its proper incineration creates the following problems for the population and the environment:

- Risks of soil and groundwater contamination with heavy metals and other hazardous substances in the vicinity of landfills, especially where industrial and municipal wastes are dumped together;
- Evaporation of substances containing heavy metals and toxic organic pollutants from uncontrolled municipal waste landfills as well as release of toxics from open-land waste burning;
- Hygienic-epidemiological risks related to rodents (cholera, tularaemia, hepatic and other diseases).

In the past, municipalities and local authorities were better-operated due to the state financing. Modern sustainable waste management requires high level of institutional strength (legal procedures for planning, designing, operation and closing of landfills, establishment/operation of fee collection system, modern technical equipment, compliance to environmental standards, public awareness and participation, etc.). The most important constraint to the development of proper waste management systems is economic hardship, low environmental awareness and weak democracies in countries (especially poor delineation of duties and powers between central and local authorities).

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2.8 Wastes and Hazardous Chemicals

2.8.2 Industrial Wastes

Industrial wastes disposed on the seashore of the Caspian sea
Source: Caspian Sea: View of journalists. Baku, 2001

During the Soviet period, different industries, e.g., gas and oil, ferrous, non-ferrous, chemical, machinery, food, cement, light industries, etc. developed in the Caucasus region generated high volumes of industrial wastes annually, including hazardous wastes, containing heavy metals, solvents, oil products, etc. Soils around industrial zones, oil and gas drilling fields, quarries, and power plants were contaminated with toxic substances. In 1988, for example, in the city of Alaverdi in Armenia, where non-ferrous industries were developed, soil lead content was 11 to 29 times the existing soil quality standard and copper content was 16 times the background concentrations. Soils around steel manufacturing plants in Rustavi (Georgia) and Sumgayit (Azerbaijan) were contaminated with benz(a)pyrene, lead, copper, zinc, mercury, molybdenum, etc. and background concentrations were exceeded more than 10 times there. In the city of Zestaphoni, where a ferrous-alloys plant was located, high concentrations of manganese were found. In Yerevan and Sumgayit fluorine concentrations around aluminium plants were 6-10 times background levels (State Committee of the USSR on Nature Protection, 1989). High concentrations of PCBs, used as semiconductors in transformers and condensers, were found in soils around power and electrical machinery plants. PCB contamination, for example, was observed around condenser manufacturing plants in Baku and Ganja (State Committee of the Azerbaijan Republic on Nature Protection, 1993).

Traditionally, some industrial wastes were either utilised or rendered harmless. A small percent was directly dumped into solid waste landfills. The majority of hazardous wastes were buried into specially arranged polygons. Some of the industrial wastes, though in small quantities, were re-used by enterprises. For example, the Nairit plant in Armenia re-used rubber waste to make glue (TACIS/MNP of Armenia, 1998).

During the Soviet era, there was no specific law regulating wastes, including industrial wastes. Only specific regulations existed for waste disposal, utilisation, transportation, rendering harmless and burial. In addition, technical and construction requirements were applied for landfills/toxic waste disposal sites.

In general, Soviet industry was a resource intensive and highly polluting sector. No tools, either regulatory or market-based, were employed to prevent pollution at source and promote cleaner technologies. The inventory system for industrial wastes, including toxic wastes, was not in force, whereas such systems, though not perfect, existed for air and water discharges. More or less full data exist for 1990, when the comprehensive inventory of industrial wastes was conducted throughout the Soviet Union.

The drastic decline in industrial activities that followed the disintegration of the Soviet Union resulted in a decline in industrial waste generation in the early 1990s. In Armenia, for example, non-hazardous industrial waste generation fell from 35.2 million tons/yr. in 1985-90 to 251,000 tons/yr. in 1995-96 (UNEP/MNP of Armenia, 2000). In parallel, the hazardous waste generation rate fell. Currently, a slight growth in industrial output can be observed. However, existing facilities still work at about 15-20% of their capacities. In general, the structure of industry shifted from heavy and chemical industry to oil and gas operations, mining, cement manufacturing, food processing, etc., which are more adapted to local markets and locally available raw materials. This itself might affect the industrial waste composition. At present, oil industries, mineral resources extraction and processing industries and power plants are major generators of industrial wastes containing oil residues, heavy metals and PCBs, etc. The problem of disposal, rendering harmless and utilisation of industrial wastes is very acute in the region. In Sumgayit, for example, about 200,000 tons of mercury sludge, with 0.1-0.3% of mercury content has been accumulated since 1980s around the chlorine-alkali production plant. These wastes are inadequately stored, contaminating ground waters and Caspian Sea bed sediments through seepage (State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan, 1998). Since 1998, about 125 million toxic wastes containing arsenic have accumulated in the Tyrnyauz molybdenum and wolfram quarry and

processing plant in Kabardino-Balkaria (Ministry of Environment and Nature Resources Protection, Russian Federation, 1998). In Stavropol kray, about 4.4 million tons of toxic wastes were registered in 1995, of which one million tons were of highest toxicity (Ministry of Environment and Nature Resources Protection, Russian Federation, 1996). In Georgia, about 1.3 million tons of toxic wastes are accumulated at present (WHO/MoH of Georgia, draft, 2001).

Overall, the rate of utilization or rendering harmless of hazardous wastes is not high in the region. However, it varies for different parts of the Caucasus. In Stavropol kray, for example, the total amount of hazardous wastes generated in 2000 amounted to 226.6 thousand tons from which over 60.7% were utilised or rendered harmless, while in Krasnodar kray, of a total of 196.6 thousand tons, only 26% were treated (State Committee of the Russian Federation for Statistics, Russian Federation, 2001).

At present, toxic wastes are mostly accumulated within territories of industrial facilities or nearby territories or dumped into municipal waste landfills or illegal dumpsites. Known hazardous waste disposal sites are overloaded and not adequately isolated from the environment. There are no finances or mechanisms to arrange new sites.

Present status in the field of waste management system, including industrial wastes, is caused by the lack of appropriate national legislations and institutions. Licensing systems for industrial wastes are not put into force. Waste classification systems are either non-existent or imperfect, not going in line with EU (yellow and corrected red lists, etc), UN and OECD, etc. classification systems. There is virtually no system of toxic waste and contaminated site inventory. Because of that, information on industrial wastes is practically absent. Finally, there are no policies promoting prevention/minimisation of toxic wastes at sources. Such principles and standards as IPPC and BAT, etc. although stated in framework environmental protection laws of some of the South Caucasus countries, are not yet implemented. Nor do the problem of liability for the past pollution is reflected in national legislations.

The problem of trans-boundary movement and disposal of hazardous wastes has become critical since the disintegration of the Soviet Union. Non-existence of sound law enforcement and monitoring systems as well as high corruption poses the threat that the Caucasus countries could become “havens” for international waste trading. In addition, existence of uncontrolled territories with practically no law and order promotes illegal trading and smuggling. Although, all South Caucasus countries and the Russian Federation are parties to Basel Convention on Transboundary Movements of Hazardous Wastes and their Disposal, they lack national capacities as well as finances to fulfil the commitments taken under the above treaty. There is a need to develop state-of-the-art waste management/custom legislation, build institutional capacities and raise public awareness. In this regard, international assistance is needed in order to promote regional co-operation in waste management and achieve environmental safety.

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2.8 Wastes and Hazardous Chemicals

2.8.3 Radioactive Wastes

The issue of radioactive wastes in the Caucasus region is basically related to the nuclear power plant operated by Armenia, military camps, and oil drilling and processing operations in Azerbaijan and some parts of the North Caucasus. Different research and medical institutions are also the sources for radioactive wastes. There are practically no data on these types of wastes and the issue needs to be further studied. Even if there is some information, it is frequently classified and not available for different users. Public awareness about radioactive wastes is also very low within the entire region. Therefore, casualties in the population are not rare. In particular, a high threat is from former Soviet military bases, where significant amounts of radioactive wastes are accumulated. There are no comprehensive inventories of radioactive sources and wastes. Nor do storage facilities exist for them. Although, the Caucasus countries have designated authorities, they have little capacity to handle the issues.

- In Azerbaijan, radionucleides of naturally occurring radium, thorium and potassium were found in oil drill fields. At some places, soils are so polluted that they need to be buried as radioactive wastes. “oil lakes” and flood fields, created while pumping bore-waters back into oil-bearing layers, aggravate the situation. Some old oil drill fields currently are used as settlements hence the population is exposed to radon noble gas damaging to the lungs. A similar situation exists for chemical plants and oil refineries. Ground waters with high radium-226, thorium-228 and potassium-40 content were used in a Baku iodine plant as a raw material. Consequently, part of plant territory and equipment were polluted by radionucleides. Especially urgent is the problem of activated charcoal decontamination, accumulated in the plant territory;
- In Georgia in 1996, three people were injured, two fatally, when they opened the container with radioactive medical wastes. These containers were sent to Russia for disposal, but they were returned to Georgia due to the failure transportation routes. The issue was completely neglected.
- In 1997, nine soldiers were injured in training centre near Tbilisi from Cs-137 and Co-60 radiation sources, left by Soviet military troops.
- In winter 2002, three people received high doses of radiation in Western Georgia, after they dismantled 2 radioactive sources of strontium-90. These and other several sources were brought to Georgia in 1980s for the construction of large-scale hydro dam and were designed to be used as power generators for radio communications. As the hydro dam project was never implemented, these sources have been left without any control. Recently, local inhabitants have found the containers with these radioactive sources and decided to use them for domestic needs. Hence, they opened these sources and imposed high threat to their and other people’s lives. After the injured inhabitants were hospitalised, the case gained wide public disclosure. With joint efforts of the Ministries of Environment and Internal Affairs and State Security Service of Georgia and the experts of International Nuclear Agency the dismantled sources were rendered harmless

Sources: State Committee of the Azerbaijan Republic on Nature Protection, 1993; TACIS/MoE of Georgia, 1998; Courier, Rustavi-2 night TV show, 04.02.02

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2.8.4 Hazardous Chemicals and Obsolete Pesticides

During the Soviet period, fertilisers and agrochemicals were intensively used in the Caucasus region, since the region’s economy was largely agriculture-based. Although total use has declined dramatically since the break up of the Soviet Union, there are some indications that the use has been slightly going up, at least for Georgia. There, about 60-70% of chemicals in use are illegally imported (MoE, expert interviews, 2000; GRID-Tbilisi, 2002). For other parts of the Caucasus, there is no information available.

There are still high volumes of obsolete and banned pesticides stored in warehouses for more than 15 years throughout the region. Many of these warehouses are completely outdate and do not meet existing technical and sanitary requirements, imposing high threat to surface and ground waters and nearby soils. Large quantities of pesticides are directly exposed to open air. Due to the lack of finances, source inventories and the measures for rendering obsolete pesticides harmless, proper storage, incineration, etc. is not undertaken by responsible authorities. Existing state inventory systems for hazardous chemicals, if they exist, mal-function and data on chemicals import-exports, production, and storage and consumption patterns are very scarce. Public awareness around hazardous chemicals is extremely low.

Local farmers lack knowledge on the safe application of agrochemicals and hence, injuries are common among this group.

Thus, the current situation can be described in a following way:

- Centralised import of pesticides was stopped in the beginning of the 1990s due to economic difficulties;
- Illegal import and distribution of pesticides and wastes is growing as a result of inadequate legislation, law enforcement and weak management capacity of authorities;
- Management of chemicals is not co-ordinated among different authorities (MoE, MoA, MoH, etc.) at both central and local levels and no appropriate information for decision-making process is available;
- There is lack of training for new farmers in safe handling of chemicals;
- No regional co-ordination policies and activities exist for the integrated management of chemicals and hazardous wastes.

There are recent positive developments in the Caucasus to overcome problems indicated above: Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

(Rotterdam, 1998) is signed by Armenia, and Stockholm Convention on Persistent Organic Pollutants by Armenia, Georgia and the Russian Federation. In this regard, initial steps to enable implementation of the provisions of these multi-lateral treaties are undergoing. However, growing poverty and general (environmental) security issues have first priority in the new democracies of the Caucasus countries. Accordingly, if no specific international assistance is made in the short-term towards this direction, the issue of chemicals and waste management will remain critical, since the countries lack financial and technical capacities to handle it.

In order to prevent or mitigate the issue, it is necessary that the governments further develop their waste management legislations, policies, and build-up their capacities. Waste inventory systems have to be established. Sound market-based tools have to be introduced for field financing. Policies promoting cleaner technologies have to be implemented. All the countries have to strengthen their capacities towards controlling illegal trades and import-exports of wastes through building co-ordinated policies.

One of the specific examples of urgent co-ordinated actions needed in the region is: inventory, monitoring and environmentally safe disposal of PCB-containing wastes and products. In this regard, GEF enabling activities to assist countries to fulfil their obligations under the Stockholm Convention need new additional inputs through bi- or multi-lateral assistance mechanisms.

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2.9 Natural disasters

Natural disasters, frequently of catastrophic character, are widespread phenomena in the Caucasus. Fortunately, not all the natural processes are observed in the Caucasus and some have relatively small intensity. The Caucasus is not an active volcanic zone, there are no tropical storms and hurricanes, and cyclones and floods are of much smaller size than those are in tropics or areas with extensive lowland topography. Nevertheless, there are other environmental disasters: landslides, avalanches, mudflows, as well as some unfavourable hydro-meteorological processes that are very real for the Caucasus. Though meteorological processes (frost, drought, sand storms, winds storms, hailstorms, ice storms, etc.) do not lead to human deaths, they may cause very serious economic losses.

During the Soviet era, different institutions studied environmental disasters. Some data were also collected. Data collection, however, was irregular and no unified system existed for this. Preventive measures against natural phenomena, such as reforestation, slope terracing, etc. were also conducted. There was no precise methodology for calculating damage incurred from natural disasters.

Natural disasters have become rather intensive recently. No single strategy to fight against environmental disasters has been yet developed, either in the region or in an individual country. Nor does any organisation with the capacity to make forecasts and manage disasters exist in the region. Nevertheless, some positive steps are being taken towards the strengthening managerial capacity in the field. For example, UNDP has financed some activities at national and regional levels for establishing early disaster warning and management systems and strengthening regional capacity for joint management of environmental disasters in the South Caucasus.

2.9.1 Landslides

Intensive landslides characterise mountainous territories of the Caucasus. The majority of landslides occur in the middle-mountain zone. Their intensification is due to excessive humidity, earthquakes, and different economic activities.

Landslides cause many changes in the environment. Specifically, they destroy topsoil and vegetation as well as settlements. For example, a landslide completely destroyed the village Marmarashen (Armenia, the bank of the river Azurn), and as a result the local population was forced to leave the place. There are numerous similar examples in different regions of the Caucasus.

Landslides intensify in case of unsustainable water use practices, water loss from reservoirs, and destruction of water distribution systems. For example, in Yerevan and its surrounding villages, favourable conditions for landslides have formed due to improperly built and maintained irrigation, water supply and sewage systems and high water losses.

Recently, a trend of increase in the amount of landslides has been observed. In Georgia alone, the amount of landslides has exceeded 50,000. The area of regions damaged by landslides has also increased. In Georgia, 3.5 million hectares are within the area of landslide and mudflow processes (Tatashidze and et al., 1996). In Armenia, the regions affected by landslides occupy 500 km sq. (2% of the total area of the republic). Landslides are especially prevalent in the south-eastern part of the Caucasus, Lenkoran (Azerbaijan), and foothills of the West and Central Caucasus and Meskheti and Trialeti ranges (Georgia) (The Map of Zoning...,1985).

- Intensification of landslides in Ajara in 1989 was connected with extensive snow (snow depth exceeded 3m) and an unusually warm spring. April average temperature exceeded 4-5^0 C. All this was followed by intensive snow melting, saturation of rocks by water and numerous landslides, especially in the river Tsablana gorge.
- In September 1999, because of heavy rains, many landslides occurred in Dagestan near the towns of Buynansk and Gunib. The landslide damaged the 75-km length transport road, water supply and sewage systems, and over 2,000 buildings, etc.;
- In 1997 in Karachaevo-Cherkessia, in the district of Ust-Jeguta, over 12,000 m^3 landslide body was formed, which damaged transport communications and the Stavropol irrigation canal.

Source: Beruchashvili, 1995; GRID-Moscow, 2001

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.9 Natural disasters

2.9.2 Mudflows

Mudflows are characteristic of the mountainous regions of the Caucasus, resulting in serious economic loss. The negative impact of mudflows on the environment is multiple. Specifically, they bring about the formation of erosive slopes, pollute rivers with mud and pebbles and destroy agriculture lands, industrial enterprises and transport communications, including oil and gas pipelines, which impose a particular threat to the environment. Mudflows are most intensive on the southern slope of the Greater Caucasus within Azerbaijan. It was considered one of the most active regions of the former USSR, and the largest mudflow danger areas in the Caucasus (Geomorphology of Azerbaijan, Baku, 1959). In average, annual economic loss from mudflows in Azerbaijan amounts to US$15 million and over hundred settlements with total population of 700 thousand people are under mudflow danger (Dangerous Natural Phenomena ..., 2002). Mudflows have frequently damaged settlements, such as Shecki, Ordubad (Azerbaijan), Yerevan, Kapan, Alaverdi (Armenia), Tbilisi, Kvareli, Telavi (Georgia), Tyrnyauz (Kabardino-Balkaria). In total, mudflows damaged about 200 settlements in Armenia, and several hundred ones in Georgia (UNDP, Armenia, 1999; Tatashidze et al. 1996).

Strong mudflows formed in the Caucasus bring down hundreds, sometimes millions of cubic meters of friable mass, forming enormous alluvial cones (Caucasus, Moscow, 1966). The region's relief, geological structure and specific climatic features, namely, steep slopes, fragile rocks, long droughts followed by downpours, etc. form favourable conditions for mudflows in many places. Mudflows have accelerated erosion processes, which have intensified over the last twenty years because of intensive woodcutting, overgrazing and unsustainable land use practices. In some places, tailings from mining operations accumulated on the slopes and riverbanks (which happen rather often) form additional factors for intensification of mudflows. In some places, one of the major reasons for the declining forest areas are thought to be erosion processes caused by mudflows.

Before the mid-1980s, over 20% of mudflows (1,130 flows) in the territory of the FSU occurred in the Caucasus. Of these, 936 (from 1978-1,030 flows) were registered in the South Caucasus, and 194 the North Caucasus (Dangerous Hydro-meteorological Phenomena in the Caucasus, Leningrad, 1984).

In order to prevent the destructive influence of mudflows special constructions against mudflows are built in Caucasus. Along the South Caucasus railway line, there are mudflow-gassings, built in the 19th century. Many constructions were built to protect against mudflow in the Soviet period. Nevertheless, there are still no perfectly regulated mudflow basins unlike in some countries of West Europe where thousands of such systems operate.

- A catastrophic mudflow was formed in the Terek Gorge at the village Larsi (the North Caucasus). It came from Devdarak glacier (from Mkinvartsveri, Georgia). It brought a huge boulder (29X15X13 m), known as "Yermolov's Stone," which is considered as one of the biggest glacier boulder in Eastern Europe. In the river Terek basin, strong mudflows occur frequently. They often damage the Georgian Military Road, one of the most important Trans-Caucasian motorways.

- Mudflows are common in the Duruji River gorge (left tributary of the river Alazani, Georgia), posing danger to the town Kvareli. In 1899, a mudflow of catastrophic character brought down 224-ton boulder ("Duruji boulder") with the size of 5.8x4.2x4m. In 1997, a mudflow damaged the town Kvareli, where stone, road metal and mud covered town streets, melioration systems and arable lands.

- Mudflow on the river Sadon (Ardon basin, North Ossetia) in 1958 was one of the strongest in the Caucasus.

- Extremely high intensity of mudflows was reported in 1989, for both the North and South Caucasus, especially in North Ossetia, Kabardino-Balkaria, Dagestan, Georgia and Azerbaijan. This was related in heavy rains and intensive snow melting in March-May.

- In 1977 due to high temperatures and extensive precipitation, mudflows were intensified in the North Caucasus, involving almost all altitude zones. In particular, mudflows were intensive in the basin of the river Bezengsky-Cherek.

Sources: Tsomaia, 1985; Dangerous Hydrometeorological…, 1983

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2.9.3 Flooding

Water hydrology of the Caucasus is largely affected by two factors: atmospheric precipitation and snow melting. Usually, annual precipitation increases together with elevation until 2,000 m above sea level and decreases from west to east. Rivers that flow in areas with high precipitation and are fed by snow melting are characterised by high flow. Many rivers originate in high mountain zones of the Greater Caucasus, where eternal snow and glaciers are located. High flood periods, lasting about 6 months, are characteristic of these rivers. In spring and summer periods, when intensive snow melting starts, water level increases considerably. Usually, one peak discharge occurs on these rivers, whereas on the rivers starting in foothills of the Caucasus there are two of them: in spring when snow melts and in fall after downpours. Floods are spontaneous only in some years, when the most intensive snow melting occurs and water covers adjacent plane territories, incurring great damage to agriculture.

The following rivers form the largest flood areas: Kuban, Terek, Kura, Araks and Rioni. Along their shores there are concrete dikes and levies to prevent material loss caused by floods. Many reservoirs regulate water, such as the Mingechevir on the river Kura, Krasnodar on the river Kuban, Chirkei, Chiri- Yurti on the river Sulak, Lajanuri, Gumati, Vartsikhe on the river Rioni, Jvari on the river Enguir, Akhurian, Arpichil, Araks hydro knot on the river Araks, etc.

During the past 30 years major floods occurred in Western Georgia in April 1978, May 1982, and January 1987; in Baksan gorge in the North Caucasus in July 1975 and in Krasnodar Kray in the North Caucasus in February 1998. All these floods had serious social-economic and environmental impacts. Specifically, they inundated settlements including the large towns Kutaisi, Zestaphoni, Krasnodar, Tikhoretsk etc. They also damaged large areas of agricultural lands and infrastructure: roads, bridges, water supply and sewage systems, etc. For instance, as a result of a 1998 flood, about 329,000 ha of agricultural land was damaged in Krasnodar Kray (Dangerous Hydrometeorological…, 1983; Ministry of Environment and Nature Resources Protection, the Russian Federation, 1994; GRID-Moscow, 2001). The flood, occurred in West Georgia in 1987 inundated nearly 200-km sq. area, significantly damaged 3.2 thousand and completely destroyed more than 2.6 thousand buildings. Total economic loss amounted to US $300 million (Dangerous Natural Phenomena ..., 2002).

CHAPTER 2. STATE OF THE CAUCASUS ENVIRONMENT AND POLICY MEASURES: A RETROSPECTIVE FROM 1972 TO 2002

2.9 Natural disasters

2.9.4 Avalanches

Avalanches are one of the most common natural disasters in the Caucasus. They impose danger to populated areas, industrial enterprises, and means of communication. In winter, traffic is often blocked between the North and South Caucasus.

Avalanches are particularly typical in highlands, although the lowest border of high-risk territories descends far below. The risk zone comes down the lowest in the West Caucasus (to 50-100 m on southern slopes, 550 m – on


Dykhtau glacier. North Caucasus
Source: http://www.mountain.ru/

North Caucasus), while in the East Caucasus it is found at elevations of 1,400-1,500 meters and higher. The whole territory located above these hypsometric levels of the Greater and Lesser Caucasus represents an avalanche-prone area (*Dangerous Hydrometeorological…,*1983). However, the frequency of avalanches varies at different altitudes. The zone of the Caucasian highlands with alpine relief is featured by the highest danger of avalanche (the main ridge of the Caucasus and Skalistyi (rocky) ridge), where the ratio of avalanche danger is 75-80%. Avalanches are observed here during the whole year, but represent danger only for mountaineers. Northern and Southern slopes of the Caucasus, individual ridges of Lesser Caucasus (Bazum, Pambak, Zangezur, and Murovdag) are also located in avalanche risk prone areas (50-75%).

The avalanche danger period lasts six to eight months, posing a significant danger to populated areas, mountain pass roads etc.

The remaining territory of the Caucasus is at relatively small risk. Here avalanches happen rarely, although because of populated areas and industrial facilities they cause great damage to the economy. In heavy snowy winters, avalanches may even be catastrophic here. In lowlands and foothills, avalanches also cause great economic damage. They are sporadic and occur once every five years or less.

The greatest number of avalanches occurs at heights of 1,000-4,000 m above sea level. They are particularly frequent from January to March, occurring in all areas of the zone of avalanche danger. Avalanches are particularly frequent in the regions not rich in forests. Avalanches destroy mountainous forests too.

There is no comprehensive monitoring of avalanches in the Caucasus, although information about them has been collected since 1804. Special research began in the 1930s. Avalanches occurring near populated areas and roads of strategic importance are studied better. Only three meteorological stations: Mamisoni pass, Kazbegi, and Sulaki located at high altitudes provide information on them. Therefore, the available data do not show a comprehensive picture.

- Following a very snowy winter, avalanches on both slopes of the Central Caucasus took place in 1976. They were especially powerful in the gorges of Nenskra and Nakra rivers (Enguri basin, Georgia) where 546 hectares of forest were destroyed.

- The winter of 1986-1987 was marked with many avalanches in West Georgia, caused by abundant precipitation that formed high snow cover. That winter was unusually warm. A powerful anticyclone, formed in Eastern Europe, provoked the movement of several warm Mediterranean cyclones to the Western Trans-Caucasus, causing heavy showers in the Colchian lowland and heavy snow in mountain areas. As a result, in Upper Svaneti several avalanches took place leading to human deaths and huge economic losses. Intensive snow melting resulted in serious floods of the Rioni, Tskhenistkali, Khobi and other rivers. Since soils accumulated huge amount of moisture, landslides occurred in spring. Finally, a number of large mudflows occurred in the summer. Overall, damage by these processes in Georgia alone amounted to about US$300 million. Many people died, hundreds of buildings destroyed, transport communications damaged, 20,000 people evacuated.

Sources: Beruchashvili, 1996; Beruchashvli, 1995

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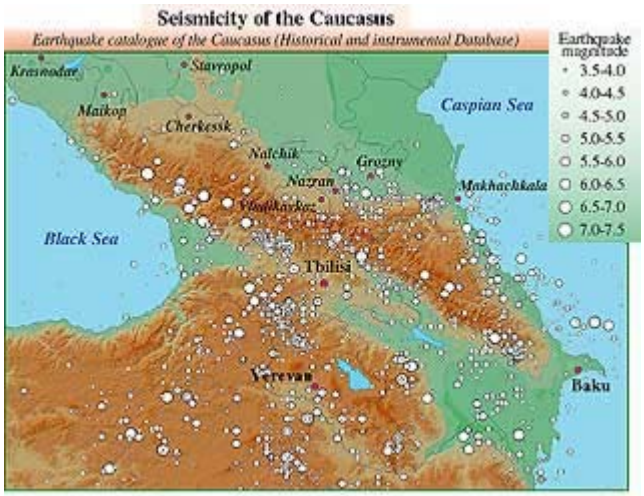
2.9.5 Earthquakes

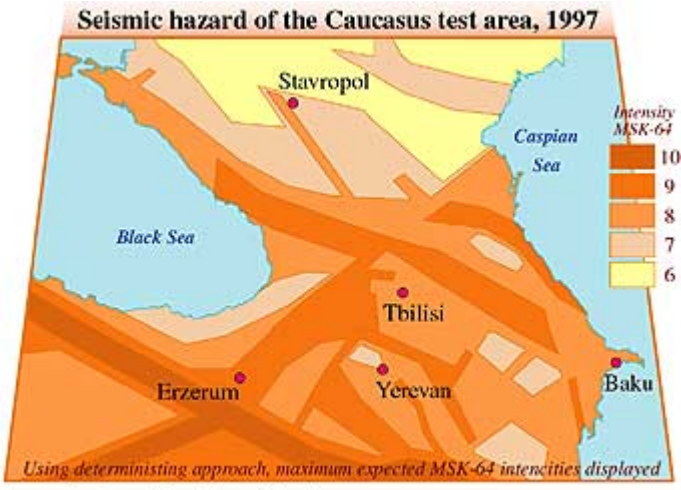
The Caucasus is located in one of the most active Alpine-Himalayan collision belt. Over the past two thousand years, there have been many earthquakes in the Caucasus. Some have been catastrophic, resulted in thousands of deaths, infrastructure destruction and environmental degradation. Sometimes damage caused by earthquakes may be more linked to landslides generated after them than to the actual earthquake.



Source: Institute of Geophysics of Georgia

The landslides and rockslides resulting from earthquakes have formed lakes in several places. Lake Abrau (near Novorossiisk) was formed two to three thousand years ago, Big and Small Ritsa-250-300 years ago, Gey-Gel (Armenia) in 1139, Amtkeli (West Georgia) in 1891 etc.

Since 1800, over 2,000 significant earthquakes have been recorded in the Caucasus, 1,200 in the last half of the 20th century. While they differed in their intensity, the intensity was generally less than 8MSK. Compared with the most active seismic regions of the world, (Japan, California) the Caucasus seems calm. However, over the past decades several powerful earthquakes of 6-6.5M have shook the region (Spitak, 1988; Sachkhere, 1991; Barisakho 1992; Eastern Turkey 1976, 1983 and 1992; North Iran, 1990 and 1997). Among these earthquakes, the most disastrous was the Spitak 9MSK earthquake of 1988, which killed 25,000 people. The earthquake damaged 21 cities, 342 villages, and left 520,000 people homeless (Ministry of Environmental and Nature Resources Protection, Russian Federation, 1994; Institute of Geophysics of Georgia). After this earthquake, some of the regions of the Caucasus were declared 9MSK earthquake zones.



Source: Institute of Geophisics of Georgia

The location of epicentres close to the earth surface (the average epicentre depth is about 20-30 km and less) is one of the specific features of the earthquakes in the Caucasus. Therefore, weaker earthquakes may cause disastrous effects there. Moreover, many of buildings of the Soviet period are not built to withstand earthquakes of high magnitude.

The Great Caucasus and Javakheti-Armenian highlands are at the highest level of seismic risk. Most important seismic centres are located along the large tectonic breaks. The Javakheti-Armenian highlands is the most active tectonic area in the Caucasus, characterised by the highest frequency of earthquakes.

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2.9.6 Wild Fires

Wild fires have some impact on the Caucasus economy and environment. However, they are not as critical as other natural disasters in the region.

Fires negatively affect forest formation, reduce forest quality and productivity, and destroy such functions of forests as water protection, recreation, etc. Fires are caused by both natural factors (lightening, peat self-firing, etc) and human activities. The greatest share falls to the latter.

Clear-cutting causes the highest risk for wild fires. Pine forests and dying damaged trees, as well as areas of arid and dry juniper forests are most vulnerable. Clear-cutting is very rare in Caucasus, however. Caucasian forests are very diverse, for example in beech forests one can find younger trees next to 200 year-old trees. In Colchic poli-dominant multi-layer wet forests, the structure is even more complex. That is why there are very few fire risks to old forest ecosystems in the Caucasus. Dry juniper forests remain only in nature reserves (Vashlovani reserve in Georgia, for example) and are fully protected from fire risk. Wild fires frequently occur because of burning of agriculture fields.

Areas with pine forests are growing very intensively at the expense of former agricultural lands. In Racha (Georgia) for instance, forested areas have increased by 5-10% over the past few decades. As mentioned, the danger of fire in pine forests is extremely high, although the wet climate in these districts mitigates this risk. In the Caucasus, wild forest fires are rare (compared with Savannas in Africa). In highlands, this is due to the wet climate, in steppes - mainly to irrigation.

The 1970-80s saw a decreasing number of wild fires, which can be explained by better technical equipment of fire fighters. That is why in the past, forest fires were not considered an important environmental problem for the region. However, in recent years wild fires have been increasing in both the numbers of fires and the areas damaged by them. One assumes that current trend will continue.

How to preserve the relatively safe situation in terms of wild fires is a critical issue at present. The only solutions are putting restrictions on clear-cutting and visiting virgin forest groves as well as establishing an early-warning system for monitoring forests in the Caucasus.

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2.9.7 Drought

In terms of humidity, the Caucasus is a region of great contrasts. Its western part and highland zones are more humid and the North Caucasus plains and Javakheti-Armenian highlands are more arid. Evaporation in the entire region exceeds the flow by 140mm, indicating a spreading of arid landscapes in the major part of the territory. Annual amount of atmospheric precipitation exceeds 1,000mm only on the Greater and Lesser Caucasus and Colchida. In the rest of the territories, it is less than above value and in many places amounts to 300-450mm. That is why in light of global warming the problem of xerophyzation (desertification) is very acute in the region. It is more acute in the lowlands and foothills of the North Caucasus, especially in Eastern part as well as in Eastern parts of the South Caucasus: Iori-Ajinauri plateau, Kvemo Kartli plain, Akhaltsikhe depression, Javakheti-Armenian highlands, Kura-Araks lowland, etc.

Droughts are more characteristic of the eastern part of the Caucasus. The lowest amounts of atmospheric precipitation fall in the Terek-Kuma and Kura-Araks lowlands and Ararat Valley.

Recently, a drop in the amount of precipitation is observed, negatively affecting agricultural output. In addition, strong arid winds bring great damage too. For example, 1998-99 autumn and winter droughts in Armenia affected more than 75% of winter wheat crops and up to 50% of orchards (MNP, Armenia, 2001). Similarly, in 1998 in Karachaevo-Cherkessia, droughts damaged more than 50% of cereals. Damage also was incurred to the agricultures of Krasnodar and Stavropol krays, Adigeya, Ingushetia. 1998 and 2000 summers were also extremely dry for Azerbaijan and Georgia, incurring significant economic losses to these countries.

In general, droughts are one of the major factors for desertification. In the Caucasus, desertification process became more intensive in recent years and thus semi-desert and desert elements are met even in places not characterised by such

elements, e.g. riparian forests. In East Georgia, for example, over 3,000 ha of total land area is under the process of desertification, caused by droughts and over-grazing (MoE of Georgia/UNDP, 2001-2002)

In the future, global warming will cause the Caucasian landscapes to be more "sensitive" to atmospheric precipitation and less to air temperature. Desertification process will considerably affect arid and semi-arid landscapes in plains and foothills of the East Caucasus as well as sub-alpine and alpine landscapes of high mountains (Beruchashvili, 1995).

CHAPTER 3. HUMAN VULNERABILITY, POVERTY AND ENVIRONMENT

3.1 Vulnerability in the Local Setting

In the majority of cases of human-nature interactions, the chain of events starts within human society, triggered by problems of societal development (economic, social, cultural, etc.). These problems may then be "imposed" on nature, either accidentally or deliberately, causing changes there and re-emerging as environmental problems. Afterwards, this chain of events may cause feedback effects on society, presenting what resembles an absolutely new set of problems. Interaction with nature does not create new problems; it just makes evident problems already existing in human society. It also often magnifies the negative consequences of human activities, leaving them to be solved by people who did not cause them in the first place, and often by moving the process far away, from where they were physically initiated.

Even when people encounter unavoidable natural phenomena *("acts of God")* such as earthquakes or tropical cyclones, tornadoes etc., this chain of events still may have begun within society. There are social-economic factors that determine why people are located in harm's way in the first place, what they know about a potential hazard and how well they are prepared to deal with it.

Thus, even in cases when human vulnerability appears to be caused by environmental factors, its real driving forces may be socio-economic. Vulnerability is a potential state, which is often case-specific; that is, attributable to either social, economic or environmental factors that activate it.

As a result, human-nature interactions are well-known for being complex. Causes and effects are hard to trace and chains of events are usually so intermingled that following them to their source is a near-to-impossible task. Hence, there are obvious difficulties in perceiving human-nature interaction problems, reaching efficient solutions and undertaking effective mitigating measures. Associated difficulties in planning and problem solving usually lead to a lack of preventive initiatives, with mitigating measures applied after the fact and on visible effects, rather than to the causes of a given problem.

These general problems in case of the Caucasus are further exacerbated by the disintegration of the USSR and subsequent weakening of the economy, governmental structures and social safety nets, along with armed conflicts and the like. The enormous changes have been negative for the vast majority of the local population, and are associated with huge gains for a very few and poverty, insecurity and struggle for day-by-day survival for the majority. For people under such circumstances environmental considerations are very low on the agenda. They come to people's attention only when negative environmental changes hit people in some drastic way, as in the case of some natural catastrophe. Environmental problems will certainly become more important to people if they are affected by large-scale environmental degradation. Nevertheless, right now environmental concerns are over-shadowed by the more pressing problems of poverty and insecurity that are considered the leading causes of vulnerability in the region.[1]

Local vulnerability in the Caucasus is very different from what is observed in other less developed regions of the world. For many, (if not the majority) it has resulted from the extremely rapid – virtually overnight – deterioration of relatively high living standards after the disintegration of the USSR. One of the main characteristics of local vulnerability is rooted in the traditionally high level of dependency on the government. By the end of the communist era, hardly anyone really trusted or respected the government, but strange as it seems, viewed it as the sole provider of services and ultimate protector in time of need. When governments began to fail in their missions as protectors and providers, for many, especially the previously affluent, poverty moved into a psychological dimension. It is often associated with not only material deprivation, but also the feeling of powerlessness and humiliation – a phenomenon clearly visible in Georgia for instance.[2] Now ten years following the collapse of the Soviet Union, the authorities still lack coping strategies and resources to ameliorate the condition of vulnerable people, while the frequency and scale of extreme events has sharply

increased.

In considering causes of vulnerability in the Caucasus, it should be understood that the ongoing transition in the region is actually the third such transition in a relatively short historical period.[3] Each transition has profoundly altered existing ideas, beliefs and value systems. Therefore, the vast majority of population has a value system much at odds with what is accepted in civilised society in terms of rights and wrongs. In such value systems, environmental concerns occupy very little space, if any.

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1 - We understand vulnerability as inability of individual or group of people to resist adverse socio-economic and/or natural phenomena as well to cope successfully with their consequences.

2 - As a result the less developed and previously less affluent communities and individuals usually find themselves better positioned to resist vulnerability as a whole and poverty in particular. They lose less, expect less, and are more dependent dependent on informal security nets (extended families, local clans) than their previously richer counterparts.

3 - Traditional society in this region was under already under a strong pressure of successful capitalist transformation when Bolsheviks got it under control. In turn, the current stage of transformation started when vast majority of population at last began to come to terms with rules of games offered by Communists. As a result, we deal with two cases of aborted development and one incomplete transformation during one century.

CHAPTER 3. HUMAN VULNERABILITY, POVERTY AND ENVIRONMENT

3.2 The Most Vulnerable Groups

Refugee camp in Azerbaijan
Source: HDR Azerbaijan, 1999

Vulnerability in the region today primarily hinges on the economic situation. One is naturally much less vulnerable to various hazards in an economically developed country than in the Caucasus, which is still in the midst of prolonged economic hardships almost after a decade of widely publicised economic reforms.[1] Even armed conflicts, for whatever reasons they were started, are mainly sustained because there are plenty of people earning their livelihood from them.[2] Chechen youngsters are dying planting mines to kill young Russian soldiers since this is the only opportunity for them to earn a few dollars to support their families. Thousands of people in the mountains of the South Caucasus are felling trees on steep slopes directly above their villages since this is the only way to earn some money to live. Hence the obvious conclusion – whatever the visible reasons of vulnerability, its ultimate solution lies in the improvement of the general economic situation throughout the region, raising standards of living and increasing state funding for social programs.

Poor people are obviously the most vulnerable. The smaller national autonomies of the North Caucasus are characterised by extremely high poverty levels. Ingushetia (where 95.1% of population is poor based on per capita monetary income in 1999)[3] and Dagestan (63.2%) are classified in Russia as belonging to "the less developed autonomous republics and units in very critical condition".[4] Two more - Karachaevo-Cherkessia (64.6%) and Kabardino-Balkaria (46.6%) are classified as "underdeveloped republics". These republics have the worst social indicators in Russia and the only other areas of the Russian Federation that bear any comparison to them are remote areas of Siberia and the Far East. According to a survey of average monthly per capita incomes in 1999, Ingushetia occupied the last (79^{th}) place in Russia, and Dagestan 77^{th}, Karachaevo-Cherkesia 76^{th}, Adygeia 70^{th}, Kabardino-Balkaria 64^{th} place respectively. The average Ingushetian earned just 22.8% of the average Russian wage. On the other hand, all these republics have the highest rates of social transfers in terms of the population's monetary income – for the average Russian it was 13.6%, in Ingushetia 28.2%, Dagestan 27.3 %, Adugeya 24.1 %, Karachaevo-Cherkessia 26.6% (State Committee of Russian Federation for Statistics, 2000).

Ingushetia (82.6%) and Dagestan (75.1%) had the highest rates of food expenditures in household budgets in the Russian Federation, closely followed by Karachaevo-Cherkessia and Kabardino-Balkaria. The former two had the lowest levels of pensions. Ingushetia is the only place in the Russian Federation where the number of pensioners exceeds the number of employed persons. The same trends are observed almost in all other republics, including North Ossetia. Naturally, unemployment levels here are among the highest in Russia.

The vulnerability of the population here is basically caused by a lack of economic development. Even in Soviet times, these areas were underdeveloped. Dagestan may be the only place in the region where high population pressure coupled with underdevelopment directly causes land degradation.

Refuges from Chechnya
Source: http://kalil-photo.ru

All other territorial units of the North Caucasus are similar to the average Russian level, and are representatives of a country in transition, just starting to overcome deep economic and social crisis.[5] The formal state social security system plays the lead role in mitigating vulnerability; although it is not as reliable, it once was under Soviet administration. Pensioners and families of unemployed workers are especially vulnerable if they cannot find some supplement to formal state support. It is interesting that in these areas collective farms are still the leading agricultural enterprise. Some of them continue to maintain social safety nets, providing mutual support to their members through the period of hardship. Although such enterprises are inefficient from an economic point of view, they continue to play an important social role.

All three South Caucasus republics have similar poverty/vulnerability trends. Poverty levels in Georgia and Armenia have been stable for the past several years at 50-55% (calculated as the percentage of households with incomes below the official subsistence level). This is very high, especially considering that these countries had some of the highest standards of living in Soviet times. In Azerbaijan according to the latest available data dating back to 1995 – poor households amounted to 61.5% of the total. How the situation has changed since then is difficult to determine (there is no data available) but it is not likely to have improved much, except for employees of the leading industries, like oil extraction. Azerbaijan follows similar patterns as its regional neighbours and "the most acute social problem continues to be extremely low level of satisfaction of the minimum material and spiritual needs of absolute majority of population". One more indicator if not of poverty but rather fragility, is the relatively high percentage of total household expenditures spent on food, in excess of 2/3 household budgets on average. Some studies even suggest that 63% of Armenia's entire population for instance is spending their entire income on food (IFRCRCS Delegation in Armenia, Yerevan, 2000). As a whole, the majority of population here is either poor or vulnerable to poverty in the sense that any unforeseen expenditure, like health care expenses (not to mention natural disasters, armed conflicts and like), may push the household over the poverty threshold. The capacity of most local households to cope with such changes is very low.

Pensioners living alone, with children or with a single adult, extended families with children and female-headed households account for the biggest percentage of poor households in the sub-region. The unemployed is another extremely poor and vulnerable group. Financial and other resources available to local social security systems are not nearly enough to improve the conditions of the millions of people who depend on them. Pensions and other social payments are well below 1US$ per day - the absolute poverty level adopted by the World Bank. In Georgia, old age pensions amount to about US 20 cents per day.

Official minimum salaries and actual remuneration also compare very unfavourably with officially adopted minimum subsistence levels, meaning that employment alone is not a safeguard against poverty and vulnerability.[6]

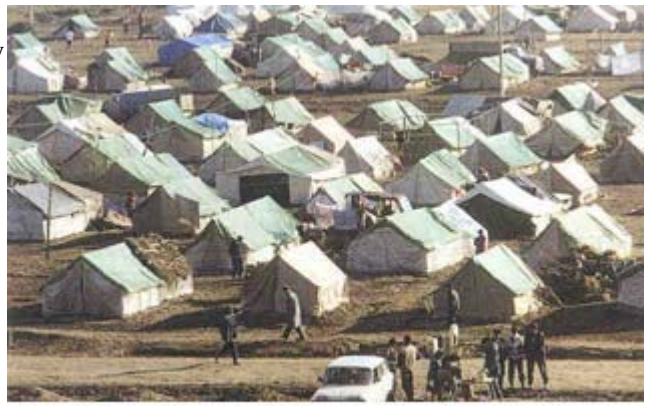
All these vulnerable groups are subject to impoverishment and are supported mainly by informal kinship ties. These ties are obviously the most widespread means of survival for poor families in the country, government support being next to nothing. Support by various international donors and/or by some local NGOs does not play a significant role. Rural households, having direct access to food production, usually cope with hardships better than urban households do.

Internally displaced persons (IDPs) form another group of the poor/vulnerable population. Numerous regional conflicts

have forced thousands to flee their homes. In the South Caucasus there are about 1 million IDPs registered in Azerbaijan, 400,000 in Armenia and 290,000 in Georgia.[7] While the IDPs themselves are very vulnerable, their displacement sharply increases vulnerability of the population in places of resettlement through strain on locally available communal services, material and financial resources, housing, the labour market, etc. It naturally leads to increasing social tensions and poverty. We do not comment specifically on the fact that no government in the region is able to provide decent material and financial support for these people. They receive assistance well below any acknowledged poverty levels and otherwise are primarily left to their own resources.

Despite the evident socio-economic causes for IDPs' vulnerability, the main reason for their current vulnerable status is that they are politically tradable assets and are usually treated as such, although the country approaches vary.[8]

Most IDPs live in refugee camps, converted public buildings, boxcars, shipping containers and other accommodation hardly fit for habitation. These accommodations are usually overcrowded and unsanitary. Depending on where the refugee camps are situated, people are either subjected to adverse environmental conditions, or they mercilessly exploit any natural resources available (especially forests), since this is the only way to earn a livelihood.



Refugee camp in Azerbaijan
Source: HDR Azerbaijan 1999

Many of these people manage to find their way to major urban centres where they remain an isolated, marginalised group, but otherwise no different from any other economic migrants.

What distinguishes them from other vulnerable groups is that their vulnerable status is formally acknowledged by international donor agencies and they receive some kind of "preferential treatment." Being rather isolated they tend to stick together and put forward their demands as a group.

The problems of forced migration may take a very long time to mitigate. First, because many people are clearly interested to use IDPs in pursuit of their private political ends, and secondly, difficult economic conditions do not leave many resources to change their conditions for the better. Extensive international assistance (as everywhere in the world) can only ameliorate their condition to some extent but clearly cannot replace local government efforts.

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1 - It should be ceaselessly emphasized – whatever the difficulties of transition human deprivation here does not goes as far as in majority of vulnerable countries of Africa or Asia where it is associated with famine or mass epidemics claiming huge amounts of human life. And especially there is not noticeable deprivation of population due to overexploitation of environmental resources.

2 - There are also plenty of people making money on these conflicts, but this is not directly related to vulnerability issue. Although one of the main (if not the main) reasons of the South Ossetian conflict preserved in a state of suspended animation is that the uncertain status of the disputed territory provides may be the largest regional smuggling opportunities.

3 - Naturally this number is rather inflated since cannot estimate undeclared monetary incomes, which here should be rather high and does not count income in kind too, but even adjusted it may be very high.

4 - There are seven such units altogether in Russia. Chechnya is of course left out of any database.

5 - Alternatively, may be they have not still encountered the real crisis. What will become to local agriculture after Russian parliament finally permits to sell agriculture lands is hard to predict.

6 - The only exception was Armenia where level of remuneration for employed was usually well above the poverty line. Average monthly salary of employed person exceeded 193% of poverty line. Of 16 branches of economy only in social sectors, such as education, culture and health care it was near the poverty line. Even administrative employees received

salaries in excess of 277% of poverty line – a rare exception in the former USSR.

7 - As to the reliability of this data, for instance almost all IDPs in Georgia are registered as displaced from Abkhazia and almost all are later registered as Georgians. This number clearly exceeds the amount of Georgians registered in Abkhazia in 1989 (234,0000). Obviously this cannot be even if one assumes that they are characterized by very high natural increase and all of them migrated to Georgia (that clearly is not so). On the other hand this is a good indicator of a real socio-economic situation in the country, where a general quality of life has deteriorated to such extent that it is clearly beneficial for many to register as IDPs. At least this way people are entitled to some kind of welfare benefits and rights to accommodation for instance. In Tbilisi, especially, this leads to numerous conflicts, open marauding and illegal trade in floor space.

8 - See "Poverty Reduction Strategy Paper" (Interim Report), Azerbaijan Republic, p.24 (http://www.imf.org/external/NP/prsp/2001/aze/01/index.htm) *Governments of the region are clearly reluctant to undertake efficient measures to integrate this people into local communities in places where they live now. They try hard to preserve their numerous IDPs as a reserve and a driving force for the future resettlement on the territories now outside their control. Armenia may be the only exception since realistically there is no place in Azerbaijan for Armenians in the near future.*

CHAPTER 3. HUMAN VULNERABILITY, POVERTY AND ENVIRONMENT

3.3 Access to Health Care, Environmental Quality and Vulnerability

Human health is affected by a broad spectrum of factors including social, economic, sanitary-hygienic and environmental conditions, life style, access to health care services and the quality of health care systems. According to WHO data, up to 80% of morbidity is due to exposure to different environmental factors of a physical, chemical and biological character **(see appendix for fuller version).**

The Caucasus was traditionally characterised by moderate to serious environmental and hygienic conditions in urban and industrial areas, linked to its underdeveloped sanitation infrastructure, environmental pollution from industries and traffic, and serious sanitary-hygienic and environmental problems in rural areas connected to the intensive use of pesticides and other chemicals and poor sanitation infrastructure or the lack thereof (Ministry of Environment and Nature Resources Protection, Russian Federation, 1994).

High figures of infectious diseases were traditionally reported in some parts of the region. High morbidity due to typhus, dysentery and viral hepatitis was observed in the cities of the North Caucasus. In rural areas, gastrointestinal diseases and poliomyelitis caused morbidity figures of higher than average values. High morbidity due to typhus was observed in cities of Armenia and Azerbaijan as well (Ministry of Environment and Nature Resources Protection, Russian Federation, 1994). Apart from this, there has always been and continues to be a high risk for epizootic outbreaks in the North Caucasus, since the region has natural sources for contagious diseases such as plague, tularaemia, brucellosis. Lack of animal vaccination and poor sanitary-epidemiological conditions only aggravate the situation.

Since 1990, sanitary-hygienic conditions have been worsening in the region. Outbreaks of infectious diseases, especially gastrointestinal ones, have become routine. They have also occurred in areas where they hardly ever occurred before, namely Georgia (State Committee of the Azerbaijan Republic on Nature Protection, 1993; UN-ECE/MNP of Armenia, 2000; WHO/MoH of Georgia, 2001; Ministry of Environment and Nature Resources Protection, Russian Federation, 1996).

This may be traced to sharply reduced abilities of state sanitary-hygienic services to conduct regular inspections of food products and drinking water due to lack of finances and technical equipment. Existing water supply and sewage systems are inadequately maintained and frequently cross-contamination of sewage and drinking water occurs. Water intake facilities are not properly protected and do not meet sanitary and hygienic requirements. In many locations, the lack of chlorine does not allow for proper treatment of drinking water. Over-loaded landfills that do not meet health and environmental requirements, and illegal dumpsites cause the contamination of ground waters, which are the major sources for drinking water in many of parts of the region.

The overall situation is such that the population in general has become vulnerable to infectious diseases. The need to treat foodstuffs and drinking water with utmost caution has become a fact of daily life – an absolutely new situation that has not been necessary for decades. The poor and IDPs living in refugee camps are especially vulnerable. Considering existing economic problems and general mismanagement, the above problems will continue to fester in the short to medium term.

Although it is very difficult to establish links between environmental pollution and morbidity rates, there is some scientific evidence linking high ambient concentrations of different pollutants emitted from stationary and mobile sources to increases in the morbidity rate for specific diseases like respiratory and cardiovascular diseases, specifically, hypertension and heart attacks, skin and endocrine diseases, cancer, and lowered children's IQ. All these have been routinely documented in leading industrial centres of the region.

Recent ambient air quality data for selected major cities of the Caucasus indicate declining or stable trends for most pollutants, due to the fall in industrial activities and hence, industry-related emissions. However, this is offset to some extent by an increase in traffic-related emissions. In the South Caucasus, there is noticeable trend of concentration of population and economic activity in the few largest urban centres. These have led to a dramatic increase in vehicles that are old (10 years or older), poorly maintained and use low quality fuel. Traffic is poorly organised, and congestion is routine. Since traffic is a major source for ambient air pollution in most Caucasus cities, particulates and lead are assumed to be the most serious health concerns. There are a number of studies supporting this thesis, for instance, the study of health effects of short-term exposure to TSP for the city of Yerevan (MNP of Armenia, 2001), studies for the cities of Baku, Sumgayit and Ganja on PM_{10} concentration (State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan, 1998), and studies on lead impact on health for Tbilisi (NORCE & MoE of Georgia, 2000).

During the Soviet era, the morbidity and mortality rates due to neoplasm and birth defects were traditionally high among the rural population of the Caucasus, mainly due to unsustainable use of pesticides. At present, whereas the overall pesticide use has declined here, health concerns related to pesticides still exist. Specifically, many individual farmers are not aware of health and environmental requirements for pesticide use, and pose a high threat to their own and other people's health and environment. Another problem is related to obsolete pesticides and other agro-chemicals that are not properly stored and cause the contamination of ground waters and soil. This poses a high risk to human health through drinking water and food contamination.

The situation in the public health care system has also dramatically changed. While during Soviet times it was never very advanced or efficient, it did provide universal access and was free. The post-Soviet transition crisis has resulted in a marked deterioration of this system, although this process has been uneven. Russia has managed to retain the previously existing model and is even expanding the system. On the other hand, a crisis in the system is obvious, and quality is falling. It has become especially more discriminatory towards the less affluent population since under-the-table payments are almost mandatory. In the South Caucasus, the poor are virtually alienated from the health-care system, in Armenia and Georgia quite perversely because of the WB sponsored reforms.[1] Even for the more affluent families paying for medical treatment can often mean sliding below the poverty line. People routinely postpone visits to doctors or self-medicate, causing additional aggravating factors in the case of contagious and infectious diseases.

More importantly, health-care systems have lost their ability to practice preventative medicine and usually treat people in advanced stages of disease. Poor infrastructure facilities, and the lack of technical and financial resources to conduct the most routine sanitary and hygienic oversight services are too much for the people in the system to cope with. Although qualified professionals in the system still exist, they too lag behind in their knowledge of recent tools and methods used in contemporary toxicology and epidemiology. Environmental and other authorities responsible for data collection also do not have enough resources to regularly monitor ambient environment quality, detect high pollution episodes and take specific measures for human health protection. Existing ambient standards are out of date and need revision. Besides, more often than not authorities simply do not react to easily observable trends and situations with obvious health hazards, while the public in general lacks information, understanding, organisation and effective means to alter the situation.[2]

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1 - Obviously, absence of these reforms would have resulted in the same alienation, but in the popular perception, reforms caused this misfortune. We also do not specifically comment on the quality of health services. High quality is rare and usually accessible only for a very restricted stratum of the population.

2 - For instance, malaria that was virtually non-existent in Georgia for decades started to re-emerge recently. It is mainly mainly imported from Azerbaijan as well as from Asian countries with a high prevalence of this disease. High incidences in the Kakheti region adjacent to Azerbaijan are primarily caused by the cessation of regular chemical processing of few local reservoirs that naturally harbour the malaria vector. This fact is widely known but no mitigating measures are undertaken, even though resumption of processing is rather cheap and well within the abilities of impoverished Georgian health-care budget.

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3.4 Conflicts and their Environmental Impact

During the final years of the USSR, armed conflicts became one of the most important determining factors of environmental quality in some parts of the Caucasus. The type of impact and its level depends on the ongoing status and intensity of the conflict.

Except for in Chechnya, all other military operations in the Caucasus are in a state of suspended animation and have no direct impact on the state of environment. Of those, the South Ossetian and Ossetia-Ingushetia conflicts were of very low intensity and their environmental impact was negligent.

As for the Karabakh and Abkhazian conflicts, military operations were intensive, affecting the environmental quality noticeably; especially forests and vegetation cover. Hundreds of hectares were badly damaged, mostly by fire because of aerial bombardments and artillery shelling. Minefields that were left behind still represent a major hazard to both people and local fauna.

On the other hand, these operations have in a broad and unintended sense led to a certain improvement in the state of the natural environment. Although the scars of war are still visible here, the territories are mainly depopulated. This is well-illustrated in the case of Abkhazia, where 550,000 people lived before the conflict. At present, its population is less than half of this figure, with a number of villages and arable lands abandoned; and life in cities (e.g. Sukhumi) concentrated only in their central parts. Because of the humid subtropical climate, which is favourable to the rapid growth of plants, weeds have begun to take over highways and railroads, wild vegetation is covering large areas and forests are recovering. The total collapse of the economy contributes to the reduction of pollution of the environment, as all industrial enterprises are standing idle.

Indirect impacts are reflected in the disruption of pre-existing, traditional land-use. In mountainous Karabakh and Abkhazia, agricultural lands formerly intended for vineyards and fruit gardens have been turned into pastures and lands for annual crops. This was caused mainly by the damage to and breakdown of irrigation systems. Selective cutting is damaging the forests of Abkhazia, which had not undergone industrial logging for the last 50 years. Valuable species such as chestnut and box-tree are being cut down for firewood and illegal sale.

A similar picture can be seen in Karabakh, and particularly in the territories outside of Karabakh proper. The city of Agdam, which had 40,000 inhabitants before the conflict and was known all over the Soviet Union for its wine industry, is now completely destroyed. Even the foundations of earlier buildings do not exist any more. Once highly fertile, lands along the frontier line in Karabakh are completely abandoned. The only known reserve of plane trees has nearly disappeared. One of the most unpleasant consequences of the landscape transformation here has been a plague of mice in neighbouring areas of Azerbaijan.

Some of these processes cannot be directly ascribed to military operations, but rather to general economic decline, breakdown of law and order in the region and wide spread corruption. Analogous processes observed throughout the Caucasus are described elsewhere in this report.

The ongoing conflict in Chechnya is the most prolonged and intensive, with many modern weapons used. As a result, both the direct and indirect impacts of this conflict on the environment surpass all others in the region. At least one-third of local forests (thousands of hectares) have been seriously impacted as a result. This has been caused not only by shelling and aerial bombardment, but also by mass felling of trees and cutting openings for new communication

pathways. Erosion has intensified, creating "hot spots" in the mountainous areas of Azerbaijan, Chechnya and Dagestan. The roads that appeared due to the movement of heavy equipment have also greatly contributed to the degradation of such areas (IUCN, 2000).

Military actions have also resulted in environmental pollution, namely, the contamination of soils, sub-soil, atmosphere, surface waters, water supply systems and settlements by chemicals. All this had a negative impact on human health (IUCN, 2000).

In Chechnya, which used to have advanced manufacturing and mining industries, military operations have had severe environmental consequences. Bombing destroyed many oil wells, refineries and storage tanks, resulting in oil spills and soil and ground water pollution. Oil ponds having detrimental environmental impacts have been found in some places. According to recent estimates, about 30-40% of the total area of Chechnya is heavily polluted by oil products. In some locations, oil products have seeped two meters into the soil.[1]

An additional local, albeit serious hazard stems from police operations to eliminate illegal, primitive petroleum refineries, often situated in backyards, which abound here. Such "refineries" even in operational condition are extremely dirty and polluting. Elimination means that they are simply blown up, scattering dirty waste across a rather large area. Left in this condition, the refineries leak oil into the soil. During one recent operation, 36 such backyard refineries were destroyed, and operations of this type are rather routine.[2]

Pollution and noise from military operations also have a high impact on local fauna, causing the destruction of habitat and migration routes. Some areas are marked by a reduction in the diversity of fauna (species impoverishment). For instance, in Dagestan in 1999 when armed operations "spilled over" from Chechnya, a significant loss of fauna in broad-leaf forests was observed.

Environmental implications are perceived not only in conflict zones but in bordering areas as well. This is reflected in the migration of animals, particularly large mammals. In recent years animals, particularly predators, have been more frequently migrating from Chechnya to Georgia and into Kabardino-Balkaria (IUCN, 2000). The local population reports that the number of wolves has significantly increased in the areas of Kabardino-Balkaria bordering with Chechnya, and their attacks on cattle have become more frequent (IUCN, 2000).[3] The majority of migrating animals have become victims of poachers.

A particularly high degree of pollution of air and surface waters was observed in neighbouring Dagestan (and was reported in the official "Reports on the State of Environment in the Russian Federation". Prevailing westerly air currents that often carry polluted air from Chechnya cause such high levels of pollution in Dagestan. In addition, all rivers in Chechnya flow toward the Caspian Sea and pass through Dagestan. Hence, explosion of oil refineries and reservoirs resulting in the discharge of oil and other matters into the Terek River has been reflected in deterioration in the ecological state of the northern part of the Caspian Sea (Ministry of Environment and Nature Protection, the Russian Federation, 1996).

In general, there is very limited "hard information on the environmental implications of military activities in the Caucasus region. Whereas some studies, although not comprehensive, have been conducted for some of the conflict areas, there is lack of information on all the conflicts. The studies that do exist are only qualitative assessments and no quantitative studies have been conducted yet. There is a definite need for a detailed assessment of environmental conditions in all conflict areas. In addition, the impacts on neighbouring countries and/or republics should be studied as well.

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1 - Ecological Situation in Chechnya **http://www.domaindom.net.moscow/ecology.html**

2 - http://gazeta.ru*, information as of 12 May, 2002.*

3 - The same was observed during other conflicts as well. For example, in Azerbaijan, from front - mountainous and low mountain landscapes large mammals migrated to the neighbouring areas (IUCN, 2000). During the conflict in former South Ossetia (Georgia), aurochs, deer, brown bear, and wild boar abandoned this area for Chechnya.

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3.5 Coping Capacities

The region as whole is vulnerable to environmental hazards that may occur both as natural phenomena and human-initiated processes. The hazard itself is not as important as the chain of events that triggered by it, which often causes the most suffering.[1]

During the years of transition the local population largely has lost the ability to cope with these "aftershocks" and is much more vulnerable to these hazards than before. The main reason is the drastically reduced coping capacity of both the population and governments due to insufficient financial and material resources at their disposal, dwindling infrastructure, institutional inefficiencies, wide-scale corruption, etc.

There are two distinctive models of coping with environmental hazards and their consequences in the region.

The Russian model is still based on the "paternalistic" approach to hazard mitigation inherited from the Soviet Union. It is based on the idea that the state should play the role of "insurer" for its subjects. It provides whatever protection possible against hazards undertakes emergency care and mitigates consequences. The system worked quite well as long as the country was strong and wealthy, especially in case of large-scale earthquakes like ones that took place in Ashgabad or Tashkent. It did not work as efficiently in the case of the large-scale natural hazards that took place in the South Caucasus in the 80s primarily because the USSR was already quite weakened and disorganised by then.

The Russian Federation still responds to hazards based on this model and is to some extent successful. Learning from the negative experience of the Spitak earthquake, it created the Ministry of Emergency Situations that has achieved wide acclaim as one of the most efficient rapid reaction forces world-wide. Thus, in the event of a real hazard Russians can receive assistance as quickly and efficiently as in any other developed country.[2]

The real problems begin during the stage of "aftershocks," when it comes to evaluation of losses, planning and implementing reconstruction, paying compensation to the population etc. These kinds of activities usually are late and inefficient, if they are implemented at all. Insufficient resources, especially financial, are only part of the problem. Whatever compensation the population may be formally entitled to is usually extremely small—the maximum being a few thousand US dollars – absolutely not enough to cover property losses and especially loss of life. General institutional incapacity and universal corruption, especially on the local level, are the main obstacles to efficient hazard mitigation. There is no information available on how funds are allocated during natural hazards in North Caucasus, but according to numerous reports by various Russian TV stations, money allocated for reconstruction in Chechnya does not reach the target population. Since Russia remains a centralised country, such problems need interference from top-level officials, all the way up to the president, to find efficient solutions.[3]

Another emerging problem is managing the deteriorating infrastructure inherited from the USSR. For example, heavy mudflows in Tirnyauz in 2000, and constant interruption of traffic and loss of lives on Trans-Caucasus highway in North Ossetia due to avalanches. These are recurring events caused primarily by improper management and over-ambitious planning, which sacrificed economic and environmental considerations to political ones. The case of the Trans-Caucasus highway is an especially telling example. It was constructed on the present location mainly to provide a connection between Russia and Georgia, although this route was known to be hazardous from the beginning. How Russian authorities will cope with this situation and other similar ones is difficult to tell, give the country's many other pressing problems. Most likely, it will take an event of truly catastrophic proportions to attract the attention of the central authorities and lead to some efficient mitigating measures.

The South Caucasus model of hazard mitigation is not based on *Paterism d'etat* approach due to the simple reason that the weakened governments of the three republics are unable to perform "parental" functions any more. The shortages of government resources, inefficient management and corruption have lead to situation where the governments if not formally, in effect, have transferred responsibility for hazard mitigation to international relief organisations as well as to the population proper. Although disaster mitigation authorities formally exist, the extent of their actual ability to cope with dangerous situations and operational efficiency are rather doubtful.[4] NGO and public interest group activities at the community level are also close to non-existent.

The coping abilities of the modern Armenian government have been tested during its response to the consequences of the 1988 earthquake and have proved to be unsatisfactory. The regions, where the earthquake took place, are some of the poorest in the country; many people there are not re-settled yet and continue to live in private garages and shacks. Restoration work is carried out almost exclusively by international agencies or funded by the Diaspora. There is an analogous situation in Georgia, where thousands of families moved from Ajara in the 80s were conveniently forgotten by the authorities and continue to live under the most adverse conditions, even in places like cowsheds.

Thus, the population here is left with little or no efficient assistance from governments and very little if any information about potential hazards.[5] Poor households are naturally the most vulnerable since virtually everything they possess is concentrated inside their homes. If something happens to a home in an earthquake, flood or mudflow, almost all family possessions are lost. Poor families can do little or nothing to avoid dangers, by moving, or making their homes safer; they are also the most helpless in dealing with government agencies and local administrations. In the absence of any government disaster insurance, there is no other form of insurance available to them. The emerging system of private insurance is naturally unattainable to poor and vulnerable people, but even the most affluent are still reluctant to insure their property. Credits when they are available are based on unrealistically high interest rates and most people have nothing to put up as collateral.

Thus, the population of the South Caucasus republics is more vulnerable to environmental hazards than it was before. People are usually left dependent on resources available to them, their families or kin; very little if any assistance comes from outside.

The most telling example of this is the series of earthquakes that shook Tbilisi in April 2002. The most damaging earthquake on April 25th was estimated at an intensity 6-7 by the MSK scale adopted in the USSR. Quite fortunately, the loss of human life was minimal—only seven people were killed in a city of approximately 1.5 million inhabitants. However, the material damage was excessive. The most preliminary damage estimate was more than US$150 million; thousands of houses were damaged, many of them beyond repair.[6] By the most optimistic calculation, at least 1,700 families need relocation. Whole neighbourhoods in Tbilisi were isolated, with many buildings on the brink of collapse.

The very first conclusion drawn from this disaster was that it damaged the poorest, old districts of the city where inhabitants were already the most vulnerable and had the least capacity to cope with its consequences.

It was obvious that the authorities had no contingency plan and were not ready to deal with emergencies like this. They acted spontaneously to provide help for victims during the very first, most difficult hours after the major tremor. Receiving hospitals had no emergency power supply and had to rely on portable electric generators (and fuel) provided by victims' relatives; local TV channels were collecting information about hot-spots and passing it to authorities, etc. Representatives from the Emergency Situations Department of the Ministry of Internal Affairs, which was created under an ambitious UNDP program and is formally charged with being the first to help and rescue, were simply nowhere to be seen.

All other activities undertaken since to mitigate consequences of the earthquake appear to be improvisation rather than some coherent plan. For instance, in a huge city like Tbilisi shelter could not be found for a few hundred homeless families and many of them were still living in tents by mid-May. Government stated that it would purchase flats for families whose houses were the most damaged and provide some monetary assistance. A detailed inventory and evaluation of damage was underway in May 2002, but there were obviously no funds available for reconstruction and no definite promises as to the exact time when it might take place. The prevailing mood of local authorities was such that President

- Hazards and disasters are often almost artificially created by shortsighted activities of population, untimely and ill-planned reforms, omnipresent corruption, absence of the rule of law, etc. There are the numerous instances of this.

- Local authorities in Baku, a city that is well known for its very active landslides, are routinely issuing building permits for sites where safe construction is impossible. As a result high-rise residential buildings are being built on active landslide zones. Structures are constantly replacing each other during relatively short period of time as soon as they are damaged and demolished.

- In Yerevan local authorities did not spare efforts to preserve the centralized heating systems at least in relatively new parts of the city, but now the population has to bear the high cost of heating. Quite naturally as soon as these costs are not met the heat supply is suspended and people are turning to local parks or trees in their yards to get themselves some firewood. There are no protests and no law enforcement is used

Shevardnadze during one of Cabinet meetings said that they preferred to "conveniently forget" the whole accident.

The only people who actually provided some real assistance to earthquake victims were local businessmen turned politicians who by mid-May 2002 managed to collect just over US$700,000. They donated about US$ 4,000 to each of the 38 poorest families among the victims and promised to extend this assistance to two more groups of roughly the same size.[7] This may cover less than 10% of all the most affected families.

The vast majority of earthquake victims seemed to be left to their own resources for an indefinite time. Even more, this earthquake coincided with the beginning of local electoral campaign, one of the toughest in the modern Georgian history. This event promptly pushed the earthquake away from the attention of the local mass media and the population as a whole.

The main lessons learned:

- Local authorities were informed about the possible earthquake hazard, its probability, possible outcomes and the scope of potential damage many years before. The ministry of Urbanisation of Georgia evaluated residential buildings in Tbilisi for their potential damage in a magnitude 7 earthquake back in the 90s, and provided their exact location in the city.[8] It was estimated then that 3,500 residential buildings were at a high risk of destruction and the cost of safeguarding them against possible earthquakes was set at about US$ 35 million.[9] Still they did not and/or could not undertake any proactive planning and preventive measures.

- The roots of this disaster can be seen in managerial practices adopted by then Soviet authorities some 25-30 years ago, when it seemed cheaper and easier to build new housing in the outskirts of the city, rather then to reconstruct the old, over-crowded historical centre. In addition, sewage water leaking for decades has damaged foundations there. This was also caused by general mismanagement and the most primitive misappropriation of funds. Districts under consideration were doomed many years ago. The earthquake simply accelerated the inevitable.
- People living here fell victims of ill-planned privatisation of state housing some 10-12 years ago. They were virtually tricked into the ownership of strongly depreciated, potentially hazardous assets. No one at the time explained them that as new owners they were ultimately responsible for maintenance and reconstruction and the state was not obliged to render them assistance any more. It took this major catastrophe to make them at least understand these realities if not to come to terms with them.

Local developers emerged as net winners from this catastrophe. Now they will be able to build within the prestigious historical centre, which previously was off limits for new development, obtaining land at lower prices. It seems as if these are the people who will ultimately "solve" the problem of resettling earthquake victims by moving them to low quality, cheap housing at the city margins.

The main conclusion is that the Caucasus as a region (and the South Caucasus in particular) is still in a transition stage when authorities are loosing or have already lost their ability to efficiently manage disasters, carry out strategic planning and undertake preventive or mitigating activities. Emergence of new systems and policies may take a long time, considering the ongoing systemic crisis.

The population has basically lost its accumulated knowledge of dealing with nature, and is too weakened by current hardships to be able to cope efficiently with them. Absence of civil society and weakness of basic democratic institutions also keeps it uninformed or misinformed as to the type and scope of potential hazards, precluding it from organising to lobby its interests or take independent mitigating actions.

protests and its law enforcement is used against such offenders.

- In the mountainous Dusheti district in Eastern Georgia forests perform an important water protection role. They have been overexploited during recent years by mainly illegal commercial logging by the local population. As a result numerous villages that depend on springs for water supply were left without water at all and their inhabitants are facing migration. Local authorities are well aware of this but are unable to mitigate the situation.

One of the emerging hazards is manifested in loss by local farmers of collective knowledge of individual, private agriculture accumulated during centuries. This is especially noticeable in areas of previously large scale, industrial agriculture. Since centralized, state supported agronomy consulting services have disappeared and have not been replaced by something viable, farmers are mainly left to their own resources. People are simply turning to each other for assistance in the easiest procedures for the lack of more viable alternatives. This routinely results in mistreatment of land.

These aspects of vulnerability are unlikely to be ameliorated in the short to medium run. Only isolated cases of well-planned intervention by national governments, bilateral donors, NGOs and concerned citizens groups may produce positive results.

Emerging hot-spots

The territory at the junction of three South Caucasus republics is one of the most important agricultural areas of the region, providing livelihood for hundreds of thousands of local families. Its well-being is primarily dependent on an extensive irrigation system that uses the Kura River and its tributaries. During the late Soviet years and afterwards this system fell victim to mismanagement and neglect.

Deterioration is the most advanced in Georgia, where during spontaneous land privatisation and distribution of property previously belonging to collective farms in the early 90s the irrigation infrastructure stripped of everything of value by the local population. Now this part of the irrigation system is hardly operative and it has no legal ownership. The WB is currently investing relatively small sums into repair and reconstruction of the system, but the actual need is measured in hundreds of millions of US$. The WB has recommended passing local irrigation systems into hands of farmers associations, which many fear will mean monopoly by the few richest landowners. Meanwhile local agriculture is in a deep crisis-- the amount of land under cultivation is constantly dropping, crops are failing, farmers are going bankrupt etc. This part of Georgia has become the source of intensive out-migration. The main reason for this as cited by local and international experts is lack of water.

Armenia and Azerbaijan are following a similar pattern, also with adverse effects on the natural environment. Agricultural lands both abandoned and exploited without sufficient water supply are subject to desertification and salinization. Merciless felling of riparian forests observed throughout the area also leads to bogging, disruption of rivers and activation of local geological processes.

The situation is further aggravated by a noticeable reduction of amount of water supplied by the Kura and other rivers due to purely natural causes. It has already led to some discussions between Georgia and Azerbaijan about water distribution priorities. Dealing with this situation calls primarily for joint efforts by all three republics of South Caucasus, developing a comprehensive action plan, financing it and organizing efficient, transparent control over its implementation. Considering the most recent history of interaction among these countries as well as their visible inability to carry out large-scale programs, the prospects for mitigating this situation before it turns into a full-scale humanitarian and environmental crisis are rather dim.

Another environmental hot-spot may be emerging in Western Georgia where tens of thousands of hectares of tea plantations were abandoned in recent years. They have not been re-stored so far, (which in any case is difficult and expensive) and are infested by imported exotic invasive species. If these “spill out” into indigenous landscapes, the consequences for the whole sub-region (population included) may be catastrophic. There are no indications that authorities are even aware of this danger to say nothing of the need for planning and undertaking some mitigating measures.

The North Caucasus will definitely face an environmental crisis of catastrophic proportion as soon as the Chechen conflict is over. Even the most fragmentary information available to us suggests that mitigating negative environmental impacts of war may be at least as costly as all other post-war reconstruction activities.

Another hot-spot may emerge in Krasnodar and Stavropol krays after the sale of agricultural land is finally legalised. This will definitely lead to the break up of the existing agricultural management system, which is still based on Soviet-type collective farms. Based on the experience of previous Russian reforms this process may be rather unruly. Most likely, it will develop along the lines of analogous reforms in Georgia, with the appropriate negative environmental implications.

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1 - These hazards are considered in different part of this report and are not subject of analysis here.

2 - Kabardino-Balkaria has recently went one step farther and united under one roof all emergency services including rescue, fire, first medical aid, community infrastructure accidents, etc. (Russian TV, First Channel, May 16, 2002)

3 - For instance, President Putin's personal control led to the prompt and efficient rebuilding of a whole city destroyed by flood in Siberia last year. However, such events are the exception and are hardly applicable to all hazard mitigation.

4 - During the Baku earthquake in 2000, these bodies were not up to their requested performance, but due to regrettable habit of circumventing any negative information regarding Azerbaijan the true situation is hard to evaluate.

5 - The reasons behind absence of information are primarily based on assumption is that it may create panic; that it will increase the current high level of apathy and fatalism; or that the information is not useful to people who do not have the means to mitigate their situation. Vulnerability Profile Update: The Social Dimension of the Causes of Disaster Vulnerability. A literature review. IFRCRCS, Delegation in Armenia. Yerevan May, 2000.

6 - Much of this damage was pre-existing since old parts of the city were virtually falling apart already decades ago.

7 - The very first reaction to this assistance by local officials was that these people received phone calls from city hall informing them that due to receiving assistance from private sources they were not eligible to official government support support any more.

8 - This information was provided for Georgia: Vulnerability and Capacity Assessment by IFRCRCS back in 1999 but for for reasons unknown did not find its way into the final draft available to us.

9 - I.e. about four times less than mitigating consequences of this earthquake will cost now. Actual type and spatial distribution of damage during April earthquakes exactly coincided with what was predicted by the Ministry. Its scope was was smaller mainly thanks to the fact that the earthquake was less intensive than envisaged.

CHAPTER 5. CONCLUSIONS, RECOMMENDATIONS AND SYNOPSIS

5.1 Conclusions

The general trend of impacts on the Caucasus environment is of the nature of regular increases, starting from the 1970s and lasting until the 1990s. After that, a sharp decline and then, more recently again, minor increases were observed. Consequently, the intensity of impacts on the environment in 2000-2001 was very close to the levels of 1970s, and in some cases even less.

In different parts of the Caucasus, this trend of decreasing environmental impacts appears in different ways and to a varying extent. Generally, it is less distinct in the North Caucasus. Within the South Caucasus states, decreasing environmental impacts are most clearly seen in Georgia and then Armenia and Azerbaijan. As for the North Caucasus, a decrease of environmental impacts is less noticeable in Krasnodar and Stavropol krays than in the various autonomies.

The major sources of impacts on environment are also changing. Whereas in the 1970s and 1980s, stationary and mobile sources were the major sources of atmospheric air pollution, at the end of the 1990s, the share of mobile pollutant sources (auto transport) increased dramatically and became predominant.

The same is happening in terms of water pollution. In contrast to the 1970s and 1980s, the share of industrial and agricultural pollution has decreased, and the role of municipal sources of pollution has increased.

Soil contamination used to be very high in Soviet times because of the intensive use of mineral fertilisers and pesticides. However, because of the decline in agricultural production and concentration on local markets only, soil contamination by pesticides and other chemicals was greatly reduced in the 1990s.

Armed conflicts contributed significantly to the pollution of the Caucasus environment in the 1990s. Apart from direct impacts on the environment, these conflicts caused a great number of fires with consequent pollution of the atmosphere, oil spills resulting from attacks on oil storage tanks, and many other direct or indirect consequences. The harmful effects of these incidents could be seen not only in conflict zones themselves, but in neighbouring districts as well. The impact of air pollution during the Chechen War was observed in neighbouring Dagestan, for instance.

Refugee camps became new “hot-spots”, contributing to environmental pollution in the region. This was especially the case in Azerbaijan and Ingushetia, where hundreds of refugees live in unsanitary conditions, and there are few if any treatment facilities to handle related waste products.

New tendencies of pollution caused by municipal services are observed in the Caucasus recently. While during Soviet times, cities were well-equipped with central heating systems, such services currently does not operate in Armenia or Georgia and are compensated for by use of firewood, gas or kerosene stoves. Municipal services in the region generally are in a very poor condition, and sewage, water pipes and electric supply are often out of order, factors that can eventually have catastrophic effects on environmental conditions there.

Thus, the observed trend of changing impacts on the environment is closely related to the intensity of industrial and agricultural production and transportation. However, the decrease in economic activities is not always accompanied by similar decreases in environmental impacts. In the Caucasus, despite declining production capacities, additional negative impacts on the environment are still taking place, due to obsolescence or complete absence of pollution control equipment.

Biological Diversity. In general, during the last 30 years, there has been little or no significant change in the biological diversity of the Caucasus. Major losses among animal life and rare floristic species took place in the 19th and first half of the 20th centuries. Currently, one sees only quantitative changes resulting from a reduction in specific rare species, mainly due to poaching. The quantity of some single populations of rare and some herbal species is also being reduced, caused either by illegal or extremely extensive harvesting.

The area of protected territories has increased over the last 30 years, from 898,000 to 13,033,000 ha (from 2% to 3% of the Caucasus’ total land area), and the total number from 37 to 43 over the last 15 years, for instance. However, many protected areas exist on paper only, or intensive cattle pasturing or poaching are occurring there.

The structure of protected areas during the last decade has changed. While in the Soviet Union, there were only two types of protected areas (nature reserves and managed nature reserves or "zakazniks"), the current number of categories has increased. The Georgian protected areas' network, for instance, now includes six categories: national park, nature reserve, managed nature reserve, nature monument, protected landscape and area of multi-purpose use.

Forests and Related Problems. Officially, the total land area designated as forestland has increased in some of the parts of the Caucasus. This is caused by the fact that in Soviet times, part of the forests were owned by the State Forests Fund (“Goslesfond”), and in the post-Soviet era because local authorities could not manage them properly, some collective farm (“kolkhoz”) forests have also been moved to this same category.

Because of de-population of some mountain regions (for example, Racha in Georgia), an intensive shift of formerly agricultural lands to forested areas is observed. Commercial logging has declined, the quality of roads has got worse, machinery has deteriorated etc. All these factors have led to a reduction in pressures on forest ecosystems. Change in climatic conditions may also be leading to a complex if poorly understood series of … background impacts on growth of forested areas.

However, forest “quality” has changed in a negative sense. Highly productive trees have been replaced by less productive species, rare species are being cut more extensively and highly productive trees are diminishing in number.

An extreme increase in illegal forest cutting, especially in those districts of Georgia (Adigeni, Borjomi, Adjaria and Samegrelo) where illegal timber export to Turkey is taking place, is also observed.

Population. During the last 30 years, the Caucasus population has been steadily growing. However, population growth has different trends in different parts of the Caucasus. Growth was more extensive in regions with predominantly Muslim

traditions (Azerbaijan and the majority of autonomies in the North Caucasus).

In the first 20 years (1970-90), population growth was regulated mainly by the dynamics of birth and death rates. In the last decade, migration processes and refugee flows from conflict zones played a more important role in population changes.

The ethnic distribution in the Caucasian states has rapidly changed, becoming in general more mono-ethnic. One reason for this may be migration and refugee flows, due partially to flight from conflict zones.

The percentage of urban population has not increased very rapidly (only by 4%). In addition, the amount of land covered by urban areas remains low. Cities do not influence the environment very much, and thus the threat of urbanisation is not a priority environmental issue for the Caucasus.

Disasters. It appears mostly coincidental that the most intensive natural disasters that occurred during the last 30 years in the Caucasus happened during the years (1987-91) when maximum anthropogenic environmental impacts were also observed. While direct "geographical determinism" does not offer real explanations for these processes, it is clear that over-population of some areas (in Ajara, Georgia for instance) provoked activation of landslides, eventually causing major economic damage to the region.

Significant damage of the 1987 avalanche in Svaneti, Georgia is a result of "disregard" to historic experiences. The avalanche destroyed only new buildings, whereas most old towers and fortifications survived.

The "Unforeseeable". There were many factors and occurrences which could not have been foreseen 30 years ago, including:

a. The collapse of the FSU and the related general decline of economic production.
b. The formation of a new sovereign countries (Armenia, Azerbaijan, Georgia) and their independent existence.
c. The formation of "not officially recognised" but de-facto territorial units (Abkhazia, Chechnya, Karabakh, South Ossetia) with local governance, as well as the strong local power of autonomous republics and regions ("oblasts").
d. The high level of ethnic conflicts (although some "ethnic competition" was already apparent), and environmental problems associated with them.
e. The change in the development structure of the Caucasus: the failure of recreation and tourism infrastructures, the change in the more traditional orientation of agriculture, the sharp decline of industrial production; and linked to this, the intensity and range of impacts on the environment.
f. The collapse of city infrastructure and deterioration of communal services. A kind of blurring or "functional deterioration" among the urban population (although officially they still live in cities, their main incomes are generated from primitive agriculture in suburban land parcels). Instead of central heating systems, many urban as well as all rural dwellers use firewood or kerosene stoves.
g. The possibility of Azerbaijan and Georgia becoming a transport pathway (corridor) between Europe and Central Asia, and the whole Caucasus transition from being a semi-closed zone to a transit region with a rapid increase of trade turnover with Iran and Turkey.
h. The rapid decline of impacts on the environment, reduced pollution and the loss of interest in many environmental problems that were critical for society in the 1970s and 1980s.

Factors Now Drawing Attention to the Caucasus Region

a. **Pipelines.** Increased interest in the Caucasus is caused by recently discovered oil- and gas-fields in the Eastern Caucasus and Central Asia, and the challenge of transporting these products to markets. Two alternative projects, the northerly (through the North Caucasus in the Russian Federation) and southerly directions (through Azerbaijan and Georgia), are already being designed. One southerly route (Baku Supsa oil pipeline) is already functioning. Currently, the project design for the southerly route's major pipe system from Baku to Ceyhan (Turkey) that will pass Azerbaijan, Georgia and Turkey is ongoing.
b. **Transport Corridor Europe-Caucasus-Asia (TRACECA).** This is a new function of the South Caucasus, a transportation corridor linking Europe to Central Asia through Georgia and Azerbaijan. This transportation system to a certain extent is already functioning. It transports oil from Baku to Batumi by railroad and transit cargo by highways Poti (Batumi) to Tbilisi (Yerevan) from Turkey and Iran. It is planned to develop these routes further in the future. However, it is expected that the transit function will significantly affect environmental

quality in the South Caucasus along the path of the transportation corridor route. Therefore, it is necessary to take all possible measures to avoid potential environmental impacts.

c. **Regional tourism**can also attract interest in the Caucasus, although it is not expected that the level of the 1980s could be achieved, when millions of Soviet citizens were spending their vacations in the Caucasus. High tourist flows were not only due to the climate and recreational potential, but also to the "Iron Curtain's" strongly restricting tourism outside of the Soviet Union. There are also possibilities to develop the Black Sea resorts of the North Caucasus (between Anapa and Sochi), Georgia (Kobuleti-Batumi) and possibly (if the situation stabilises) the Abkhazian part of Georgia (Gagra-Pitsunda-Sukhumi). The Caspian Sea will probably take on a local function for recreational purposes. There are also good possibilities for developing winter resorts, as well as mountain climbing and hiking (alpinism). Nevertheless, because of state barriers (boundaries), as well as conflict zones and insufficient security, these would for the time being, at least, have some limitations. Eco-tourism and recreation in rural areas would also seem to have a good chance of being developed.
d. **Agriculture** will hardly achieve the level of Soviet times, and probably only continue to have regional significance. Kuban and Stavropol in the North Caucasus would still play a critical role for the Russian Federation's agriculture. Intensity of agricultural processes in the South Caucasus will depend on the demands of local markets. However, some products (Kakhetian wine of Georgia, for instance) could also gain a regional market. Because of the very high competition in the international market, the sub-tropical agriculture of the Caucasus, once very advanced, has little chance to survive even at the regional level, and is likely to turn towards production for local use only.
e. Because of low economic potential, **industrial production** would only be suitable for local and occasionally regional markets.

The Caucasus Perspectives from Other Viewpoints

a. This is a relatively unaffected "island" in terms of the natural world and at the same time very distinct due to its high biological diversity for the temperate and sub-tropical climate zones.
b. The Caucasus is also very distinct in having one of the highest levels of landscape diversity. Nearly 40% of all world landscape types are represented here, and thus the Caucasus is truly one of the "world's landscape laboratories".
c. Much of the Caucasus is thinly populated and thus nature is relatively well-preserved. Nowhere else in the Europe can one observe as many diverse virgin landscapes as in the Caucasus.
d. Many Caucasus regions still have a very low level of environmental pollution. This significant asset can be used for recreational and touristic purposes.
e. The Caucasus is very rich in its cultural heritage and ethnic diversity, a factor that can attract attention of many people from different parts of the world.
f. Overall, probably the most exceptional feature of the Caucasus is its high conservation level, extended network of protected areas and preservation of relatively untouched natural resources and a clean environment.

CHAPTER 5. CONCLUSIONS, RECOMMENDATIONS AND SYNOPSIS

5.2 Recommendations

Having analysed the trends of changes in the Caucasus environment over the last 30 years, assessed the present state of the Caucasus states and territories, and considered the basic tendencies of the development of the Caucasus from the point of view of near-future potential, it is now useful to provide some recommendations for measures to be put in place and activities to be carried out. These recommendations would allow for the mitigation of negative trends observed, and reducing the threat of environmental degradation in the Caucasus.

The recommendations for the activities and measures are divided into two groups. The first group, including general recommendations developed by UNEP in connection with the project GEO-2000, should be interpreted in the light of specific conditions of the Caucasian region. The other group will include the most urgent (present-day) recommendations that should be put into practice in the near future, and for most of which financing is required as rapidly as possible.

5.2.1 General Recommendations

In accordance with the GEO-2000 Report, UNEP's recommendations are to focus on four key directions in the future, consequently to:

- Eliminate gaps in knowledge;
- Address the root causes;
- Apply an integrated approach;
- Mobilise efforts.

There are linkages among these directions, such that success in one will influence the rest and, on the contrary, an unsuccessful solution to one of these proposals would lead to negative effects in the other fields of activity. It is useful to examine how these directions are interpreted in the context of the Caucasian region.

Elimination of Gaps in Knowledge. Along with the recommended measures proposed in GEO-2000 (definition of the set of indices for the determination of the state of environment, selection and collection of global assessments on sustainable development, improvement of monitoring and data standards and others), the following issues are also very current for the Caucasus:

- Elaboration of concerted (co-ordinated, agreed) methodology of monitoring of the state of environment and creation of a common network of ambient monitoring in the countries of the Caucasus region. Establishment of monitoring systems should also include the development of quality assurance and quality control systems, which will guarantee data reliability and validity.
- Elucidation of the issues on how the state of the environment of one region affects the state of another, for example, defining the directions of prevailing winds and their role in the pollution of the environment of neighbouring regions, defining the effects of trans-boundary rivers on the state of environment, study of the new transport corridors and how they contribute to pollution of the environment.
- How global processes affect the state of environment of the Caucasus, and the assessment of the role of the Caucasus in the global environmental processes.
- Study of the negative experience of environmental pollution in the former Soviet Union, with the purpose of preventing similar mistakes in future.

Addressing the Root Causes. In the GEO-2000 report, a number of generally recommended activities of a global nature are proposed: limiting population size, changing consumption patterns, increasing the efficiency of resource use and carrying out structural transformations in economies. As this study showed, currently in the Caucasus, these original (primary) reasons for environmental degradation and pollution are being transformed in a specific way. This is connected with the fact that the processes of environmental change in the Caucasus very often differ from global trends. For example, in a number of areas of the Caucasus, the population is decreasing and the problems of de-population come to the foreground, contrary to over-population. Due to the economic decline, environmental pollution has significantly declined. But at the same time, impoverishment of the population has increased and new negative forms of environmental impacts are emerging. This could very well be illustrated by the illegal woodcutting that has caused significant degradation of forests in a number of areas of the Caucasus. The absence of finances for restructuring of enterprises led to the shut-down of a number of mining enterprises (e.g. output of coal in Tkibuli, manganese in Chiatura, etc.), which resulted in large-scale unemployment in these districts and sharply aggravated the social situation, not only in these locations but also in neighbouring cities, particularly in the capitals (high crime rate, problems connected with unemployment). It was not only armed conflicts that negatively affected the Caucasus, but the consequences of these conflicts which were no less serious. It should be recalled that at present, various types of migrants (refugees, internally displaced people) constitute 12% of the population of the Caucasus.

Application of an Integrated Approach. The application of an integrated approach is particularly important for such a complex and diverse region as the Caucasus. Actually, any reasonable measures aimed at protecting the environment applied in the past were based on an integrated approach. Scientific schools of the former Soviet Union were characterised by a high degree of complexity in research and studies. Thus, achievements of landscape studies in physical geography were both remarkable and highly successful. In ecology, this led to the development of bio-geocineology and economic geography, and teaching on "territorial-industrial complexes". Certainly, over the last ten years, a significant decline in scientific research has taken place. However, there still exists sufficient human resources capable of applying such an integrated approach for environmental protection activities, on the basis of the past rich experience, combined with the latest developments in Western countries.

Mobilisation of Efforts. Mobilisation of efforts assumes the involvement of all stakeholders (individual citizens, communities and NGOs, the private sector, national authorities and others) in the elaboration and implementation of measures for environmental protection. Environmental awareness is one of the most important issues for the Caucasus. Hence, it is particularly important to assure access to information on environmental protection and encourage the mass media to pay attention to environmental protection to the same or greater extent as is devoted to issues such as crime, politics, sports and finance.

In addition to the above recommendations, three additional ones of a general nature, addressing the major needs of all Caucasus countries can be drawn, based on this study of the region's environmental outlook:

- **Institutional strengthening** in the field of environmental management**,** including staff training, development of modern communication and information systems and decision-making support tools;
- **Capacity building** for implementing international treaties and conventions;
- **Regional co-operation** towards harmonisation of legal/institutional settings, as well as managing shared resources and natural and human-related disasters.

CHAPTER 5. CONCLUSIONS, RECOMMENDATIONS AND SYNOPSIS

5.2 Recommendations

5.2.2 Specific Recommendations

Along with general recommendations, there are as well a number of specific ones that should be considered due to their importance, and which require prompt responses. These recommendations may be seen as proposals for specific projects directed at improving the study of the state and trends of the Caucasus environment. Implementation of these recommendations would, without any doubt, greatly contribute to the improvement of environmental protection activities for the Caucasus as a whole.

1. **Creation of a common GIS and information retrieval system for the Caucasus**. Presently, GIS development is being carried out in all Caucasus states. However, the countries are applying different methodologies and in varying degrees of detail. Therefore, the elaboration of a common GIS protocols seems particularly urgent, and would assist in providing continuous monitoring of the state of the Caucasus environment. The creation of a common GIS for the entire Caucasus region is therefore highly recommended.
2. **Study of the effects of armed conflicts and natural disasters on the Caucasus environment.** Both are very important driving forces for the Caucasus environment. On the one hand, it is necessary to study their direct impacts (effects of bombardments, forest fires, landslides, avalanches, etc), and on the other hand, their indirect effects (consequences related to refugee flows and internally displaced persons).
3. **Study of new "hot-spots" and creation of a current environmental atlas of the Caucasus.** New "hot-spots" have appeared in the Caucasus caused by local concentrations of environmental pollution in these areas. These "hot-spots" should be identified and mapped, and environmental maps or even an environmental atlas should be produced showing the present state of the Caucasus environment.
4. **Carrying capacity of landscapes.** One current complex and interesting issue is the carrying capacity of landscapes; i.e., what is the maximum population, and what intensity of economic activities, can the natural environment of a given region endure. It is well-known that the dramatic consequences of the heavy precipitation in Ajara in 1989 were connected not only with natural processes, but also with the over-population in the mountainous areas there.
5. **Elaboration of a common network of protected areas.** The difference should be drawn between the notion of a network or set of protected areas and a more complex and nested system of protected areas comprised of different hierarchical categories. In this respect, the existing categorisation in a number of Caucasian states (preserve – national park – order or "zakaznik") is no longer up-to-date. New designations such as "protected landscape", "natural monument", "multi-purpose use area" (and other units if possible) should be brought into a single unified system, which would create a common, inter-related infrastructure of Caucasus protected areas. This connection should in particular also be carried out with the help of ecological corridors, thus enabling fauna (and flora) to

move freely between and within the various protected areas of the Caucasus.

6. **Conducting an inventory and assessment of the Caucasus landscape and biological diversity, and developing a Caucasus "Red Book"**, including unique landscapes and flora and fauna requiring conservation and protection:

- Designing, mapping and developing a database on pristine and relatively unchanged landscapes of the Caucasus. Thus far, few if any data are available on pristine landscape areas. It is necessary to define and carry out an inventory of these areas, and assess the potential dangers of their loss and degradation.
- Studying biological and landscape diversity within the protected area's network. The inventory and assessment of individual flora and fauna species, as well as ecosystems and landscapes, should be performed within the defined protected areas. Databases and GIS for protected areas also ought to be established.
- Performing a detailed landscape and environmental assessment of areas where intense forest cutting is expected. The World Bank Forestry Development Project is expected to result in increased harvesting. It is important to ensure that these activities do not lead to serious or even minor landscape degradation. Therefore, proposed harvesting areas should be inspected in terms of potential environmental consequences. Areas with fragile or unstable landscapes should be excluded from active forest exploitation.

7. **Deserted areas, de-population, demographic decline ~ self-recovery of ecosystems and natural landscapes.** Contrary to the global trend of population growth, in a number of areas of the Caucasus, de-population has become the dominant phenomenon over the last ten years. This is accompanied by specific processes of "abandonment" of these areas. Such processes are clearly seen in Racha, e.g., where the population (compared to the beginning of the 20th century) has declined by a factor of six, and many areas previously covered with vineyards and orchards are at present covered with thick pine forests or brushwood. Similar processes are observed in Abkhazia and Karabakh, where armed conflicts and consequent streams of refugees have resulted in vast abandoned areas.
8. **Conducting an inventory of historical and natural heritage**, since the Caucasus has a very rich historical and natural heritage, which are closely inter-related.
9. **Raising public awareness about and participation** in environmental matters, and improving the current level of enforcement of environmental legislation, should also be Caucasus regional priorities. This could be done, *inter alia*, through the greater involvement of existing civil society institutions such as the Regional Environmental Centres (REC) for the Caucasus and Russian Federation.
10. **Poverty in the Caucasus and its linkages to environmental problems.** During the Soviet era, the Caucasus was one of the best-developed and flourishing regions of the Soviet Union. Since 1990, the situation has significantly changed, with over half of the population currently living below the poverty line. It would thus be interesting to study how poverty influences the use of natural resources and impacts on the state of the environment.
11. **Study of how finances already invested contribute to improving the Caucasus state of environment,** since significant funds have already been invested in environmental activities. For example, over the last ten years a considerable amount of money (over US $10 million) has been invested for the creation of Borjomi-Kharagauli and Kolkheti National Parks and their adjacent territories. It would be most interesting to study how these investments have improved the state of the environment there, what the effects have been and how these have occurred.
12. **Transition from regional to local level.** A deepening of the GEO process could involve a transition from the global to a sub-regional level. This first CEO report was conducted at a regional level. However, more detailed research, including a transition from the regional to a local level (i.e., individual administrative districts and even communities (selsovets) may hold additional interest for better understanding the underlying driving forces of environmental change. This level of analysis in turn would offer the basis for an interesting local-to-regional synthesis, and help to clarify the impact of local peculiarities on the development of regional and global processes and trends.
13. **Impact of TRACECA, pipelines and new industrial infrastructures on the environment.** The Caucasus during the Soviet era was an isolated region, totally cut-off from neighbouring countries and having no transport communications. At present, the situation has fundamentally changed, with the Caucasus as a transport corridor attracting growing interest. The study of the impact of this corridor on the environment, as well as of new industrial infrastructures, would be of great interest.
14. **Finally, assuring the sustainability of the CEO process** by establishing a regional centre, or strengthening an existing one, for this purpose. Such a centre could take on the role of supervising/implementing the ongoing CEO reporting process, and/or the responsibility for seeing recommendations suggested in the CEO are moving forward and being implemented in the Caucasus region.

CHAPTER 5. CONCLUSIONS, RECOMMENDATIONS AND SYNOPSIS

5.3 Final Synopsis

This first Caucasus Environment Outlook report has demonstrated that the region faces significant environmental challenges in relation to future economic and human development. Political processes in the new states of the Caucasus also remain frail due to a broad number of factors. But the focus of the current Report is the regional environmental situation, for which the economy and human society are seen from the perspective of "background" or "underlying factors". These nevertheless help to determine both the current environmental state of, and future environmental trends in, the Caucasus.

It has been clearly shown that the Caucasus region as a whole has a unique environmental endowment, recognised since ancient times, and which merits an array of efforts to defend and preserve it from the harsher impacts of economic development and human society. The panoply of cultural and ethnic diversity, natural landscapes (or ecosystems) and relatively elevated levels of biodiversity found in the Caucasus are all major reasons for keeping a close eye on potential environmental impacts of current and future development processes in the region, and taking measures to see these are minimised. The eventual global impacts of Caucasus regional environmental changes should also be kept in mind.

In many ways, the current environmental situation of the Caucasus is both rather advantageous, and anomalous, vis-a-vis other regions of the world. Due to low (and in some cases declining) population levels outside of the few major cities and towns, human pressures on the landscape are generally low. Where they are present, they are typically exerted locally, and because of the generally poor economic situation, are often related to human poverty and the need to extract and use natural resources on an individual basis for survival. Thus, one can foresee that with a return to economic prosperity (as the region knew in the past), that such local exploitation would be greatly reduced or cease altogether.

On the other hand, some recent developments are perhaps a real threat to the regional environment, if they would be carried to their logical (and purely economic) extreme and without proper consideration for the surrounding environment. With the opening up of the region overall and current possibilities for the South Caucasus in particular to become one of transit for both goods and people, there are sure to be rising pressures exerted in the form of construction (roads, railways, pipelines) and transport (cars, trucks, trains and pumping of oil and gas). If such related developments are carried out without due regard for the natural environment, it is all but certain that increased pollution of air, land and waters will take place. While the economics of today may tend to give a "push" to such development in order to improve the living situation of Caucasus citizens, it is hoped that serious mistakes which might compromise their futures can be avoided in the process.

Thus, the major challenge of the moment is that faced by many peoples and regions of the world: how to create further economic development, which can better the living standards for the greatest number of persons in the Caucasus, without seriously or even irreparably damaging local environments on which all depend for basic "life-support" systems? The unique beauty and diversity, and relatively unspoiled nature of the Caucasus region, can only serve to re-inforce the timeliness of this question.

ACRONYMS AND ABBREVIATIONS

ACCO Agreement on the Conservation of Cetacean of the Black Sea, Mediterranean Sea and Contiguous Atlantic Areas

BAT Best Available Technology

BOD Biological Oxygen Demand

BS-AP Biodiversity Strategy and Action Plan

BSEP Black Sea Environmental Programme

BUWAL Swiss Agency for Environment, Forests and Landscape

^{0}C centigrade degree

CAID Canadian Agency for International Development

CBD Convention on Biological Diversity

CEE Central and Eastern Europe

CENN Caucasus Environmental NGO Network

CEO Caucasus Environment Outlook

CFC(s) Chlorofluorocarbons

CIP Centre for International Programmes

CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora

CLD Convention on Liability for Oil Pollution Damage

cm centimetre

CMS Convention on the Conservation of Migratory Species and Wild Animals

Co Cobalt

COD Chemical Oxygen Demand

CO_2 Carbon dioxide

CO Carbon monoxide

COWI Danish Consulting Engineer

Cs Cesium

DAI Development Alternatives Inc. (US consulting firm)

DDE Dichlorodiphenylethane

DDT Dichlorodiphenyltrichloroethane

EAP Environmental Action Plan

ECE Economic Commission for Europe

EIA Environmental Impact Assessment

EMAS Environmental Management Systems

EU European Union

FAO Food and Agriculture Organisation of the United Nations

FSU Former Soviet Union

g gram

GCCW Georgian Centre for the Conservation of Wildlife

GHG Green House Gases

GDP Gross Domestic Product

GEF Global Environmental Facility

GEO Global Environment Outlook

GIOC Georgian International Oil Corporation

G.Info Geographic Information Centre

g/kg gram per kilogram

g/l gram per litre

GRID Global Resource Information Database

GOST Gosudarstveniy standart (State Standard)

GTZ Deutsche Gesellschaft für Zusammenarbeit (German Agency for Technical Cooperation)

ha hectare

-HC- Hydrocarbons

HMS Hydro-meteorological Service

H_2S Hydrogen sulphide

IBA Important Bird Area

IDP Internally Displaced Person

IFRCRCS International Federation of Red Cross and Red Crescent Societies

IMO International Maritime Organisation

ISAR Initiative for Social Action and Renewal in Eurasia

IPCC Intergovernmental Panel on Climate Change

IPPC Integrated Pollution Prevention and Control

IQ Intelligence Quotient

IUCN International Union for Nature Conservation

JSC Joint-Stock Company

kcal kilocalorie

kcal/cm sq. kilocalorie per square centimetre

kg kilogram

kg/ha kilogram per hectare

KFW Kreditanstalt für Wiederaufbau

km kilometre

km^3 cubic kilometre

km^2 square kilometre

km sq. square kilometre

kton(s) kiloton

kW kilowatt

kW/h kilowatt per hour

l litre

LDC London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters

Ltd Limited

m metre

m^2 square metre

m^3 cubic metre

m^3/s cubic metre per second

MAC Maximum Allowable Concentration

MARPOL International Convention for the Prevention of Pollution from Ships

µg microgram

µg/m^3 microgram per cubic metre

µg/dl microgram per decilitre

mg milligram

mg/kg milligram per kilogram

mg/l milligram per litre

ml millilitre

mln million

MNP Ministry of Natural Resources

MoA Ministry of Agriculture

MoE Ministry of Environment

MoH Ministry of Health

MSK Medvedev, Sponheuer and Karnik intensity scale

NACRES Noah's Ark for the Recovery of Endangered Species

NARSD National Assessment Report for Sustainable Development

NATO North Atlantic Treaty Organisation

NEAP National Environmental Action Plan

NGO Non-governmental Organization

NH_3 ammonia

NIS Newly Independent States

NO_x Nitrous oxides

NORCE Norwegian Consortium for Energy and Environment

O_3 Ozone

ODP Ozone Depleting Potential

ODS(s) Ozone Depleting Substances

OECD Organisation for Economic Co-operation and Development

O/M Operation and Maintenance

Pb Lead

PC Personal Computer

PCB Polychlorinated biphenyls

$PM_{10/2.5}$ Particulate Matters with aerodynamic diameter less than 10/2.5 microns

POJA Program of Joint Action

POPs Persistent Organic Pollutants

ppm parts per million

QA/QC Quality Assurance/Quality Control

REC Regional Environmental Centre

RF Russian Federation

ROE Regional Office for Europe

SEE State Ecological Examination

SIBE Memorandum of Understanding Concerning Conservation Measures for the Siberian Crane

SO_2 Sulphur dioxide

SS suspended solids

t ton

t/km ton(s) per kilometre

t/km^2 ton(s) per square kilometre

TAC Total Allowable Catch

TACIS Technical Assistance to the Commonwealth of Independent States

TN Total nitrogen

TP Total phosphorus

TRACECA Transport Corridor Europe-Caucasus-Asia

TSP Total Suspended Particulates

UN United Nations

UNCCD UN Convention to Combat Desertification

UNDP United Nations Development Programme

UN-ECE United Nations Economic Commission for Europe

UNEP United Nations Environmental Programme

UNEP/DEWA UNEP's Division of Early Warning and Assessment

UNFCCC United Nations Framework Convention on Climate Change

USA United States of America

USAID United States Agency for International Development

US$ US dollar

USSR Union of Soviet Socialistic Republics

VOCs Volatile organic compounds

WB World Bank

WHO World Health Organisation

WWF World Wide Fund for Nature

yr year

Zn Zinc

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APPENDIX 1. CONTRIBUTION TO REGIONAL AND GLOBAL ATMOSPHERIC PROBLEMS

Climate Change. According to the World Resources Institute's estimates, Armenia, Azerbaijan and Georgia together have contributed about 2,270,521 kilometric tons of CO_2 to world emissions since 1950. Adding the North Caucasus does not change this value greatly, since its share of Russia's industrial sector is tiny and does not exceed 10%, while the Russian contribution to Global emissions is about 10% (World Resources, 2000-2001).

The figures of CO_2 emissions vary from country to country within the region, depending on existing industrial and energy capacities and the utilisation of fossil fuels. Of the South Caucasus countries, Azerbaijan has the largest contribution (72% for Caucasus figure and 0.23% for global figure) and Armenia the lowest (6% of Caucasus figure and 0.02% of global figure). Georgia's contribution to 1950-96 global emissions is about 0.07%. This variation is explained by the fact that these countries have different energy capacities and power generation capacities. Azerbaijan, for example, has a well-developed oil and gas industry and power generation sector, and is almost self-reliant in energy generation. Armenia in turn uses nuclear fuels and hydro-resources for power generation. Additionally, during the Soviet era, the country imported a small percent of energy as well. Georgia does not have enough reserves of fossil fuels and was historically dependent on its hydro resources as well as electricity and fuel imports. Electricity imports amounted to about 10-25% and hydro resources 44-53% of total consumption during the 80s in the Georgia (UNDP/GEF-Georgian Government, 1998). In the North Caucasus, the power sector is highly dependent on domestic fossil fuels.

Usually, fuel extraction, conversion and consumption, referred as energy production module in IPPC guidelines, is considered as a major source for CO_2 emissions. In the Caucasus region, this sector, similar to other countries and regions, historically was a bulk emitter of CO_2. Over 90% of total emissions were due to this module. The share of non-combustion industrial processes was very low, varying from 1 to 3% from country to country. In energy production module, energy production and conversion had the highest share, followed by the industry, transport, households and agriculture sectors.

Since the break up of the Soviet Union, total energy generation and consumption has fallen in almost all FSU countries, leading to a temporary decrease in CO_2 and other GHG emissions. In 1997, per capita power consumption was 508 kg oil equivalent for Armenia, 1,568 kg oil equivalent for Azerbaijan, 444 kg oil equivalent for Georgia and 4,009 kg oil equivalent for the Russian Federation.[1] All South Caucasus countries are below the world average of 1,635 kg oil equivalent, with Azerbaijan coming the closest to global value, and well below the European average to be 3,507 kg oil equivalent. Decline in power generation amounted to about 57% for Armenia, 42% for Azerbaijan and 59% for Georgia. The figure was 25% for the Russian Federation. Since 1987, the average percent decrease in energy consumption amounted to about 67% for South Caucasus countries, from which Armenia accounted for 77%, Azerbaijan for 63% and Georgia for 63%. The figure for the Russian Federation was 52% (World Resources Institute, 2000-2001). In 1996, the average figure of per capita CO_2 emissions for South Caucasus amounted to about 1,836 kg, two times lower than the world average and about five times lower than the European average. The value was 3,945 kg for Azerbaijan, which is close to global average, 1,037 kg for Armenia and 572 kg for Georgia, figures well below the global and European averages (World Resources Institute, 2000-2001). 1996 figures reflect the post-Soviet economies, characterised by economic fall and changes in economic structure. For example, in Georgia net CO_2 emissions declined from 37,067 ktons in 1985 to 2,791 ktons in 1995 (UNDP/GEF-Georgian Government, 1998). This reflects the general economic decline on the one hand and the structural changes in power generation on the other hand. Specifically, amount of electricity generated by thermo-power, which was the major source of carbon dioxide emissions in the 1980s, has fallen in Georgia since the demise of Soviet Union, due to the unavailability of fossil fuels and high fuel prices. Hydropower's share has increased from 43.6% in 1980 to 84.5% in 1997 (UNDP/GEF-Georgian Government, 1998). In Armenia, for example, a nuclear power station was restarted in 1995, leading to decreases in CO_2 emissions. In 1997, per capita emission figures were 4,200 kg for Azerbaijan, 800 kg for Armenia and 900 kg for Georgia, indicating a slight increase in per capita emissions for Azerbaijan and Georgia and decrease for Armenia compared to 1996 figures that could be explained by increased fossil fuel utilisation by Azerbaijan and Georgia and increased nuclear fuel and natural gas utilisation by Armenia (UNDP, Armenia, 2001).

The second peculiarity of the post-Soviet period is a significant change in fuel consumption patterns. For example, during the 80s the industry sector was the second highest energy consumer after the power generation sector, but since the break up of the Soviet Union its share of total consumption has sharply fallen, due to general economic decline. In turn, the household and transport share of total consumption has increased.

It is assumed that as the economies of FSU countries begin to grow, GHG emissions will increase respectively. However,

whether or not they will reach the1990-baseline year level depends on macroeconomic development scenarios and measures taken to reduce GHG emissions, e.g., implementation of energy efficiency and energy saving policies, promotion of cleaner fuels and technologies, wider use of hydro and other renewable resources, re-forestation, etc.

Ozone Depletion. In the late 1970s and the 80s, refrigeration (commercial, domestic or industrial) followed by agriculture, was the major user of Ozone Depleting Substances (ODSs) in the Caucasus region. Chlorofluorocarbons (CFCs), basically CFC-12, were used as cooling agents in refrigeration and methyl bromide as a fumigant in agriculture. There were no ODS or ODS-based manufacturing capacities within the region, except for Azerbaijan, which was an only republic using ODSs in the production of air conditioning systems. In order to meet domestic needs, most of the republics imported ODSs, mainly from other parts of the FSU.

During the Soviet era, ODS consumption figures were higher than current ones. For example, in Georgia in 1989 about 783.15 ODP tons of ODSs were consumed, while the figure was only 25.95 ODP tons in 1996 and 21.51 tons in 2000 (MoE of Georgia, Country Program, Draft). Although data on ODS consumption for the whole Caucasus are not available, however, per capita consumption values for some of the Caucasus countries that are believed to be more or less typical for the entire sub-region, indicating a decline in ODS consumption. Per capita OD consumption figures for Armenia and Georgia, for example, are about 0.0003 kg and 0.004 kg respectively (MoE of Georgia, Ozone Unit, 2001; OECD/MoE of Armenia, 2000, Armenia). Current demand for ODSs is mainly met by imports. Imported ODSs are mostly used by technicians to serve refrigeration sector, which still is a major ODS consumer. Agriculture application is very insignificant. From refrigeration sector, the highest consumption figures are due to domestic refrigeration.

The present low levels of ODS consumption are mainly due to the general decline in economic activities, specifically in those sectors which were major ODSs users. The South Caucasus countries and Russian Federation have also taken measures under the Vienna Convention to Protect Ozone Layer and Montreal Protocol on Substances that Deplete the Ozone Layer. All these states are parties to both of these instruments and make efforts to comply with obligations to freeze ODS consumption to baseline levels and finally phase out them. However, countries have little capacities to make ODS inventories and monitor and control illegal imports, sales and uses.

It is believed that over the next ten years, as economies recover and grow, ODS demand will increase. Agriculture demand for methyl bromide will increase as well, especially for exporting countries. Whether or not ODS consumption will reach the levels of 80s depends on the economic development scenarios and the implementation of commitments taken by the countries under the Vienna Convention and Montreal Protocol.

Trans-boundary Air Pollution: Acid Rain Problems. Acid Rain is a trans-boundary problem, caused by sulphur and nitrogen emissions, predominantly in the oxidised form of sulphur dioxide and nitrous oxides. As emitted, SO_2 and NO_x, move long distances with air fluxes and return to the earth either through dry or wet deposition as sulphuric and nitric acids, causing damage to human health, ecosystems and amenities. The major source of SO_2 emissions is burning sulphur in fossil fuels, predominantly coal and fuel oil, mainly by large stationary sources. Gas-fuelled power plants, together with mobile sources are major contributors to NO_x emissions. In addition to NO_x emissions, nitrogen is released into the atmosphere as ammonia from livestock, fertiliser application, fuel combustion, industrial activities and land filling.

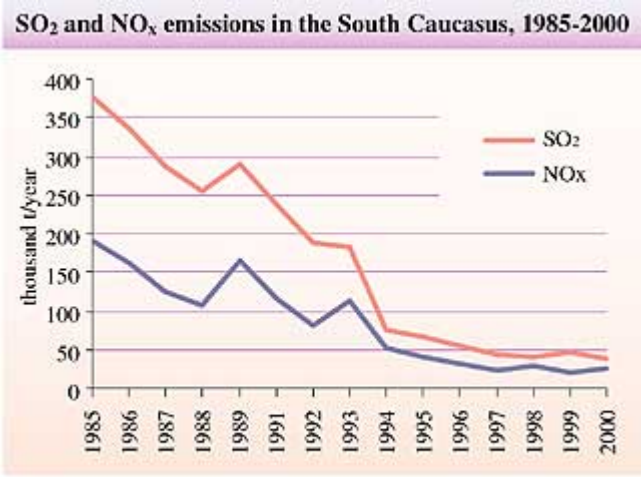
Traditionally, acid loads in the Caucasus were 2-3.5 times less than that in the European part of the FSU Ministry of Environment and Natural Resources Protection of Russian Federation, 1994). This was accounted for by the sub-region's lower level of industrial development, distant location from major pollution sources, low level of fossil fuel utilisation and type of fuels used, and its physico-geographical features. Specifically, its relatively mild climate meant that fewer fossil fuels were needed for heating. In addition, the Greater Caucasus range and Black Sea served as natural barriers and sinks for incoming trans-boundary fluxes. 1982-1990 regional background measurements of some of common pollutants, including SO_2 and NO_x conducted in Caucasus biosphere reserve have proven this fact (Ministry of Environment and Natural Resources Protection of Russian Federation, 1994). However, higher average annual acid deposition figures, determined by local emission sources, were observed for large urban and industrial centres: Rustavi, Tbilisi, Yerevan, Ararat, Alaverdi, Baku, Sumgayit, Mingachevir, etc.

In general, domestic emission sources, either anthropogenic or natural, were the major contributors to acid deposition in the Caucasus region. Incoming trans-boundary fluxes were insignificant due to the relief and climate peculiarities of the region. Apart from this, emissions were unevenly distributed within the Caucasus. This was largely due to the extremely uneven distribution of population and hence, anthropogenic activities. For example, 1990 NH_3 emission distribution map

with 1^0 x 1^0 resolution (NH_3/grid/yr) showed extremely unequal distribution of emission density over South Caucasus countries. High values were observed around large cities: Kutaisi, Tbilisi, Yerevan, Kirovobad and Baku. The highest density was characteristic of the Ararat Valley (Russian Academy of Science, Institute of Global Climate and Ecology, Moscow, Russia, 2001).

Before the disintegration of the Soviet Union, SO_2 emissions share of total aggregated emissions was high for most of Caucasus republics. In Armenia, for example, stationary source emissions were about 150,000 tons annually and the share of sulphur dioxide in the total value amounted to about 42% (Ministry of Environment and Nature Resources Protection, Russian Federation, 1994; UNEP/MoE of Armenia, 2000). Major sources of SO_2 emissions were power utilities and large industrial facilities, metallurgical, petrochemical, chemical, machinery, non-ferrous metal plants etc. NO_x emissions also were high in the 1980s. Energy sector and industries were the major sources of NO_x emissions. Significant share was from mobile sources as well. Animal husbandry accounted for ammonia production. A high share also came from human beings, home pets and landfills. Emissions from industrial activities and fossil fuel combustion were the most insignificant, with the highest figure being transport emissions (Russian Academy of Science, Institute of Global Climate and Ecology, Moscow, Russia, 2001).

After the break-up of the Soviet Union, all the sector activities have ceased or decreased dramatically. This has resulted in decreased emissions from both stationary and mobile sources. Consequently, SO_2 and NO_x emissions have fallen by several times. The fall was particularly severe in Armenia and Georgia, during the power shortage.



Source: Complex Scheme of Environment Protection Azerbaijan, 1987. State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan, 1993. MoE of Georgia, 1996. State statistical services of Armenia, Azerbaijan and Georgia, 1985-2000

There is currently only limited data on acid deposition and its effects on ecosystems in the region. Little is known about regional background levels of pollutants and their long-range movements. At present, existing ambient monitoring stations do not measure regional background levels. Only statistical data on emissions are available. Even these data are unreliable, due to the lack of quality assurance and quality control systems.

It is expected that in the future sulphur dioxide and nitrogen oxide emissions will soar, as the number of vehicles and industrial activities increase. Moreover, the problem may become very acute, taking into account the inefficient and out of date technologies employed. In the short-term, the major threat can be expected from rapidly growing road transport with its obsolete fleet and poorly maintained vehicles. Hence, the problem with NOx emissions is becoming acute. The implementation of TRACECA project will significantly increase traffic in major highways and may highly contribute to trans-boundary air pollution as well.

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1 - Separate data on the North Caucasus are not available

APPENDIX 2. ENVIRONMENT AND HUMAN HEALTH: LINKS BETWEEN ENVIRONMENT HOTSPOTS AND HEALTH PROBLEMS

According to WHO data, up to 80% of morbidity can be attributed to environmental exposure to various substances. The health status of local populations depends on economic and social indicators and the level of environmental pollution. Health indicators vary for urban and rural areas.

The Caucasus, traditionally, is an agriculture-based region, with some industrial territories. The urbanisation index varies from 47% to 70% in the region. A low level of social infrastructure and services, especially in rural areas, characterises the region. The region historically was characterised by moderate to serious environmental and hygienic conditions in urban and industrial areas, basically linked to its underdeveloped sanitation infrastructure and environmental pollution

from industries and traffic, and serious sanitary-hygienic and environmental conditions in rural areas, linked to intensive use of pesticides and other chemicals and poorly developed sanitation infrastructure (Ministry of Environment and Nature Resources Protection, Russian Federation, 1994).

In the 1980s, infant mortality was 19.2 per 1,000 in the North Caucasus and 20.2 per 1,000 in the South Caucasus. Mortality due to the cancer of respiratory ways and lungs varied from 11 to 26 per 100,000 people in the South Caucasus, and was 1.6-4 times less than in highly industrialised and developed regions of the FSU (Ministry of Environment and Nature Resources Protection, Russian Federation, 1994).

Sanitary-Hygienic Conditions

High figures of infectious diseases were traditionally reported for the Caucasus region during the 1970s and 80s. High morbidity due to typhus, dysentery and viral hepatitis was observed in the cities of the North Caucasus. In rural areas, morbidity figures of higher than average values were due to gastrointestinal diseases and poliomyelitis. High morbidity due to typhus was observed in the cities of Armenia and Azerbaijan as well (Ministry of Environment and Nature Resources Protection, Russian Federation, 1994). In Azerbaijan, in 1980-1990, the largest outbreaks of waterborne infectious diseases were recorded for the cities of Baku, Kazakh, Shamkir and Zakatala (State Committee of the Azerbaijan Republic on Nature Protection, 1993). Poor living conditions and inadequately operated and maintained sanitation systems, or non-existence of such systems in many of locations may serve an explanation for high morbidity due to infectious diseases.

Since 1990, sanitary-hygienic conditions have been worsening in the region. Outbreaks of infectious diseases, especially gastrointestinal ones are common. Many of these cases are traced to poor drinking water and food quality. In Azerbaijan, for example, a large outbreak for enteric fever, caused by sewage leaking into water supply system, was recorded for the city of Zakatala in 1991 (State Committee of the Azerbaijan Republic on Nature Protection, 1993). In Armenia, there have been outbreaks of waterborne diseases involving 401 persons. Eleven outbreaks, affecting 1,500 persons, were reported in 1995 and 1998 respectively (OECD/MoE of Armenia, 2000). An outbreak of waterborne diseases, involving 1,904 persons, was recorded for the city of Rustavi, Georgia in 1997-98 (WHO/MoH of Georgia, 2001). A poor sanitary-hygienic situation is observed in the North Caucasus as well. In Chechnya, for example, about 3,000 cases of infectious diseases were recorded in 1995. High incidence rate for poliomyelitis among children was recorded as well, caused by inadequate sanitation and low vaccination coverage rate (Ministry of Environment and nature Resources Protection, Russian Federation, 1996). Apart from this, there is high risk for epizootic outbreaks in the North Caucasus, since the region has different natural sources for contagious diseases, such as plague, tularaemia, bruccelosis and the lack of animal vaccination and overall poor sanitary-epidemiological conditions may aggravate the situation.

At present, state sanitary-hygienic services lack finances and technical equipment to conduct regular inspections over food products and drinking water. Existing water supply and sewage systems are inadequately maintained and frequent cross-contamination of sewage and drinking water occurs. Water intake facilities are not properly protected and do not meet sanitary and hygienic requirements. In many locations, there is not enough chlorine for proper disinfecting. Overloaded legal landfills that do not meet health and environmental requirements, and illegal dumpsites cause the contamination of ground water, which is the major source of drinking water in many parts of the region. In Azerbaijan, an analysis of potable water samples taken in 1983-1993 has revealed a trend of deteriorating drinking water quality. Specifically, whereas in the early 1980s about 10-12% of samples did not meet water quality standards for toxicity, in 1991 the figure reached 74%. The figure was about 15-16% for bacteriological contamination in the 80s and it became about 53% in 1991 in Zakatala (State Committee of the Azerbaijan Republic on Nature Protection, 1993). According to State Sanitary and Hygienic Oversight Service of Georgia, about 13.3-17.3% and 15.2-16.0% of samples taken from centralised water supply systems in 1999-2000 did not meet existing drinking water quality standards for toxicity and bacteriological contamination respectively. These values were 23.6% and 24% respectively for water samples taken from water intake facilities. Samples taken from artesian wells of 29 administrative districts and water drills of 18 districts of Georgia show that over 36% of samples don't meet existing drinking water quality standards (WHO/MoH of Georgia, Draft, 2001).

Recent ethnic conflicts in some of the parts of the sub-region have destroyed the sanitation infrastructure in some areas, aggravating the sanitary-hygienic conditions there. Military actions have resulted in the displacement of local populations and the establishment of refugee camps where sanitary-hygienic conditions are extremely poor. Diarrhea, for example, is prevalent among children of IDPs.

Environmental Pollution and Population Health Status

Urban Areas. In general, morbidity rates due to cardiovascular, upper respiratory, digestive system diseases and neoplasms have increased in the 1970s and 80s among urban population of the FSU (Ministry of Environment and Nature Resources Protection, Russian Federation, 1994). During this period, increased morbidity due to the above-mentioned diseases was also observed in urban areas of the Caucasus region, following the general trends for the Soviet Union. In particular, high morbidity rates were reported for large cities and industrial centres. The city of Sumgayit, for example, was included on a list of Soviet cities with the highest morbidity rates (State Committee of the Azerbaijan Republic on Nature Protection, 1993). The city of Baku had a higher morbidity rate than St. Petersburg, Odessa, Tallin, Kiev, Minsk, Dushanbe, Almaty and other industrial centres (State Committee of the Azerbaijan Republic on Nature Protection, 1993). In Armenia, acute cases of respiratory diseases and high general morbidity figures due to respiratory diseases were frequently reported within populations living around the Nairit chemical plant in Yerevan, the cement factory in Hrazdan, the Roubin chemical plant in Vanadzor and the two cement factories in Ararat. High morbidity rates due to malignant diseases were reported for the cities with petroleum, petrochemical and chemical industries and heavy traffic, since these activities are one of the major sources for carcinogenic substances, e.g., benz(a)pyrene and other aromatic hydrocarbons.

Although it is very difficult to establish the links between environmental pollution and morbidity rates, there is some scientific evidence that high ambient concentrations of different pollutants emitted from stationary and mobile sources cause increases in the morbidity rate for specific diseases. Phenol, formaldehyde, SO_2, H_2S, etc. are linked to increased morbidity and mortality in respiratory and cardiovascular diseases. Dust, NO_x, and CO, etc. are related to respiratory and cardiovascular, skin and endocrine diseases. High lead concentrations are related to the morbidity due to cardiovascular diseases, specifically, hypertension and heart attacks, and lower children's IQ. High concentrations of benz(a)pyrene are linked to increased cancer rates.

In Baku and Sumgayit since 1983 and in Ganja since 1989, the local population's health status has been studied by means of an automated state information system "HAGIS-HEALTH" and the correlation has been established between ambient air pollution and morbidity rate. In Baku, symbolically dirty (experimental) and clean zones (control) were selected to study the correlation between environmental factors and morbidity. In the dirty zone, incidence rates for endocrine disorders, hearing and eye impairment, rheumatism, hypertension, respiratory and skin diseases were higher than those in symbolically dirty zone. Blood diseases in experimental zone were also higher than in the clean zone amounting to 46% of total morbidity in 1985, 55% in 1987 and 68% in 1989. Growth rate for pregnancy pathology was also higher than in the symbolically clean zone (State Committee of the Azerbaijan Republic on Nature Protection, 1993). Similar studies were conducted in selected cities of Russian Federation in 1989, including North Caucasus cities, revealing 1.5 times higher than average figures for respiratory diseases for the city of Stavropol ((Ministry of Environment and Nature Resources Protection, Russian Federation, 1994).

Recent ambient air quality data for selected major cities of the Caucasus region indicate declining or stable trends for most of the pollutants monitored. Such trends are due to the fall in industrial activities and hence, industry-related emissions. However, this is offset to some extent by increased traffic-related emissions. 1997 ambient air quality data for Yerevan, for example, indicate high ambient concentrations of lead and NO_x. In 1994-97 ambient concentrations for dust and NO_x were several times higher than national ambient air quality standards in the cities of Vanadzor and Ararat. In Yerevan, SO_2 mean values also often exceed both national MACs and WHO guidelines. Mean daily dust levels exceed 150 $\mu g/m^3$ and the annual mean is above 150 $\mu g/m^3$ (OECD/MoE of Armenia, 2000; UNEP/MoE of Armenia, 2000). Annual average soot concentration in Baku was about 95 $\mu g/m^3$ in 1993-95, 1.9 times the existing air quality standard to be 50 $\mu g/m^3$. SO_2 concentrations in Baku and Guanja were 60 and 65 $\mu g/m^3$ respectively, slightly exceeding existing national standard of 50 $\mu g/m^3$. Dust concentration in the city of Sumgayit was about 200 $\mu g/m^3$, 1.3 times the existing national standard to be 150 $\mu g/m^3$ and 2.2-3.3 times the WHO guideline to be 60-90 $\mu g/m^3$ (State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan, 1998). A slight improvement in ambient air quality may be the reason for the decrease in acute respiratory diseases and increase in chronic respiratory diseases. These trends have been observed since 1990. In Baku, for example in the early 90s the highest morbidity rates were for bronchitis and emphysema among adults and chronic diseases of tonsils and adenoids among children (State Committee of the Azerbaijan Republic on Nature Protection, 1993). However, decrease in non-selective immune response may be the reason for above trend.

At present, since the traffic is a major source for ambient air pollution in the majority of Caucasus cities, particulate matters and lead are assumed to be the most serious health concerns. The study of health effects of short-term exposure to

TSP for the city of Yerevan, for example, suggests that 250 - 500 children might suffer from diseases of the lower respiratory tract; 10-20 deaths per year may be related to short-term peaks in pollution; over 5% decrease in mean level of pulmonary function can be expected in 200,000 – 250,000 persons, and 3 – 7% of new cases of respiratory tract disease can be expected from the exposure to TSP peaks above 150 μg/m^3 (MoE of Armenia, 2001). In particular, fine particles with aerodynamic diameter less than 10 μm or 2.5μm ($PM_{10/2.5}$) pose high threat to urban population. $PM_{10/2.5}$, when inhaled, reaches the lower parts of respiratory tract and causes the lung cancer. Although, there are no monitoring data on $PM_{10/2.5,}$ estimates indicate the existence of such problem. Studies for the cities of Baku, Sumgayit and Ganja show that 65 to 75% of population is exposed to annual average PM_{10} concentration of 100 μg/m^3. The exposure to this level of pollution causes 1,450 to 3,800 premature deaths and 9,800 new cases of chronic bronchitis and other respiratory problems annually. The social cost for such health impacts is estimated to be about 3 to 4% of GDP (State Committee on Ecology and Control of Natural Resources Utilization, Azerbaijan, 1998).

Although, data on lead concentrations are very limited, the studies for selected cities, however, indicate that impacts from lead are high. A study, for example, conducted by the Research Laboratory of Tbilisi Medical University in 1995-97 indicates at a high lead level in the air and soil samples taken from areas near of two busiest roads of the city of Tbilisi. 25% of the population under the study had blood lead concentration of 38.2 μg/dl or more, three times greater than WHO guidelines. The study of the health status for the population of experimental area showed that 60% of examined people had carboxyhaemoglobin in the blood and 20% had high lead level in hair and urine. Cardiovascular pathologies, especially hypertension, staenocardy and heart insufficiency were reported for 20.7% of studied population and this pathology was particularly high among people over the age 40. During the first year of observation, children showed morpho-functional disorders. In the third year of the study, an increase in chronic diseases was observed among children, which might be the result of decreased overall non-selective immune response (NORCE & MoE of Georgia, 2000). In 1998-1999, NORCE and Georgian experts conducted the study for the city of Tbilisi, by using the air dispersion model to provide the baseline traffic-related air born lead data for the health risk estimation as well as the compartment model to study presumed blood lead level in affected population with base input from air model. The study indicate that with current average lead level of 50 mg/l in gasoline pool, roadside maximum 1-hour average concentration of 2.0 μg/m^3 and area average lead concentrations ranging from 9.2 to 0.4 μg/m^3 for different microenvironments, the estimated blood lead content among infants living in suburbs and city centre is 47.4 μg/dl and 71.9 μg/dl respectively, among adult women 25.0μg/dl and 30.2μg/dl respectively, among adult men 22.3 μg/dl and 27.2 μg/dl respectively and among elderly 30.8μg/dl and 41.4μg/dl respectively. These values are much higher than that of 10μg/dl, recommended by WHO. Moreover, it was assumed that without any measures for leaded gasoline phase-out and with estimated demand for leaded gasoline, by the year of 2005 the average lead content in gasoline might become 80 mg/l, which would significantly increase blood lead levels. The estimated annual benefits for reducing of lead in gasoline from 50mg/l to 13 mg/l are as follows: 200,000 adults with reduced hypertension; 600 adults with reduced risk for non-fatal heart attacks; 600 adults with reduced risk for cardiovascular death. IQ points improved per child are 6.48 (NORCE & MoE of Georgia, 2000).

Rural Areas. During the Soviet era, the morbidity and mortality rates due to neoplasms and inborn anomalies were traditionally high among rural population of the Caucasus region, mainly related to unsustainable use of pesticides. In Krasnodarsky Kray and Armenia, for example, where annual loads of pesticides exceeded average values for Soviet Union 3-5 and 20-25 times and more respectively, general morbidity among children under age 6 was 4.6 times higher than that among children living in regions with minimum pesticide loads (State Committee of the USSR on Nature Protection, 1989). In Azerbaijan, in 1983-1985, the Ministry of Health studied the impacts of pesticides on health status, taking into consideration the intensive use of pesticides in agriculture, great percentage of women employment, female morbidity rate and the geographic distribution of diseases. High morbidity for gynaecological diseases was revealed among women dealing with pesticides. Pathological pregnancy, miscarriages, premature birth, toxicosis, etc. reached 30-45%. Premature death, foetus hypertrophy, etc. was more frequent in women dealing with pesticides, than that in women of the control group. About 70% of women in the target group suffered from anaemia. While studying the effects to pesticide exposure, it was found out that the morbidity rate among children under age 11 of experimental group was 3.6 times higher than children in the control group. The most sensitive groups were revealed children under age one. An overall decrease in non-selective immune response was also observed (State Committee of the Azerbaijan Republic on Nature Protection, 1993).

At present, whereas the overall pesticide use has declined in the Caucasus sub-region, health concerns related to pesticides still exist. Specifically, many individual farmers are not aware of health and environmental requirements for pesticide use. Their improper use poses a high threat to their own and other people's health and environment. Another problem is related to obsolete pesticides and other agro-chemicals that are not properly stored, causing the contamination of ground waters and soil. This poses a high risk to human health through drinking water and food contamination.

Measures to Protect Human Health from Adverse Environmental Impacts

In order to protect human health from environmental pollution, health-based standards for drinking water, ambient air, soil and food quality were set during the 1970s and 80s in the Soviet Union. Special sanitary and hygienic inspection bodies were established to check the compliance with existing sanitary-hygienic requirements. Various research institutions studied the health status of population. State statistical reporting for health indicators became also mandatory since late 1970s. Hydrometeorological services were responsible for measuring and reporting the ambient air, water and soil concentrations for several criteria and toxic substances. High capital investments were made into water supply and sewage systems. The majority of wastewater treatment facilities were built in the late 1970s and 80s.

Significant health resorts were concentrated in the Caucasus. The region historically was known for its abundant recreation resources. Diverse climate conditions and significant reserves of mineral and geothermal waters created favourable conditions for the building of health-based resorts and the development of appropriate infrastructure there. Many of well-known resorts: Borjomi, Abastumani, Kojori and Black Sea resorts, etc. have been operating since the 19-th century.

In the Caucasus, traditionally, major resorts were located in two regions: the North Caucasus and Black Sea coastal zone. During the Soviet era, they served the entire country. There also were the resorts of national and local importance. These resorts had diverse profiles, from recreation to sports and health care. Abundant infrastructure was developed for this. Special attention was also paid to children's health care. In Georgia, for example, over 102 resorts with 394 sanatoria and guest houses, including 29 children's sanatoria, and other recreation infrastructure were operated that could simultaneously serve about 100,000 persons, including 3,200 children (UNEP/GRID-Tbilisi). Different diseases were treated in these resorts. In mountainous resorts, for example, tuberculosis, bronchitis, asthma, neurosis, anaemia and some of the cardiovascular diseases were treated. Black Sea climate resorts are very effective against blood and respiratory diseases, nervous system disorders as well as for primary and secondary prophylactics. In resorts with mineral and geo-thermal waters cardiovascular, digestive, gynaecological, endocrine, and locomotive systems diseases were treated. The most prominent resorts of this type were located in the North Caucasus: Mineralnye Vody, Esentuki, Jelezanvodsk, Kislovodsk, etc. and Georgia: Borjomi etc. The Caucasus is rich in bicarbonate mineral waters that are effective against digestive system, liver, urinary systems disorders and diabetes. Sulphur, radon, nitrogen and selenium containing mineral waters, also being abundant in the region, are effective against peripheral nervous system, skin and gynaecological diseases. Sukhumi, Tbilisi, Gagra, Makhindjauri are resorts of this category. In addition to its mineral water-based resorts, the Caucasus is rich in mud-based resorts effective for treating conditions of the locomotive systems, peripheral nervous systems and gynaecological diseases.

Since the break-up of the Soviet Union, the situation in the public health care system has dramatically changed. The post-Soviet economic crisis has resulted in the deterioration of existing infrastructure. Countries lack finances to properly operate and maintain sanitation systems or plan for new projects. Sanitary and Hygienic Oversight services lack technical and financial resources to regularly check compliance with existing standards. Health care authorities and research institutions cannot conduct regular studies revealing the links between environmental pollution and human health. They are not aware of recent tools and methods used in contemporary toxicology and epidemiology. Environmental and other authorities responsible for data collection also do not have the capacity to regularly monitor ambient environment quality, detect high pollution episodes and take specific measures for human health protection. Existing ambient standards are out of date. Although Soviet ambient standards are high enough in terms of quantitative measure, some of them are imperfect. Ambient air quality standards, for example, do not reflect the different exposure effects of various substances. A uniform approach is applied for all substances. Thus, existing standards need revision.

A difficult situation exists concerning the health-based resorts as well. Many of the resorts are not properly operated and maintained. Many of the buildings are completely outdate and need in major repair. Some of the resorts have stopped functioning, particularly Black Sea resorts in Abkhazia, which have been destroyed in the conflict there. Some of the operating resorts do not meet sanitary-hygienic requirements. Hence, the needs are tremendous in the public health field.

Overall, due to the economic crisis, much of the public, especially low income and marginal groups, such as elderly and retired persons, refugees, IDPs, etc. has little or no access to health care services. The number of doctor calls and bed occupancy has dramatically dropped during the last ten years. The quality of health care, per se, has also declined, because of reduced public financing. This, of course, affects general public health.

APPENDIX 3. MAJOR LANDSCAPES OF THE CAUCASUS AND ITS ADJACENT TERRITORIES

I. Plain, Foot-hill and Hilly Landscapes

A. North Sub-tropical Humid landscapes are located in the West Trans-Caucasus, mostly in the Colchida and extremely south-eastern part of the Caucasus (Tallish mountains and the west part of Elburs Mountains). They are found at 400-600m above sea level, though in certain regions (Upper Imereti for instance) they spread as high as 800m.

Rododendrum ponticum. Colchida. Georgia
Source: Efremov I Nature of my country. Moscow, 1985

There are three distinct units of relief in the West Trans-Caucasus: the Colchic lowland, the foot-hills and the Imereti upland.

The majority of marshes and lakes are concentrated in the central part of the Colchic lowland at 20m below sea level. Paliastom is the largest lake among them. In this part of the Colchic lowland, the drainage works have been conducted for already a number of years. However, these works have not yet yielded a great success because of low hypsometric location of the plain hindering the formation of a drainage network. The edge of the Colchic lowland gradually rises, reaching 100-200m above sea level. This part is more suitable for land reclamation. That is why the great majority of marshes existing here have been dried and transformed for arable lands. Territories with hilly relief are met above them. On approaching the mountains, they turn into foot-hills, made of neogenic and palaeogenic clays and sandstone, and more rarely, of limestone.

The Lenkoran lowland and a zone of hills and foot-hills are located in the south-eastern Caucasus (Hyrcan landscapes). The Lenkoran lowland is an area of 5-20km width characterised by flat relief. Marshes appear rarely. Foot-hills with an erosive-denudative relief are distributed as a narrow (2-5-km) strip.

The climate is humid sub-tropical. The January temperature varies within $+4^0$C,$+7^0$C and the July – $+24^0$C,$+26^0$C. The annual amount of precipitation fluctuates within 1,000-2,500m. The climate of Hyrcan landscapes is close to that of Colchic landscapes. However, it has a number of specific features, among them a hot arid summer, excessively humid autumn, and mild warm snowless or less snowy winter being the most prominent. Nevertheless, winter temperature within Hyrcan landscapes is 2-3 degrees less than that within the Colchida. The summer minimum of precipitation gives the Hyrcan landscapes the features of the Mediterranean climate. The relatively southern location (38^0C-39^0C N.L.) determines the highest values of total radiation and radiation balance throughout the Caucasus.

At present, Natural Territorial Units (NTUs) slightly changed by human activities are met only in nature reserves. However, not long ago (by description of Prince Vakhushtii, the 18th century) a major part of the Colchida was covered by deep forests.

In the past, polydominant forests prevailed in the Colchic lowland and foot-hills, and now they are spread only as separate spots in different parts of the region. Chestnuts, alders, maples and ash-trees dominate in arboreal layers. Beech trees, oaks etc. appear from place to place. Under this forest canopy, rhododendron, cherry laurel, box-tree, ilex form evergreen under-woods. Red and yellow soils are formed underneath the forests.

Hemygileas are distributed on the coastline of Ajara, where evergreen plants occupy all vegetation tiers, except for the top. The NTUs of the Colchic forests with leaf-shedding evergreen under-woods are found in drier places of the habitat.

In humid areas of the central part of the Colchic lowland, NTUs composed of Quaternary alluvial deposits with sphagnum-reed marshes and marshy alder-thickets on peat bog and mineral- bog soils are distributed.

Overall, red and yellow soils characteristic of sub-tropics prevail in Colchic landscapes.

The Colchic lowland and foot-hill and hilly landscapes are considerably changed by human activities and natural-agrarian territorial units (NTUs) with maize crops, tea, and more rarely citrus occupy drained lands.

A major part of the Lenkoran lowland and mountainous parts are transformed by human activities. In some areas, marshy alder thickets, alpine alder and oak woods with lianas are met. In the past, foot-hills were covered by chestnut, oak, parrotia, hornbeam forests with silk acacia and thorny lianas (blackberry, etc), but now the majority of them are replaced by arable lands.

Lower parts of the plains are characterised by silt-marshy sub-tropical, podzol and podzol-glean soils, while sub-tropical yellow podzol soils prevail on elevated parts.

Sub-Colchic forest landscapes are met in Turkey, on south coastline of the Black Sea, westward from Trabzon. Here they are distributed as small parcels and are met near the cities of Heresum, Ordu and Sinop. They are characterised by the climate and vegetation common to the Colchida.

B. Sub-Mediterranean Semi-Humid Landscapes are spread as spotty areas in different parts of the Caucasus.

This sub-type of landscapes is largely found in the north-western part of the Black Sea coast close to the cities of Tuapse and Anapa.

The area between Novorossiisk and Anapa is characterised by a plain relief, turning into hilly inter-mountainous depressions. Foot-hill and hilly landscapes appear in the section between Novorosiisk and Tuapse. The climate is weakly continental Sub-Mediterranean. NTUs of Sub-Mediterranean type with steppe, xeric and phrygana vegetation prevail there. These NTUs in majority of cases are distributed on brown soils and rendzins. Along with this, mixed oak forests of Quercus pubescens, Q.Iberica, Q. Petraea, and Q. Hartvwissaana are met. Pine forests are represented by two species: P. Stankewiczi and P. Pitiusae. Juniper and open forests are also widely spread. South slopes and crests are over-grown by phrygana vegetation and shiblyaks (dry shrubs), mostly on brown soils and rendzins.

At present, arable lands are widely spread there. Of special interest is a part of Sub-Mediterranean landscapes in the region of the Pitsunda cape and the Myusera upland. These landscapes have features transitional to Colchic. They are such unique for Georgia that the Pitsunda -Myusera nature reserve was established there. In the light of sufficient amount of precipitation, the relative dryness (deficit of precipitation) is observed in the period from May to June that determines an effect of Mediterranean climate with relatively arid summer. Soils on the Pitsunda cape are sandy, whilst brown, yellow-brown and yellow (zheltozem) soils prevail on the Myusera upland.

The Pitsunda cape is covered by coastline pine forests of Pinus pitiusae, mixed broad-leaved forests of hornbeam and hornbeam thickets with a layer of box-trees. The bottoms of Myusera upland are covered by polydominant broad-leaved forests represented by hornbeam, beech, chestnut, maple and evergreen under-woods of Rhododendron ponticum. Crests and slopes of the southern slope are covered by oak-groves of Quercus iberica with under-woods of azaleas and heather. Abyssal lines of the shore are covered by cliff forests represented by Pinus pitsunda, wild strawberry tree, heather and other Mediterranean species.

In the East and Central Trans-Caucasus, large areas are occupied by sub-Mediterranean semi-humid landscapes framing the Inner Kartli and Lower Kartli plains and, partially, the Kura-Araks lowland. They are distributed at 400-800 m above sea level, rarely reaching 1,000m. Sometimes they are met at 200-300m above sea level. Foot-hill and hilly erosive-denudative, denudative-accumulative or erosive-accumulative and rarely, arid-denudative reliefs are met here. They comprise ridges, depressions, terraced valleys, foot-hills with alluvial fans, plateau and plateau-type elevations, ravines and badlands. The climate is transitional from sub-tropical to thermo-moderate. Annual distribution of precipitation is similar to that of the Sub-Mediterranean climate with two: summer and winter minimums and well-expressed one spring maximum.

The variety and the distribution of NTUs are strongly related to thermal and moisture conditions. Along the small meadow plots and ravines and the slopes of the western macro-slope, NTUs with shiblyak vegetation grown on brown soils (represented by hornbeam, paliurus, mixed shrubbery shiblyaks) are met. With increasing humidity on the northern slopes and terraces, mesophyte meadows on meadow, brown and alluvial soils are spread. Large areas are also occupied by steppe vegetation.

Sub-Mediterranean Semi-humid Landscapes are one of the most cultivated landscapes in the Caucasus. Natural-agrarian units with grain crops, vineyards, vegetable gardens and technical crops are located here.

C. North Mediterranean Landscapes are distributed along the coastline of the Black Sea in Turkey near the cities of Ordu and Sinop. They represent relatively small sections of typical Mediterranean landscapes. They are characterised by plain, foot-hill and hilly reliefs. Vegetation cover is represented by maquis, pseudo-maquis, beech and oak forests with deciduous bushy under-woods. In difficult to pass and excessively humid, shady gorges, polydominant Colchic forests are grown. These landscapes are transformed to some extent, especially, in plain areas.

Steppes. Eastern Caucasus
Source: National parks of Georgia. WWF 1998

D. North Sub-Tropical Semi-Arid Landscapes occupy the Inner Kartli, Lower Kartli and the Kirovabad-Kazakh plains, significant part of the Iori-Adjinaur upland and the right bank of river Araks within the boundaries of Iran. These landscapes are the most prevalent at 200-600m above sea level. However, they are also met at 800 m above sea level.

Plain, sometimes ridged accumulative and arid-denudative relief is characteristic of these landscapes. Sloppy, terraced and mounded plains composed of clay, send-stone and pebbles appear here as well.

The Iori-Adjinaur upland is characterised by plateau, depression, arid-denudatiative relief composed of molassa formations.

The climate is sub-tropical in the Inner Kartli plain and becomes transitional to moderately warm, dry and moderately and slightly continental in the Iori-Adjinaur upland.

Landscape differentiation here is connected with moisture conditions. Shiblyaks and steppes are spread on chermozems, while brown and grey-brown soils are met in areas with significant humidity. Dry steppes on ash-brown soils with semi-desert vegetation are also met here.

Natural-agrarian units with orchards and gardens are concentrated on irrigated lands. Lands unsuitable for irrigation are used for winter pasturing.

E. North Sub-Tropical Arid Landscapes are mostly distributed within the Kura-Araks lowland and Absheron peninsula. In Georgia, they are met in the Eldar lowland.

Flat lowlands, and rarely wavy and terraced plains made of Quaternary deposits prevail here. In terms of their origin, they represent alluvial, delta, alluvial-proluvial and marine abrasive-accumulative plains and lowlands. In some places, there are sections with hilly arid-denudative relief. The climate is sub-tropical, arid, moderately and slightly continental. NTUs with fragrant-absinthe, saltine desert and semi-desert vegetation on grey and grey-brown soils dominate here.

F. Thermo-Moderate Semi-Humid landscapes are spread within the Alazani-Avtoran lowland in the East Trans-Caucasus and the left bank of river Kuban from Taman peninsula to the valley of river Laba. They are distributed at 600m above sea level.

These landscapes are characterised by sloppy alluvial, alluvial-proluvial plains, in some places covered by alluvial cones composed of Quaternary deposits: pebbles, sands, loam and clays. Floodplain of rivers Alazani, Agrichai and Kuban are very distinct. The banks of the Alazani-Avtoran lowland are distinguished by plains with hilly erosive-denudative and erosive-accumulative relief. Saline parcels are met occasionally.

The climate is moderately warm, semi-humid and weakly continental. Annual sums of precipitations make up 500-700mm.

Natural-territorial units occupy no more than 5-10% of this territory. Riparian (Tugay) forests grown on alluvial meadow

and saturated soils represent them. Forests in the East Trans-Caucasus consist of oaks, zelcova and are characterised by a great variety of species of trees, shrubs and lianas. Dry terraces are over-grown by oak forests with various shrubberies, whilst much drier terraces with alluvial soils are grown by beech and hornbeam forests. On the Kuban section, vegetation is represented by hornbeam-oak and oak (Quercus robur, Q.petrae, Carpinus caucasica) forests, which belong to the group of the North Caucasian humid mezophilous oak-groves. Forests are usually grown on wide terraces and floodplains with different types of grey soils. Considerable areas are also occupied by alluvial and grey soils.

At present, natural-agrarian units with vineyards and grain crops prevail on the Alazani-Avtoran lowland. Inhabited territories occupy vast areas as well. The Kuban section is characterised by natural-agrarian units grown by crops (wheat, barley, and maize), orchards, and tobacco plantations. Meadow forests are widely used as pastures.

G. Temperate Semi-Arid Landscapes occupy large areas in the North Caucasus, prevailing in the pre-Caucasus. Four types of relief are met within these landscapes:

1. Lowland (pre-Kuban or Azov-Kuban) delta, delta-alluvial and alluvial plains with weekly-distorted flat relief.

2. Down-hill (pre-Kuban, Mineralovodskaia, Kabardinski, Khasaviurt-Kiziliurtskaia) flat and inclined hillock plains, with accumulative and denudiative-accumulative relief, containing molassa formations.

3. Intermountainous (Ossetian and Chechen) depressions, hillock accumulative and denudative-accumulative plains, made up of molassa (pebbels, clays, loam and sands) formations;

4. Uplands (Stavropol) with structural-denudative plateaux, plains, and hills with denudative-accumulative relief forms.

The climate is moderate, transient to thermo-moderate in Dagestan. The temperature in January falls as low as -3˚, -5˚ (in Dagestan - 2˚), but in July equals + 20˚, + 24˚. Although in geo-morphologic terms, sub-mountain and intermountain plains make up a single structure, climatic and especially, moisture conditions vary greatly within the plains. This is connected with both significant altitude variations (from 50 to 700m) and the “barrier"-like effect of increasing precipitation in the territories adjacent to mountains. Consequently, the amount of precipitation increases up to 350-400 mm in the lower parts of the plains, becoming even equal to 500-600 mm in the upper parts. The duration of snow cover increases as well and lasts from 40 to 70 days.

Climate variability affects vegetation cover. Overall, there is a dominance of steppe ecosystems. However, in upper parts of plains they are replaced by oak and oak-hornbeam forests.

Following major NTUs are met within the moderate semi-arid landscapes: dry semi-desert steppes on chestnut soils; absinthe-cereal (with absinthe Taurus and Larha) steppes on chestnut soils and chernozems (black soils); steppes rich in grass on black soils; steppified meadows, meadow-steppes and meadows on black soils and meadow chernozems; thickets and fragrant thickets on brown and chestnut strong skeleton soils, shiblyaks on brown and grey-brown soils (only in Dagestan); oak hemi-xeric forests on brown and brown forest soils; mezophyte oak forests with well-developed herbage on brown forest soils; and oak hornbeam mezophyte forests with rare herbaceous cover on brown forest soils.

At present, naturally growing vegetation is almost entirely replaced by agricultural lands though, varying from region to region. The Pre-Kuban lowland is occupied by sugar beet, sunflower and crops. The Stavropol upland is grown by such crops as wheat, barley, and maize. Similar territorial units prevail also on foot-hills and intermountain plains of Kabardinia, North Ossetia, Ingushetia and Chechnya. Natural-irrigating units with vineyards and orchards are characteristic of Dagestan.

H. Temperate Arid landscapes have limited distribution in the Caucasus and occupy small areas in northern part of Dagestan and eastern part of Stavropol region, being well-adjusted to the south-western part of the Pre-Caspian lowland.

The relief is flat, weakly distorted. Marine, delta and mixed marine-delta accumulative plains prevail here. The most widespread form of relief is Aolean. The Kuma-Manich depression is characterised by the relief of lake-alluvial nature. Southwards from Makhachkala, desert and semi-desert landscapes stretch as 10-20km line along the Caspian Sea coastline to Derbent. The relief is represented by marine abrasive-accumulative plain with coastal sands, gradually turning into a sub-mountain downhill plain.

The climate within the pre-Caspian lowland is moderate (the temperature in January varies within -3˚, -6˚); being thermo-moderate southwards to Makhachkala with average annual temperature of the coldest month varying from -1.5˚ to +1.1˚. The temperature in July riches +24˚, +25˚. Annual amount of precipitation is 250-350mm.

Following NTUs pre-dominate within the Temperate Arid landscapes: xeric semi-shrubbery and xeric halophytic semi-shrubbery saline deserts on grey soils. Absinthe-cereal semi-deserts on chestnut soils appear rarely.

Northern parts of these landscapes are the least transformed by anthropogenic activities. They are mostly used as winter pastures. The coastline of the Caspian Sea has undergone significant transformations for agriculture uses and is mostly occupied by natural-irrigation units of vineyards, orchards and vegetable gardens.

I. Hydromorphic and Sub-Hydromorphic Landscapes are distributed in those parts of the Caucasus, where ground moisture becomes the major factor for forming landscape types. Such conditions usually prevail in areas with flat relief, where an excessive atmospheric or ground humidity promotes the formation of wetlands. Floodplains of large rivers located in areas with arid climate belong to these landscapes. They, in great deal, differ from steppe or desert landscapes, surrounding them, for their tugay shrubbery and meadow vegetation.

A comparatively low marshy part of the Colchic lowland with its depression-accumulative plain relief and sphagnum-reed marshes is of special mention.

Drained areas are occupied by NTUs with cereal crops, orchards and vineyards, yielding invariably high harvests.

II. Mountainous Landscapes

J. North Sub-Tropical Sub-Mediterranean Landscapes are met in extremely north-western part of the Caucasus between the cities of Anapa and Tuapse. They are located at 600m above sea level though, nearby the cities of Mikhailovka (between Gelendjik and Arhypo-Osipovka) and Orial (between Novorosiisk and Anapa) they go down to the seashore breaking the belt of foot-hill and hill landscapes into separate parts.

In the north-western part, these landscapes are represented by erosive-denudative steeply sloped down-hills. With increasing altitude of the south-eastern part of the Greater Caucasus, they turn into sloppy down-hills of high and medium steepness. They are composed of terrigenic-carbonate rocks.

The climate is sub-Mediterranean semi-humid. The January temperature varies within 0^oC-+ 3^oC and the July temperature within $+20^oC$ - $+22\ ^o\ C$. Annual amount of precipitation is 600-800 mm, with well-expressed summer minimum connected with prevailing semi-humid and semi-arid conditions. Snow cover is stable during the entire year. By some features, these landscapes are close to the southern shore of the Crimea.

Under such conditions, mezophyte oak (oak rocky and oak Medvedev-Quercus petraea, Q. Mtdwedewii) and Crimean-North Caucasus mountain and foot-hill forests mixed with other broad-leaved species, including pre-Mediterranean (Quercus pedunculiflora, Carpinus caucasica, etc) hemi-xeric and mezophyte forests become prevalent. Shore ridges are grown by pine forests (Pinus pithiusa), often with under-woods of Carpinus orientalis and Rhus coriaria. Juniper vegetation is well-adapted to such extremely dry climate conditions and thus, appears from place to place. There are also arid jumper sparse groves. These areas are dominated by brown and dark brown forest soils, usually forming a weak skeleton.

Agriculture lands do not occupy large areas within these landscapes. Natural-agrarian territorial units with vineyards, orchards, and tobacco plantations are only located on sloping hillsides and terraced bottoms of river gorges.

K. North Mediterranean Landscapes are well-adapted to the gorge of river Chorokhi within the area between the cities of Artvin and Borchkha (Turkay). The relief is mountainous-depression type, erosive-accumulative, gradually becoming erosive-denudative. Dominating forms of relief here are the slopes of high and medium steepness. Bottoms of gorges are located at 200-300 m above sea level, sometimes spreading as high as 600 m and reaching 700 m on the southern slopes.

Within small distance from Borchkha to Artvin, the climate changes sharply. Annual sums of atmospheric precipitation

reduce from 2,500 mm to 300-400 mm. The summer minimum plays an important role in annual distribution of atmospheric precipitation. Similarly, winter temperatures fall sharply from +6˚ to +1˚, +2˚.

Bottoms of river gorges are covered by maquis of wild strawberry tree, rockrose and heather, grown on brown soils. Southern slopes are covered by xeric vegetation of shiblyak type, whilst northern slopes are occupied by Colchic forests grown on dark brown forest soils.


Tulip. Iori plateau. Georgia
Source: Nationalparks of Georgia. WWF, 1991

L. North Sub-Tropical Semi-Arid Landscapes are characteristic of the low mountains of the East Trans-Caucasus. They are met in Kobistan, on the Iori upland, Ceyran-Chele, and the Adjinaur, Shekin and Karamaryam plateaux.

All these territories are characterised by folded and blocked low-mountain ridges and depressions. The relief is distinctly outlined by anticline (anti-wedge) ridges with prevailing straight tectonic relief. Along with this, folded ridges with less distinct structures of relief are met. The relief is of arid-denudative and erosive-denudative type. Along with slopes of lower steepness there are very steep slopes turning into badlands. Molassa, rarely terrigenic-carbonate rocks are dominant geological structures.

The climate is sub-tropical semi-arid, weakly and moderately continental. The January temperature fluctuates within $+0^0$C – $+2^0$C. In winter, temperature inversions are not rare, when low temperatures stand long in locked valleys. The July temperature varies within $+23^0$C – $+25^0$C. Annual amount of precipitation is 400-500mm and is distinguished by two minimums of precipitation, one – in winter and the other in summer. The latter determines a long duration of semi-arid conditions, which itself determines specific features of landscapes. A stable snow cover is seldom phenomenon.

These types of landscapes are grown predominately by xeric (arid) open forests. Open forests of pistachio trees (Pistacia mutica) are widely spread within low-hill semi-arid landscapes. They usually grow on brown, rarely on grey- brown soils. Their upper tier is extremely sparse. Shrubberies with the dominance of Paliurus spinacliristi, Rhamnus palasi and Cotinus coggygri are grown under these woods. Steppe cereals: Botriochloa ischaemum, Festuca valesiaca, Stipa capillate are of high importance. Archy open forests are formed with several species of arborescent junipers (Juniferus polycarpos, J. foetidisima, J. excelsa, J. Obloga), often succeeding with pistachio. Their upper tiers are very sparse, with prevailing under-woods of xeric shrubs and steppe cereals. Large areas are occupied by hemi-xeric shrubs and shiblyaks (with prevailing Paliurusian Schibyak: Paliurus spina christi). Along with this, astragal and Acantalimon fryganas etc. are distributed here. Desert and semi-desert vegetation is met on dry southern slopes. Steppes occupy large areas.

Because of arid climate and highly eroded relief, this type of landscapes is relatively pristine. They are usually used as winter pastures.

M. Thermo-Moderate Humid Landscapes are one of the wide-spread landscapes in the Caucasus. Eight sub-types are distinguished within this type of landscapes.


Colchian forests. Georgia
Source: Nationalparks of Georgia. WWF, 1991

Colchic Low-Mountain Forest Landscapes infringe the Colchic foot-hills as a relatively narrow (5-10km) strip, widening up to 10-12 km in Upper Imereti and Guria – Ajara (Georgia). Mountainous-valley landscapes of Racha-Lechkhumi and Inner Ajara also belong to this sub-type of landscapes. In the North Colchida, low mountain landscapes are found at altitude of 400-600m. In the central part, they are distributed at altitude of 300-600m, reaching the height of 700-800m in the South Colchida. In the Racha-lechkumi depression as well as within the basin of river Ajaristskai they are distributed as high as 900m above sea level.

The relief and geological structures are distinguished by high diversity. In the North Colchida, these landscapes are well-adapted to the southern slopes of steeply slopping ranges, made of limestone, as well as the bottoms of river gorges and canyons. Karst relief is widely spread here. Slopes of high and medium steepness with erosive-denudative relief composed of palaeogenic volcanic-sedimentary rocks prevail on the north macro-slope of the Ajara-Imeretian range. Various mountain rocks represent the Racha-Lechkhumi depression. The major part of the depression is composed of terrigenic and carbonate rocks with erosive-accumulative and karst relief. The Inner Ajara, composed of palaeogenic volcanic sedimentary rocks, is characterised by alternating patterns of relatively broad terraced gorges and narrow gorges and canyons. The relief is erosive-accumulative and erosive-denudative.

The climate is transitional from humid sub-tropical to thermo-moderate. The temperature fluctuates within $+4^0$C – -1^0C in January and $+20^0$C–$+22^0$C in July. Annual precipitation increases from 1000 to 2500mm. On the slopes facing the sea (and correspondingly the humid air masses) precipitation amount, on the contrary declines.

Hemi-xeric oak herbaceous forests on yellow-dark brown and brown forests soils prevail on the steep southern macro-slope, composed of limestone. Polydominant forests with thick evergreen under-woods grown on dark brown soils are dominant in shady gorges. In upper parts of gorges and on the northern macro-slope, they are replaced by beech forests with evergreen under-woods. NTUs, composed of hornbeam and hornbeam-beech forests with leaf-shedding under-woods grown on dark brown forest soils occupy intermediary habitats. In mountain depressions, lands are extensively cultivated. Natural-agrarian territorial units with vegetable gardens, tobacco plantations are widely spread here.

Colchic Middle-Mountain Forest Landscapes are spread in the mountainous areas of the Colchida at 600 (400)-1,200 (1,400) m above sea level. In some places, in southern Imereti for instance, they wedge out low mountain forest landscapes and come close to foot-hill and hilly landscapes of the Colchida, from place to place breaking a zone of middle mountain beech-dark coniferous forests, joining immediately uphill-forests and even high mountain sub-alpine landscapes of the Colchida. The greater part of these landscapes is composed of porphyrites, Jurassic schist (in the North and Central Colchida) and palaeogenic volcanic sedimentary rocks (in the South Colchida). An erosive-denudative relief with slopes of high and medium steepness is characteristic of these regions.

The climate is thermo-moderate, humid and littoral. The temperature decreases with increasing altitude. In January, it falls from – 0.6^0C to – 5.5^0C and in July from $+19^0$C to $+16^0$C. The amount of precipitation is connected with the number of factors. One of the major determining factors is the location of mountains in relation with prevailing arid air masses. For instance, if annual amount of precipitation in middle mountainous area of littoral Ajara varies within 2,500-3,000mm – it falls to almost 1,000 mm in deep locked gorges. In terms of precipitation distribution - the altitude is not a determining factor.

NTUs with beech forests and evergreen under-woods grown on dark brown (in karst region – humus consisting carbonate) soils prevail within the Colchic Middle Mountain Forest Landscapes. Drier areas such as crests or ranges of southern macro-slope are occupied by beech-hornbeam herbaceous forest grown on dark brown (or rendzin) soils. Transitional location is occupied by NTUs of beech forests with deciduous shrubs or herbaceous tier grown on dark brown soils (or rendzin). In the South Colchida and Lazistan, the morphological structure of landscapes becomes simpler. NTUs of beech-chestnut forests, with thick evergreen under-woods and sparse “Shkeriani” become prevalent. Populated areas, orchards and vegetable gardens emerge only on bottoms of wide terraced gorges.

Hyrcan Low-Mountain Forest Landscapes are spread in the south-east part of Azerbaijan in Tallish mountains and in Elburs mountains in Iran at altitude from 200 to 600m. Higher locations (up to 1,200m) are occupied by *Hyrcan Middle Mountain Forest landscapes.*

The relief in low and middle mountains is erosive-denudative with prevailing slopes of medium steepness, composed of Palaegene, volcanic-sedimentary rocks. In places where rivers (Vilyashchai, Lenkkoran and its trinutaries, Tangerud, Astara) cross dominating tectonic structures, directed from north-west to south-east, steeply sloped and weakly terraced gorges are prevalent.

The climate is thermo-moderate, moderately continental in the *Low-Mountain Forest Landscapes* and thermo-moderate, weakly continental, humid in *Middle-Mountain Forest landscapes*. The temperature in low mountains varies within +1°– - 2° in January and +18°– +21°in July. Annual sums of precipitations vary within 900-1,200 mm (in some gorges they may reach 1,700 mm). In terms of precipitation distribution, there is no distinctly expressed summer minimum, so much

characteristic of the Lenkoran lowland. Therefore, the moisture is evenly distributed during the year within the Hyrcan landscapes. Middle mountains have the amount of annual atmospheric precipitations (700-1000 mm) lower than low mountains. However, much lower temperatures determine less evaporation. Therefore, the humidity is much higher.

Hyrcan Low-Mountain Forest landscapes are mostly occupied by NTUs with mixed coniferous Hyrcan forests of chestnut-leafed oak, oak-hornbeam-iron clay and hornbeam-oak trees grown on mountainous yellow and yellow-brown soils. Crests and tops of medium mountains, and the south macro-slope are over-grown by pure oak forests of chestnut-leafed oak relicts, belonging to tertiary flora of Hyrcan origin. On medium hills, the amount of Georgian oak trees (Q. iberica), and in some places, of oriental oak trees (Q. macranthera) increase with an increase in altitude. Georgian oak becomes dominant at an attitude over 800m. Underneath oak forests, brown forest soils are formed. On the northern slopes of Middle Mountain Forest landscapes, beech (Fagus orientalis) and hornbeam-beech forests, grown on brown forest soils are prevalent.

One of the peculiarities of Hyrcan mountainous landscapes is the decrease in atmospheric precipitation with an increase in altitude, determining an increase in the share of semi-arid NTUs.

In Soviet times, due to high aesthetic value, the Tallish forests were designated a first category forest, with a restricting regime of commercial logging. That is why there are not many areas transformed by human activities. Small settlements, orchards and vegetable gardens are met only on the terraces of river gorges.

Kakhetian Low- Mountain Forest landscapes are spread in eastern part of the Greater Caucasus: Kakheti and Nukhi-Zakatala regions. Lower border passes foot-hills of the Alazani-Agrichai lowland at an altitude of 300-500m. Upper border is located at an altitude of 800m, runs through river gorges and crests, where it reaches 1,000m altitude.

The relief is erosive-denudative with slopes of high and medium steepness, laid of terrigenic and terrigenic-carbonate rocks. Under these conditions, forests rich in species specific to both Colchic and Hyrcan relict flora are formed.

The climate is thermo-moderate (+1°, -2° in January, +19°-+22° in July), humid, weakly continental with annual amount of precipitations varying within 700-1000 mm. The snow cover is formed at the end of December and lasts until the beginning of March.

The landscapes are very complex. The bottoms of river gorges and the slopes of northern macro-slope are dominated by high quality beech-chestnut forests (in lower parts mixed with hornbeam) with well-expressed tier of deciduous shrubbery, grown on brown forest soils and sometimes mixed with lianas. Moderately humid slopes and upper parts of crests are occupied by beech- hornbeam forests, including oak trees with herbaceous tier.

With a decreasing humidity and an increasing atmospheric temperature, derivative oak forests with a shrubbery tier and oak-hornbeam forests grown on brown soils, succeed each other. Small patches of shiblyak, grown on brown soils, occupy relatively dry areas.

The Kakhetian Low-Mountain Forest landscapes are relatively intact and thus, natural-agrarian territories appear rarely.

South-East Caucasian (Transitional to Semi-Humid) Low-Mountain Forest Landscapes are distributed in the Central and East Trans-Caucasus. They are met at an altitude varying from 400m to 1,400m. In relatively humid regions, lower border goes down, while in more arid regions, it goes up. Most typically, low mountain forest landscapes are spread at 800-1,200m above sea level.

The relief is erosive-denudative, rarely erosive-accumulative, with prevailing slopes of medium and high steepness, mostly composed of terrigenic and volcanic-sedimentary rocks.

The climate is thermo-moderate (January -1^0C -20^0C, July $+18^0$C $+21^0$C), humid, transitional to semi-humid. Annual sums of precipitations vary within 600-700mm and in summer, some deficit of humidity is noticed.

Oak forests (Q. iberica) with deciduous shrubs and rare herbaceous tiers, grown on brown lixiviated soils are most widely spread in low mountain forest landscapes, well-adapted to habitats with warm, moderately humid climate. Oak forests with herbaceous tiers, grown on brown lixiviated soils and dark brown weak unsaturated soils are adapted to relatively arid and colder habitats. Oak trees with thick shrubbery tier and correspondingly thin vertical structures (8-

16m), grown on brown lixiviated soils are well-adjusted to crests and slopes of the South macro-slope. In lower parts, they are substituted by oak-hornbeam forests with herbal tiers. On the border with middle mountain forests, NTUs of transitional character with hornbeam-oak shrub and herbaceous forests, grown on brown weak unsaturated soils are distributed. On extremely humid and relatively cool northern slopes, NTUs characteristic of middle mountains, such as beech forests with shrubbery tier are widely spread.

South-East Caucasian Middle-Mountain Forest Landscapes are widely spread in middle mountains of the Central and East Trans-Caucasus at altitudes varying within 1,000-1,600m. On the southern slopes of Kakhetian "Kaukasioni" and adjacent regions of Azerbaijan, due to relatively humid climate, lower border descents to 700-800m and in Karabakh, due the arid climate this border, on the contrary, rises to the height of 1,400m.

The relief is middle-mountain erosive-denudative, rarely, erosive-accumulative, with slopes of medium and high steepness.

The climate is thermo-moderate and moderate (January temperature -2^0C -5^0C, July temperature $+16^0$C $+18^0$C), humid. Annual amount of precipitation is 700-900 mm. However, on the slopes of Kakhetian "Kaukasioni" the amount of precipitation increases to 1,200-1,400mm, and in the south-east part of the Lesser Caucasus, falls to 600mm.

NTUs of beech forests with deciduous shrubbery and herbaceous tiers, grown on typical brown forest soils are the most widely spread. More seldom appear beech-hornbeam forests, grown on brown forest and weak unsaturated soils and oak and oak-hornbeam forests with herbaceous tier, grown on brown weak unsaturated forest soils. Place to place, pine forests with herbaceous tier on acid brown soils are met. On the slopes of Kakhetian "Kavkasioni" beech forests with hornbeam, and rarely with chestnut, grown on brown typical forest soils are distributed. On the Lesser Caucasus, forests turn into meadows, connected with human activities.

Overall, the landscapes are not significantly changed by human activities. Settlements, orchards, vegetable gardens, rarely, arable lands represent Natural-Agrarian Territorial Units here. Broad terraced river gorges and flat areas are occupied by cultivated lands.

Pontic Middle Mountain Forest (Sub-Colchic) Landscapes belong to East Trans-Caucasus Forest landscapes. They are spread in Pontic Mountains in Turkey. Here they are well-adapted to the West macro-slopes and are mainly composed of middle mountain erosive-denudative relief, being a friendly environment for flourishing oak forests with a number of Colchic elements.

N. Thermo-Moderate Semi-Humid Mountain Landscapes are mostly distributed in Pontic Mountains in Turkey where they are well-adapted to the southern macro-slope and are spread in gorges of rivers Kelkit and Chorokh, and in inter-mountainous depressions southwards from the main chain of the Pontic range.

The climate is semi-humid, very favorable for growing oak trees. Thus, oak forests grown on brown soils together with Schibyaks having Mediterranean elements are widely distributed there. Middle mountains are occupied by pine forests and meadows adjacent to forests.

O. Thermo-Moderate Semi-Arid Landscapes are divided into three sub-types: *Anatolian Upland and Middle Mountain Forest Landscapes; Pontic Mountainous-Steppe and Shiblyak Landscapes; and Front Asian Middle-Mountain Steppe and and Shiblyak Landscapes.*

Anatolian Upland and Middle-Mountain Forest Landscapes are usually found in the central part of the Anatolian upland in Turkey and the northern part of the Iranian plateau. The Caucasus part involves only the most northern part of these landscapes. Due to semi-arid climate, steppes and Shiblyak vegetation, grown on brown soils are widely spread. These landscapes are beyond the Caucasus eco-region.

Pontic Mountain Steppe and Shiblyak Landscapes are widely spread in the lower parts of rivers Kelkita, Chorokhi and Oltu in Turkey. The aridity of the climate provides favourable conditions for wide distribution of steppe, shiblyak and phrygana vegetation.

Front Asian Middle-Mountain Steppe and Shiblyak Landscapes are found in the northern part of the Iranian plateau. Steppes together with shiblyak and phrygana vegetation are widely spread here. The extreme part of these landscapes

belongs exclusively to the Caucasus eco-region.

P. Thermo-Moderate Arid Landscapes are distributed in Iran and the south side of the Kura-Araks lowland near the borders of Armenia and Azerbaijan. They are represented by down-hill and low-hill desert type hamadas and semi-deserts. Middle mountains and plateau landscapes are occupied by deserts, saltines and semi-deserts.

Q. Temperate Humid Landscapes are widely distributed in the North Caucasus. These landscapes are divided into two sub-types.

Belaya river canyon.
Source: http://lavkimaved.ru

North-Caucasian Low-Mountain Forest Landscapes stretch as a narrow (5-20km) strip along the northern macro-slope of the Greater Caucasus, breaking into parts from place to place. They are met at an altitude of 300-500m, sometimes reaching 1,000-1,100m. Erosive-denudative, and in some places, karst reliefs are mainly met here. The relief consists of terrigenic, terrigenic-carbonate and carbonate, more seldom molassa deposits. Slopes of medium and high steepness are dominant forms of relief. In places, where river gorges are cut by mountain ranges, difficult to pass canyon-type gorges are formed.

The climate is moderate humid, weakly and moderately continental. The temperature in January is -3^0C, -5^0C, in July $+18^0$C, $+21^0$C. The annual amount of precipitation is 600-800mm, recorded mostly in warm seasons.

Under such condition, mixed-oak forests are dominant. In the western part of the northern macro-slope of the Greater Caucasus, the most prevalent is the Georgian oak. Along with oak forests, oak-hornbeam forests are spread. In Dagestan, due to arid climate, thorny shrub thickets are prevalent, but their existence is also connected with cutting of aboriginal forests. Here prevail brown forest soils, rarely, brown lixiviated soils, and in karst regions-rendzins.

The landscapes are not transformed significantly by human activities. Small plots of settled areas with orchards, vegetable gardens, rarely, arable lends are met here.

North-Caucasian Middle- Mountain Forest Landscapes are located along the northern macro-slope of the Greater Caucasus, at altitudes varying from 800-1,000 to 1,500-1,800m. In the regions of the Kabardin and North Ossetian plains they encounter plain landscapes and on the meridian of Elbrus, on Bermamit plateau are wedged out by middle mountain forest landscapes.

These landscapes are characterised by middle mountain erosion-denudative relief with slopes of medium and high steepness, laid of terrigenic, rarely terrigenic-carbonate and molassive formations. Canyon-like gorges characterise the karst regions.

The climate is moderate, weakly or moderately continental. The temperature in January varies from-3^oC to -6^oC and in July $+15^0$C $+19^0$C. The amount of precipitation is the same as in low mountain forest landscapes but the humidity is higher due to lower summer temperatures. Precipitation maximums are recorded in summer seasons.

These landscapes are mostly occupied by beech forests. There are also beech-hornbeam, rarely, hornbeam-oak and oak forests. In places, where forests are located close to human settlements, meadows adjacent to forests and thickets of mezophyte shrubs are distributed. Brown forest soils; rendzins-in karst regions; and humus containing-carbonate soils are dominant types of soils.

The landscapes are slightly changed by human activities. Natural-agrarian territorial units are mostly met in wide, terraced river valleys.

R. Temperate Semi-Humid Landscapes are represented by two sub-types of landscapes.

North-Caucasian Middle-Mountain Meadow and Meadow-Steppe Landscapes are distributed as a number of isolated patches. The largest sector is found between the cities of Cherkessk and Baksan. The region is characterised by karst middle mountain relief with slopes of medium and high steepness, laid of carbonate and terrigenic-carbonate deposits. These landscapes are also met in the Inner Dagestan, where they are well-adapted to river valleys. Here two types of relief are pre-dominant: karst, with slopes of medium and high steepness and erosive-denudative, with slopes composed of terrigenic deposits.

The climate is moderate, semi-humid, moderate-continental. The temperature in January is -4° C, -5 ^{0}C and in July -+16^{0}C, +18^{0}C. Annual sums of precipitation fluctuate within 450 to 600mm. Semi-arid conditions are frequent in summer, determining the relative aridity of these landscapes.

In the western part, middle mountain meadows and meadow-steppes, rarely (in more humid gorges) beech and hornbeam-oak forests, grown on rendzins and humus-carbonate soils are widely distributed. Meadows, meadow-steppes, phrygana vegetation, etc. grown on brown soils are dominant in Dagestan. An absence of forest vegetation s connected with the influence of human activities.

A considerable part of the landscapes is changed by human activities, especially in Dagestan. The major part of the land area is occupied by NTUs with settlement, terraced agricultural lands, orchards and vegetable gardens. Arable lands are also widely spread together with pastures and hey fields.

Pontic Middle-Mountain and High-Mountain Meadow-Steppe and Forest Landscapes are spread on the South chains of Pontic Mountains, in the very place, where they border the Anatolian upland. Medium Mountainous plateaux with pine forests and meadows are characteristic of this sub-type of landscapes.

S. Temperate Semi-arid Landscapes are spread in the North Caucasus and on the Javakheti-Armenian volcanic plateau. In the lake Sevan basin (south and west parts), these landscapes are located at an altitude of 1,800-2,000m, in Akhaltsikhe depression - 900-1,500m, and on the Armenian highlands – on the slopes of ranges framing the Ararat Valley.


Khanchali lake
Source: GCCW

The relief is of mountain-depression type denudative-erosive-accumulative. It is characterised by flat and inclined alluvial - proluvial bottoms adjacent to erosive-denudative foot-hills, laid of volcanic terrigenic formations.

The climate is moderate (January is -4 ^{0}C-6 ^{0}C and in July +16^{0}C +19^{0}C), semi-arid, moderately continental. The annual amount of precipitation is 400-450mm.

There prevail following NTUs:

- Shiblyaks on brown typical soils;

- Phrygana on brown carbonate soils;

- Grasslands and grassy-multi-herbaceous steppes on brown soils and chernozems;

- Meadow-steppes on brown soils.

The landscapes are considerably changed by human activities and there prevail natural-agrarian territories with arable lands, vegetable gardens and settled areas. The Akaltsikhe depression is mostly occupied by orchards.

Of special mention is the high Javakheti-Armenian volcanic plateau, over-grown by steppe and meadow-steppe vegetation. These landscapes are spread on the Akhalkalaki and Tsalka plateaux in Georgia, karst plateau in Turkey and

the surroundings of the city of Giumri (the former Leninakan) in Armenia. The height interval is 1,500-2,000m. These landscapes represent typical high volcanic plateaux with plain relief in the centre and hills and foot-hills - in peripheries. Occasionally, plateaux are cloven by deep canyons, cut down by rivers. Plateaux are composed of young volcanic deposits alternating with lake and alluvial deposits. The remains of former lakes occupy considerable areas even now.

The climate is moderate, semi-arid, moderately continental (-4°, -5° in January, +15-18° in July). Total annual precipitation varies within 500-600 mm. However, summer time is distinguished by reduced humidity.

The major NTUs are as follow:

- Feather-grasses and steppes on black soils (chernozems);

- Meadow-grassy and multi-herbaceous steppes on black soils;

- Steppified multi-herbaceous and grassy-herbaceous meadows and steppes on meadow chernozems;

- Fragments of pine forests on brown forest podzol soils.

A major part of the landscapes is ploughed and occupied by grain fields and potatoes. Hilly areas and high foot-hills are used as summer pastures. Selitebic plots occupy considerable areas as well.

In the North Caucasus, moderate semi-arid landscapes are well-adjusted to the altitudes varying from 600-700 m to 1,100-1,300m, and are spread exclusively in inter-mountainous depressions. The depressions are made of terrigenic and molassa rocks and their bottoms are characterised by erosive-accumulative relief.

Due to the locked nature of depressions, there is a great deficit of moisture, especially, in summer periods. The annual amount of precipitation is 400-600mm. The January temperature is -2 ^{0}C, -4 ^{0}C and the July - +15^{0}C, +17^{0}C.

Under such conditions, specific vegetation is formed. Mountain steppes are represented by feather grass communities, sometimes with the participation of bear grass. They are changed by the shrubbery thickets with the participation of Acer campestre (species Crataegus, Comus mass, Paliurus spina-christi, Rhammus pallastii). Among upland xerophytes, the most widely spread are the species of Ostragalus, Acanthlimor, and Onobrychis.

In the Inner Dagestan, meadow-steppes (multi-herbaceous- peristo- feather- grass, etc.), arid steppes and steppified meadows are widely spread. Tragacant thickets are most frequently represented by thyme- feather- grass (species Thymus) and steppe-specific grass (with the participation of feather grass, etc) on brown and occasionally alluvial soils, including rendzins.

A major part of landscapes is significantly changed by man. Natural-agrarian territorial units with Selitebic plots, grain crops, orchards and vegetable gardens occupy wide areas within these landscapes.

T. Temperate Arid Landscapes are specific to the bottoms of the Ararat Valley and the slopes framing it, as well as Nakhichevan and Turkey (at an altitude of 1,000-1,200m). Arid-denudative disported steep and slightly sloped low-mountains, foot-hills, and rarely, hilly plains are major relief forms. They are composed of volcanic sedimentary and terrigenic carbonate rocks. The Ararat Valley has flat, and on edges sloppy, feebly cloven plain relief, composed of alluvial and proluvial Quaternary deposits.

The climate is moderate (January temperature is -4 ^{0}C, -6 ^{0}C and July +21^{0}C, +24^{0}C), moderately continental, arid in the Ararat Valley and thermo-moderate in the region of Megri. Annual amount of precipitation is 200-300mm with an observed great deficit of humidity from June through October.

Such climate conditions are favourable for forming ephemeral fragrant absinthe (Artemisia fragans, Poa bulbosa, Colpodium humile, species Gagea, Tulipa, Bronus, Eremopyron, Aegilops) deserts, (Artemisia fragans, Poa bulbosa, Colpodium humile, species of Gagea, Tulipa, Bromus, Eremopyron, Aegilops) on hilly desert-steppe fallow and hilly lightchestnut, somewhat skeleton soils.

In the Ararat Valley, the closeness of water table to the earth surface provides additional moisture. That is why here meadow NTUs occupy considerable areas. "Mediterranean" rich perennial-salty halophytic deserts with participation of annual solonchaks on somewhat moist solonchak saltines in combination with halophytic meadows and communities of halophytic species of absinthe are well-adapted to relatively saline conditions. In areas adjacent to foot-hills, phrygana vegetation, grown on grey-brown soils is prevalent.

These deserts, known in the scientific literature as the "Kura-Araks" (east-Caucasian) deserts, are mixed with the semi-shrub thickets (Salsola nodulosa, S.ericoides, S. dendroides) or tragacant astragals, acantalimon, semi-shrub labiatase, and sometimes steppe grains. Relatively humid areas are occupied by arid open woods (at present nearly fully removed) and vegetation, grown on brown and grey-brown soils.

A major part of the Ararat Valley is transformed by human activities and occupied by irrigated agricultural lands (arable lands, orchards, and vineyards). Within these landscapes, a lower part of Yerevan, Armenian capital and the main industrial region of Armenia are located. Steep slopes are also occupied by irrigated agricultural lands (arable lands, orchards, and vineyards). Settlements occupy considerable areas as well.

U. Cold-moderate Landscapes are one of the most specific types of landscapes among the Caucasus landscapes. Of them, the most distinct are the *Middle Mountain Dark Coniferous Forest Landscapes.*

Middle-Mountain Dark Coniferous Forest Landscapes are characterised by the optimum combination of heat and moisture, which enables the NTUs to accumulate biomass the largest not only in the Caucasus but also all over Europe. They are distributed in the western part of the Caucasus. In the Central Trans-Caucasus, they are represented by a number of small patches until the village Bevreti, located in 15-km distance westwards from Tbilisi. In the North Caucasus, they are spread until the river B. Zelenchuk basin.

The relief is erosive-denudative and karst. The erosive-denudiative relief is characterised by slopes of medium and high steepness, composed of various geological deposits: crystal and metamorphic rocks of Palaeozoic, Jurassic slates and porphyrites, palaeogenic and neogenic sandstones. On the Ajara-Imereti and Trialeti ranges widely-spread are the volcanic sedimentary rocks of palaeogenic period. It is noteworthy, that the high diversity in geological structure is not reflected in relief, vegetation and even soils.

The karst relief provides the formation of very specific vegetation and soil types. Existence of limestone determines a wide dissemination of canyon-type gorges, rocky deposits and karst reliefs. Under such conditions, calcic flora and rendzin and humus-carbonate soils are formed.

The climate is cold moderate, humid, littoral and weakly continental. The temperature in January is -3 ^{0}C, -6 ^{0}C and in July +14^{0}C, +16^{0}C. Annual amount of precipitation is sufficient everywhere, though is characterised by high variation, ranging from 700mm in the Central Trans-Caucasian and North Caucasus up to 3, 000mm in the mountains of Adjara and Guria and also on the ranges of the Great Caucasus facing the sea. There is no deficit of humidity. The snow cover is stable from the end of October-November through April.

Beech-dark coniferous forest with Colchic under-woods, grown on brown forest acid and podsolized soils are met only in the Colchida. Dark coniferous forests with high capacity vertical structure, grown on podsolised brown forest soils are spread exclusively in favourable for wood growth ravines of Svaneti, Abkhazia and some other regions of the mountainous part of the Colchida. Beech-dark coniferous still-cover forests are distributed everywhere, often replacing the forests with evergreen under-woods. Beech-dark coniferous forests with leaf-falling shrub layer, moss cover, herbaceous layer and also dark-coniferous tiers, grown on brown typical forest soils appear from place to place. The Borjomi gorge and eastern part of the landscapes under discussion, located in the North Caucasus are occupied by pine trees, grown on brown forest soils.

The landscapes are only slightly changed by man. The plots with


Pine Forest. Borjomi national park. Georgia
Source: National parks of Georgia. WWF, 1998

settlements, vegetable gardens and small arable lands are mostly met on the bottoms of broader terraced parts of river gorges.

V. High Mountain Forest-Meadow Landscapes are widely distributed in those high mountainous regions of the Caucasus, which are located on two largest parts of extended mountain system (Central and Dagestan) corresponding to the newest Caucasian transverse uplift, as well as in orographically isolated deep inter-mountain depressions and river gorges. In other regions, these landscapes have limited area of distribution.

The relief is erosive-denudative, with steep slopes, composed of the most diverse geological formations varying from crystal and metamorphic to sedimentary Quaternary. From place to place, wide bottoms of river gorges and depressions are met, having both erosive-accumulative and palaeo-glacial origin.

The climate is cold moderate, humid. The temperature in January is -5 ^{0}C, -7 ^{0}C and in July +12^{0}C, +14^{0}C. Annual sums of precipitation fluctuate within the broad range from 700mm in Dagestan to 2,000-2,500mm in the Colchida.

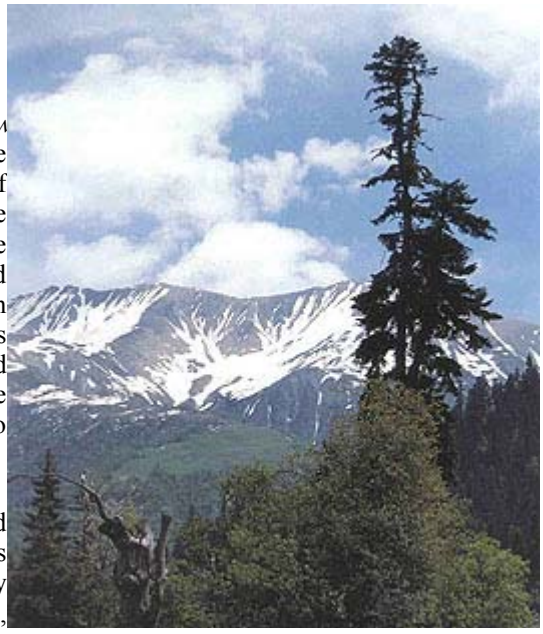
The forests are mostly composed of birch (Betula Litwmowii, B. Medwedewii, B. Megrelica), pine (Pinus Sosnovskii), oak (Quercus macrantera, in Colchi - Q. pontica), maple (Acer Trautvetteri) and some other wood species specific to high mountain forest landscapes. They form specific groups: open forests, low forests, crooked forests and shrubs, connected to the plants' adaptation to the extreme high mountainous conditions. Woodlands alternate with sections of upper-mountain and high-mountain meadows, among which tall herbaceous vegetation is worth of mentioning. Mountainous, forest-meadow, typical and dark soils are the dominant types of soils. Occasionally, appear the fallow forest, podzolised and typical soils. Limestone containing regions are pre-dominated by rendzins.

Historically, high mountain forests were intensively cut for farming activities. Therefore, at present, meadows, used for grazing and hey production, occupy significant areas here. High mountains are favourite places for seasonal settlements, occupied by shepherds.

Anatolian Middle-Mountain Forest and Forest-Meadow Landscapes are spread in Turkey and in the North Anatolya. In addition, they are characteristic of areas embracing meadow-steppes and occasionally xeric vegetations.

Unlike middle-mountain forest landscapes specific to Anatolia, *Anatolian High-Mountain Coniferous Forest Landscapes* belong to the sub-type of high mountain forest landscapes. From place to place, coniferous forests are mixed with xeric vegetation and have Mediterranean elements.

V. High Mountain Meadow Landscapes are distributed at high altitudes and are divided into several sub-types of landscapes.



Caucasian High-Mountain Sub-Alpine Forest-Shrubbery-Meadow Landscapes occupy the lowest hypsometric location among the Caucasus High Mountain Meadow landscapes. In different regions of the Caucasus, the lower border of these landscapes fluctuates within the height of 1,800-2,600m and the upper – 2,400-2,900m. In these continental, relatively arid regions, as compared with very humid littoral regions, the duration of nival *staxes* is less and under such conditions, the production of phytomass is somewhat greater. That is why in these regions, highland sub-alpine landscapes are well-adapted to high altitudes. It is noteworthy that sub-alpine landscapes rarely have well-delineated upper borders and they, usually, gradually turn into alpine landscapes.

Sub-alpine meadow landscapes are characterised by denudative and palaeo-glacial reliefs. In terms of morphology, the denudiative relief is related to steep, often rocky slopes. Palaeo-glacial relief is strongly related to the morphological forms created by ancient glaciation,

representing valleys, bottoms and circus inclines and a set of smaller forms ("roche mountonnee" ("the ram's forehead"), moraines, "hanging valleys" etc).

Central Caucasus
Source: National parks of Georgia. WWF, 1991

In terms of their origin, mountain rocks, making up of high mountain sub-alpine landscapes, can be sub-divided into three groups: volcanic, carbonate and silicate. These rocks determine the existence of special forms of relief. For instance, volcanic rocks are characterised by high mountainous lava plateaux and volcanic cones, whilst carbonate rocks are characterised by Karst reliefs.

The climate is High Mountain severe. The temperature is -8 ^{0}C - -10 ^{0}C in January and in July +8^{0}C - +12^{0}C. The annual amount of precipitation fluctuates from 500mm (in arid regions of Inner Dagestan and Armenia) to 1,500-2,000mm (in the Colchida). The snow cover is stable from the early October through the early May.

Following major NTUs are met within the *High-Mountain Meadow Landscapes:*

- Sub-alpine oblong forests (beech, birch, highland maple, etc);
- Sub-alpine shrublands (thickets of the Caucasian rhododendron ("dekiani"), and sub-alpine willow);
- High-herbaceous lands (with prevalence of carrot family-Heracleum, Augelica etc., composite family-Telekia, Senecio, Circerbita, bellshaped-Campanula latifolia, C. lactifolia etc);
- Sub-alpine meadows (grasslands, loose turf, multi-herbaceous, multi-herbaceous-grassy, bean-like-grassy-multi-herbaceous).
- Meadow-steppes and steppifed meadows in Armenia and Dagestan and highland xeric vegetation in Nakhichevan.

The vegetation is grown predominantly on mountain-forest-meadow, typical mountain-meadow and turf soils. Rendzins are also met.

Front Asian High-Mountain Meadow and Meadow-Steppe Landscapes are specific of the Minor Asia Highlands. They are found drier in comparison with the Caucasus sub-alpine meadow landscapes. Therefore, meadow-steppes dominate here, whilst sub-alpine meadows are found only as separate parcels.

Caucasian High-Mountain Alpine Shrubbery-Meadow Landscapes are widely spread in axial part of the Main Caucasus Range and its spurs. They are met in the highest parts of the Lesser Caucasus and the Javakheti-Armenian highlands. High locations are mostly, determined by thermal conditions. An important role is also played by the continentality and humidity of the climate. In the Colchida, alpine landscapes are distributed at the altitudes varying within 2,400-3,000 m. In the North Caucasus, the central part and the Lesser Caucasus, the alpine landscapes are found at 2,600-3,100m. The highest locations by these landscapes are occupied on the Javakheti-Armenian highlands and in the Inner Dagestan, where they are distributed at altitudes of 2,700-3,300m.

Similar to sub-alpine landscapes, alpine landscapes are composed of various mountain rocks. However, crystal and metamorphic rocks and Jurassic schist prevail on the Great Caucasus, while the Lesser Caucasus and the Javakheti-Armenian highlands are characterised by volcanic and volcanogenic rocks of Palaeocene-Quaternary ages. Limestone appears from place to place. Due to the diverse geological structure, the relief is also characterised by high variety. Both volcanic and karst reliefs are found here.

The climate is High Mountain severe. The temperature is -12 ^{0}C – -14 ^{0}C in January and +5^{0}C – +7^{0}C in July. The annual amount of precipitation varies within 600-1,500mm. The snow cover is formed from the late September – early October through the late May –early June.

Alpine meadows (of Festuca supina, Carex tristis, C.Medwedewii Alchimilla caucasica, Lofus caucasica, etc) are the dominant NTUs within the alpine landscapes. The "Alpine carpets"-thickets of low-grown compact turf forming plants resembling the multicoloured Persian carpets, emerge occasionally. The Northern slopes are grown by thickets of the Caucasian rhododendron.

The soils are mostly mountainous-meadow typical and turfy; Rendzins prevail in the karst regions.

High-Mountain Sub-Nival Landscapes are distributed on the Greater Caucasus. Specifically, they occupy the highest hypsometric locations on the Main Caucasian Range, Svanetian and some other ranges. On the Javakheti-Armenian highlands and the Lesser Caucasus, sub-nival landscapes occupy summits of separate mountain massifs and the ranges (Aragats, Abul-Samara, Hegam, Murovdag and Zangezur ranges). The height interval is 3,000-4,000m, though in the West Caucasus these landscapes may be found below 300m and in the Central and Eastern Caucasus may start only from 3,500m.

In the West and the Central Caucasus, sub-nival landscapes are composed of intrusive (granite etc.), metamorphic and sedimentary formations. Volcanic rocks pre-dominate in the Central and East Caucasus and on the Javakheti-Armenian highlands.

Sub-nival landscapes are characterised by typical and steep rocky crests, often with summits difficult to reach. Palaeo-glacial forms of relief – circus and glacial moraines are widely-spread as well. In volcanic regions, major and side volcanic cones and lava plateau represent the major morphological forms of relief. The sub-nival landscapes are characterised by continuous rocks and "stony rivers and seas".

The climate is severe. The January temperature is -15 ^{0}C - -17 ^{0}C and in July +3^{0}C - +5^{0}C. The annual amount of precipitation varies within 700-1,500mm.

The vegetation cover within the sub-nival landscapes is extremely reduced. Species like Alopecurus glacialis Jurinella subacualis, Delfinium caucasicum etc are found prevalent. Alpine species appear occasionally. In Dagestan, endemic high mountainous rocky talus flora is pre-dominant. The volcanic regions are characterised by Physoptychis gnaphaloides, Didymofisa aucheri, Astragalus geseldarensis, Symphyandra armena, etc.

The soils are of primitive structure, often of "nested" nature, thin and very skeletal.

The sub-nival landscapes are practically intact and rearly visited by mountaineers.

Sunrise on the peak Gistola
Source: http://org.chem.msu.su/mynthon/c00a03-4/a08.html

W. Glacial–Nival Landscapes. The Contemporary Glaciation is represented only on the Greater Caucasus and the m. Ararat. However, the majority of glacial-nival landscapes are located in the West and the Central Caucasus.

There are 2,047 glaciers in the Caucasus and nearly 70% of all glaciers, including glaciations' regions, are located on the northern slope and the rest on the southern one. The difference is explained by orographic peculiarities, the amount of snow carried by snowstorms, watershed barriers, and increased insulation on the southern slope. The Central Caucasus is the most glaciated region, where five glaciers (Dikhsu, Bezengi, Karaugum -on the North slope, Lekhzir and Tsanner on its South slope), with a total area exceeding 35-40km sq. and the length over 12 km, are located.

The climate is extremely severe. The January temperature is -17 ^{0}C, -25 ^{0}C and the July - +1^{0}C, +2^{0}C in the zone of ablation, but the temperature in the zone of glacier formation equals -3˚, -5˚. The amount of atmospheric precipitation is not much varying within 500-700 mm, mainly in the form of snow.

The vegetation is represented only by separate species of lower (mainly lichen, rarely moss and water plant) plants, which are grown on individual boulders, moraines and rocky outlets. Therefore, the glacial-nival landscapes are considered to be devoid of soil-vegetation cover.