MINISTRY OF NATURE PROTECTION
OF THE REPUBLIC OF ARMENIA

NATIONAL REPORT

STATE OF THE ENVIRONMENT OF THE REPUBLIC OF ARMENIA IN 2002

National Report

on the State of the Environment

in Armenia in 2002[1]

This Report was prepared by the Information Analysis Center of the Ministry of Nature Protection of the Republic of Armenia, in cooperation with the United Nations Economic Commission for Europe, with the financial support of the European Commission and with the participation of the United Nations Environment Programme.

Y E R E V A N, 2003

[1] This document was not formally edited.

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Presentation by the Minister of Nature Protection of the Republic of Armenia

For the Republic of Armenia, the beginning of the twenty-first century has been characterized by democratic reform and trends towards sustainable economic growth.

The process of recovery of different branches of the economy and of industrial enterprises has proceeded; the period of cold and dark years is now in the past.

However, numerous activities still should be implemented to eliminate the impacts on the environment created in previous years.

During the short period of its independence, the Republic of Armenia has already joined 14 international conventions in the sphere of environmental protection and signed related protocols, with the aim of integration into the broad European family.

The Ministry of Nature Protection of the Republic of Armenia has developed a number of environmental programs, including The National Action Plan on Environmental Protection and The Complex Program on Rehabilitation, Conservation, Reproduction and Use of Lake Sevan Ecosystems, which were approved by the Government of the republic.

This National Report was prepared by the Information Analysis Center of the Ministry of Nature Protection of the Republic of Armenia, in collaboration with the UN Economic Commission for Europe (UNECE), with the financial support of the European Commission and with the participation of the United Nations Environment Programme (UNEP). The aim of the report is to raise the awareness of the National Assembly, the Government of the Republic of Armenia and international organizations regarding environmental problems requiring immediate solution.

This National Report, *State of the Environment of Armenia, 2002*, is presented for your attention and is aimed at describing the current state of the environment, revealing negative impacts on the environment as well as problems of conservation and sustainable use of resources. It is a result of five months of laborious work.

This National Report of Armenia is distinguished also by the fact that it was prepared in accordance with the Guidelines for the Preparation of Government Reports on the State and Protection of the Environment, endorsed by the Fifth "Environment for Europe" Ministerial Conference, Kiev, 2003.

I would like to express special acknowledgments to the United Nations Economic Commission for Europe, EC TACIS Programme, United Nations Environment Programme, the international expert group, as well as to the working group for report preparation and assisting consultants.

The Republic of Armenia fully realizes the seriousness of the problems of nature protection and sustainable use of natural resources and, being a full member of the international community, aims to preserve the beautiful and diverse nature of its small country for future generations.

Vardan Ayvazyan

Foreword

This National State of the Environment (SoE) Report is the second report in the twelve years of independence of the Republic of Armenia. It has been prepared by the Information Analysis Center of the Ministry of Nature Protection of the Republic of Armenia, with the participation of a group of experts in cooperation with the United Nations Economic Commission for Europe (UNECE), with the financial support of the European Community and with participation of the United Nations Environment Programme (UNEP). The report is a result of work within the framework of a joint project, with the participation of the UNECE and the European Environment Agency (through the UNECE Working Group on Monitoring and Assessment).

This report is prepared in accordance with the Guidelines for the Preparation of Government Reports on the State and Protection of the Environment, developed by the UNECE Working Group and endorsed by the Fifth "Environment for Europe" Ministerial Conference (Kiev, 2003).

A preparatory meeting was held in Yerevan from 30 June to 4 July 2002 to discuss report structure, mechanisms for data gathering, distribution of functions among members of the national group for report preparation, work schedule and other issues. National and international experts (representatives from the Russian Federation, UNECE Secretariat and GRID Arendal UNEP) participated in the meeting.

The first draft was presented by the report coordinator, Mr. Harutyunyan, to the UNECE Working Group on Monitoring and Assessment during its fourth session in September 2003 in Geneva. The next draft was presented at a joint working meeting of the UNECE and European Environment Agency in November 2003 in Geneva. International experts' comments were taken into consideration in the process of final development of the report.

The main aims of the report are the environmental assessment of the processes in the country since the previous national report (1993), development of proposals for the improvement of the environmental situation in the country as well as support to the efforts of state institutions and civil society to improve this situation.

The objectives of the report are the following:

- carry out qualitative and quantitative assessment of the state of the environment and natural resources as well as to reveal prevailing trends in environmental changes;
- analyze the causes of the current situation and changes - environmental impacts of economic and other activities, as well as natural disasters;
- evaluate the efficiency of the state environmental policy and measures taken to mitigate negative anthropogenic pressures on the environment;
- forecast changes anticipated in the future; and
- develop proposals on the issues mentioned.

Main sections of the report present the analysis of environment quality and of the state of natural resources, as well as sources of biosphere pollution and ecosystem degradation; priority ecological problems and "hot spots" are highlighted. The analysis of the environmental policy being implemented in the country, its efficiency, links with the environmental movement and the level of public participation in the process of environmental decision-making are also presented.

For the selection of indicators and explanation of specific problems, the authors of the report tried to take into account the issues expressed in the final documents of the aforementioned Kiev Ministerial Conference, as well as in the Millennium Development Goals of the UN Millennium Declaration (New York, 2000) and in the Plan of Implementation of the World Summit on

Sustainable Development (Johannesburg, 2003). It should be mentioned that it was a challenging task, since these requirements exceed the capacities of monitoring and statistical assessment carried out in Armenia even before the crisis. During the last decade, the geographic scope and the number of components of environmental monitoring have been reduced significantly. For this reason, some data presented in the report are based on expert assessment.

As was already mentioned, the first National SoE Report was prepared and published by the Ministry of Nature Protection of the Republic of Armenia in the first years of independence. During the following decade there were no official, published national environment reports. However, information was gathered, analyzed and presented to the public in the country and abroad.

During this period, the following materials were developed and published:

- 1998 - State of the Environment: Country Overview. Armenia (with the support of the TACIS Programme);
- 2000 - Environmental Activity Overview: Armenia (with the support of the UNECE Environmental Policy Committee) and State of the Environment: Armenia (with the support of UNEP/GRID Arendal);
- 2003 – The Ministerial Report "From Aarhus to Kiev" was published for the Fifth "Environment for Europe" Ministerial Conference (with the support of the UNDP and REC Caucasus).

All three publications were issued in English (only electronic versions are available in Armenian).

Along with these, in 2002 the National Assessment Report, Rio+10, was prepared and published in Armenian and English, with the support of the UNDP Interministerial Group of Experts and with the participation of public sector representatives.

In addition, national reports on the following priority environmental conventions were published with the support of GEF/UNDP:

- UN Framework Convention on Climate Change;
- UN Convention on Biological Diversity;
- UN Convention to Combat Desertification.

All the aforementioned sources were used for the preparation of this National Report.

This report may serve both decision-makers in the country and the broad public. It can be useful as well for representatives of the international community and international organizations interested in the analysis of environmental situation in Armenia.

The authors hope that this report will assist the process of integration and harmonization and the efforts of legislative and governmental structures, self-government bodies, scientific-technical and business structures, non-governmental organizations, unions and the mass-media for the resolution of urgent environmental problems and the establishment of a basis for environmentally sustainable development in the Republic of Armenia.

Part I

State of the Environment and Natural Resources

Chapter 1 Air Quality

Functions to monitor the state of air are given to the Environmental Impact Monitoring Center, a State Non-Commercial Organization of the Ministry of Nature Protection.

According to the data of the Environmental Impact Monitoring Center, in 2002 average annual concentrations of hazardous substances monitored in the atmosphere were in excess of MPC (maximum permissible concentration) in six cities (Yerevan, Alaverdi, Vanadzor, Gyumri and Hrazdan), whose total population is 1.448 million (Tables 1.1.2 - 1.1.5 and Figures 1.1.1 - 1.1.19).

In these cities, concentrations in excess of maximum one-time concentrations were recorded for dust (in Yerevan, Ararat, Alaverdi, Hrazdan, and Gyumri), sulphur dioxide and nitrogen oxides (in Yerevan, Vanadzor, and Alaverdi). In Ararat and Hrazdan, dust concentration were 5 times above MPC. In 2002, no cases of average annual concentration 10 times or higher above MPC were measured. The combined population of the cities of Ararat and Hrazdan, where dust concentrations more than 5 times above MPC were recorded, over 73 000. These inhabitants are exposed to the risk of upper respiratory tract diseases. The cities with the highest levels of sulphur dioxide pollution are Yerevan (population 1 101 600), Vanadzor (106 200) and Alaverdi (17 100). In the cities mentioned, average annual concentrations of nitrogen oxides (one of the components of photochemical smog) were in excess of MPC. Concentrations of carbon monoxide, formaldehyde and ozone were not measured in 2002.

It should be mentioned that previously in the Republic, pollution was assessed using an air pollution index. Nowadays, however, this assessment is replaced by comparison with maximum permissible concentrations (MPC).

Measures of the air pollution index in the cities of Yerevan, Vanadzor and Alaverdi, for the period of 1991-1996, are given in Table 1.1.1.

Table 1.1.1 **Air Pollution Index Levels**

City	1991	1992	1993	1994	1995	1996
Yerevan	48,3	42,9	33,6	19,4	15,2	26,2
Vanadzor	10,9	5,3	3,4	2,4	2,4	2,4
Alaverdi	2,3	1,7	2,0	1,0	1,7	1,7

Air quality monitoring in 1997 and 1998 was carried out in four Armenian cities: Alaverdi, Ararat, Yerevan and Vanadzor (11 permanent monitoring sites). Since 1999, air quality has been monitored as well in Gyumri and Hrazdan. In the period 1997-2002, there were no cases of “high” or “extremely high” levels of air pollution. Four main pollutants (dust, sulphur dioxide, carbon monoxide and nitrogen dioxide) are monitored in Alaverdi, Yerevan and Vanadzor. Only dust is monitored in Ararat, Gyumri and Hrazdan.

In 2002, a total of 33 830 air samples were taken to measure the concentrations of dust, sulphur dioxide, carbon monoxide and nitrogen dioxide. In addition to these substances, in Yerevan concentrations of nitrogen monoxide, chlorine, chloroprene, aromatic hydrocarbons, benzene, toluene, xylene and ethylbenzene were also measured. After 1997, the monitoring of carbon monoxide was stopped.

Brief characteristics of air pollution in the cities monitored and of the dynamics of air quality changes by month and year are given below in the form of tables and charts.

Table 1.1.2 Air Pollution in Alaverdi

Substance, maximum one-time concentration and (MPC), mg/m^3	Number of samples						Maximum one-time concentration recorded						Average annual concentration						Number of samples in excess of maximum MPC											
							mg/m^3						mg/m^3						MPC						5 MPC					
	Years						Years						Years						Years						Years					
	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02
Dust 0.5 (0.15)	1217	1050	1008	909	496	0	0.4	0.4	0.4	0.4	0.4	-	0.1	0.1	0.2	0.1	0.1	-	0	0	0	0	0	-	0	0	0	0	0	-
SO_2 0.50 (0.05)	1579	1675	1588	1816	1803	1801	0.06	3.38	0.81	0.98	1.89	0.98	0.01	0.21	0.08	0.19	0.17	0.23	0	160	17	231	195	120	0	5	0	0	0	0
CO 5.0 (3.0)	1579	1675	1576	1816	1803	1801	4	4	5	5	4	4	1	1	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
NO_2 0.085 (0.04)	1579	1675	1579	1816	1803	1801	0.08	0.12	0.09	0.09	0.09	0.09	0.02	0.03	0.03	0.03	0.03	0.04	0	70	27	60	63	77	0	0	0	0	0	0

Source: "Environmental Impact Monitoring Center" State Non-Commercial Organization of the Ministry of Nature Protection of the Republic of Armenia

Note: 2 monitoring sites (functioning)

Table 1.1.3 Air Pollution in Yerevan

Substance, maximum one-time concentration and (MPC), mg/m^3	Number of samples						Maximum one-time concentrations recorded						Average annual concentration						Number of samples in excess of maximum MPC											
							mg/m^3						mg/m^3						MPC						5 MPC					
	Years						Years						Years						Years						Years					
	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02
Dust 0.5(0.15)	2072	1315	2125	2295	1765	1265	2	2.3	2.2	2.2	1.9	2.5	0.4	0.6	0.7	0.7	0.5	0.4	518	596	1090	1324	659	345	0	0	0	0	0	0
SO_2 0.50 (0.05)	3335	2108	2140	2332	2537	2575	0.28	0.21	0.30	0.33	0.27	0.55	0.10	0.11	0.12	0.13	0.10	0.11	0	0	0	0	0	5	0	0	0	0	0	0
CO 5.0 (3.0)	1000	-	-	-	-	-	8	-	-	-	-	-	4	-	-	-	-	-	144	-	-	-	-	-	0	-	-	-	-	-
NO_2 0.085 (0.04)	3335	2107	2140	2332	2537	2574	0.53	0.41	0.16	0.31	0.38	0.42	0.15	0.18	0.15	0.13	0.09	0.09	2781	1994	2013	2045	1370	1293	28	0	0	0	0	0

Note: Yerevan: in 1997-1998 out of 7 monitoring sites only 5 were functioning, in 1999-2002 out of 5 remained monitoring sites only 3 were functioning.

Table 1.1.4 Air Pollution in Vanadzor

Substance, maximum one-time concentration and (MPC), mg/m^3	Number of samples						Maximum one-time concentrations recorded						Average annual concentration						Number of samples in excess of maximum MPC											
							mg/m^3						mg/m^3						MPC						5 MPC					
	Years						Years						Years						Years						Years					
	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02
Dust 0.5(0.15)	1217	1050	1008	909	496	0	0.4	0.4	0.4	0.4	0.4	-	0.1	0.1	0.2	0.1	0.1	-	0	0	0	0	0	-	0	0	0	0	0	-
SO_2 0.50 (0.05)	1579	1675	1588	1816	1803	1801	0.06	3.38	0.81	0.98	1.89	0.98	0.01	0.21	0.08	0.19	0.17	0.23	0	160	17	231	195	120	0	5	0	0	0	0
CO 5 (3)	1579	1675	1576	1816	1803	1801	4	4	5	5	4	4	1	1	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
NO_2 0.085 (0.04)	1579	1675	1579	1816	1803	1801	0.08	0.12	0.09	0.09	0.09	0.09	0.02	0.03	0.03	0.03	0.03	0.04	0	70	27	60	63	77	0	0	0	0	0	0

Note: in 1997-1999 all 4 monitoring sites were functioning, in 2000-2002 out of 3 remained monitoring sites only 2 were functioning.

***Table 1.1.5* Air Pollution in Ararat**

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City (MPC)	Number of samples						Maximum one-time concentrations recorded mg/m^3						Average annual concentration mg/m^3						Number of samples in excess of maximum MPC: MPC						Number of samples in excess of maximum MPC: 5 MPC					
	Years						Years						Years						Years						Years					
	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02	97	98	99	00	01	02
Ararat(0.1)	810	798	918	868	862	909	2.2	2.2	1.4	1.3	2.4	2.9	0.6	0.5	0.4	0.3	0.3	0.3	562	459	444	238	289	322	30	27	-	-	4	7
Gyumri (0.15)			615	890	729	849			2.0	2.3	2.4	2.2			0.6	0.6	0.4	0.5			324	465	197	311			-	-	-	-
Hrazdan(0.1)			439	872	889	897			1.1	0.8	1.6	1.8			0.2	0.2	0.5	0.5			18	251	504	398			-	-	5	3

Note: 1 monitoring site, Gyumri - 1 monitoring site, Hrazdan - out of 2 sites only 1 is functioning. Only dust is measured.

Figures 1.1.1 to 1.1.15
Air Pollutant Concentrations (mg/m^3)
in Cities of the Republic of Armenia

Dust

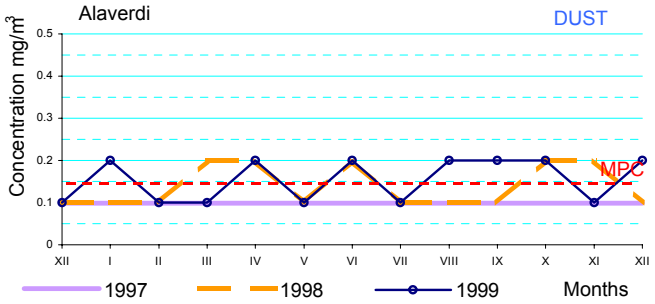
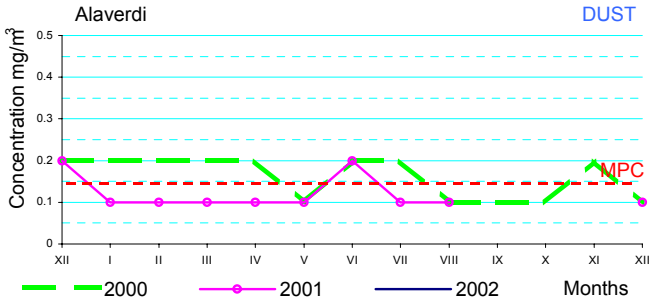


Figure 1.1.1



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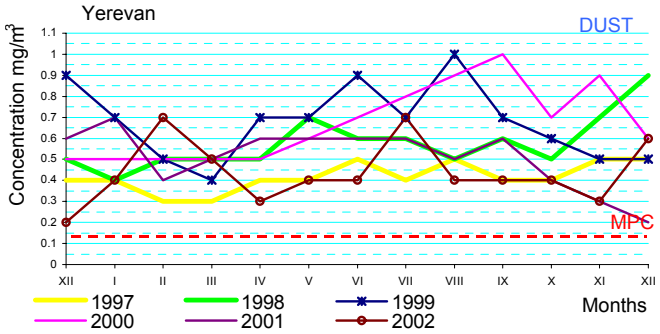

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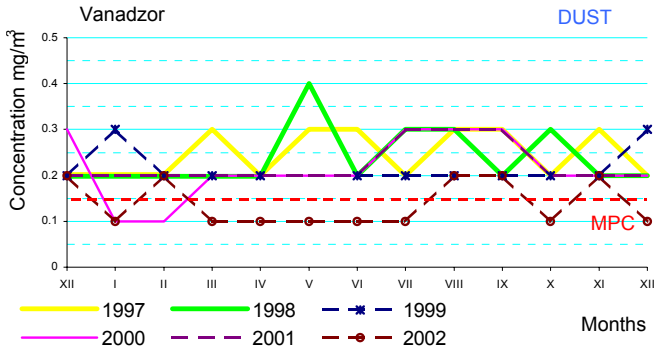

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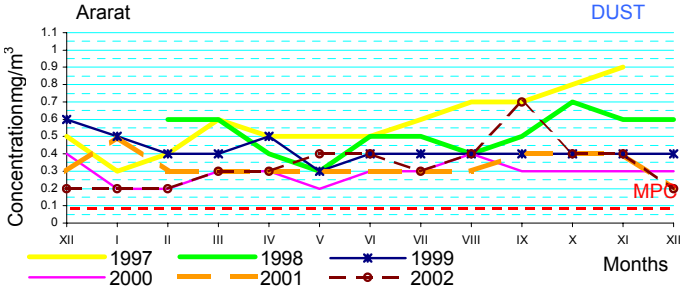

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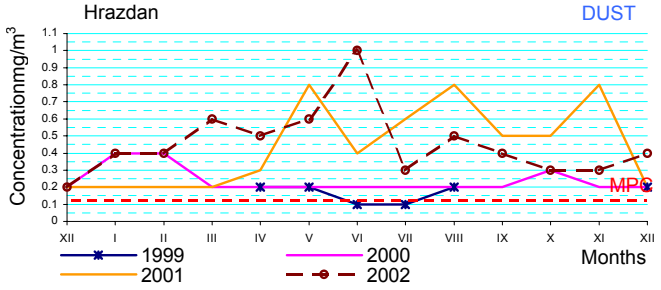

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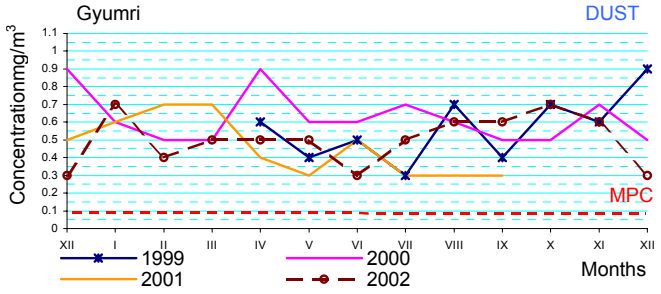
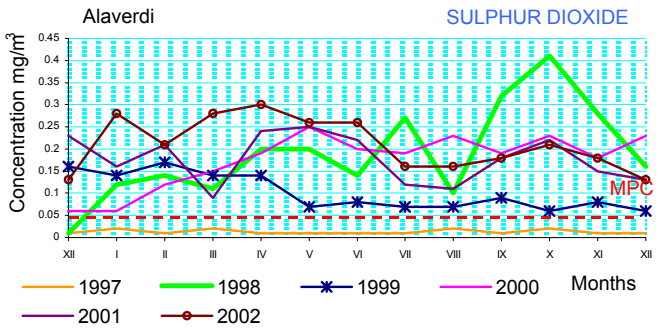


Figure 1.1.7

Sulphur dioxide



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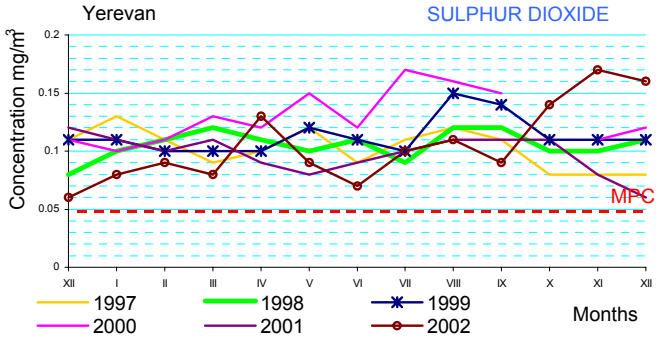

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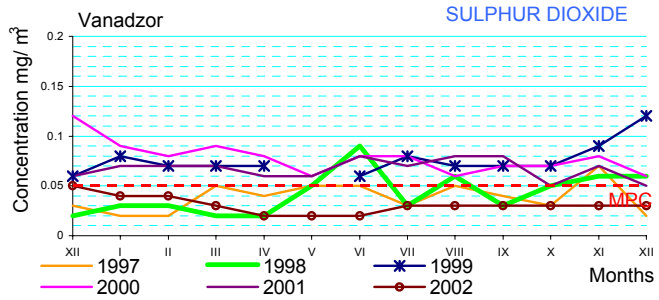
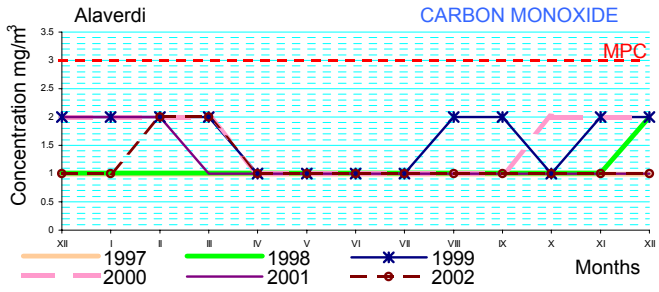


Figure 1.1.10

Carbon Monoxide



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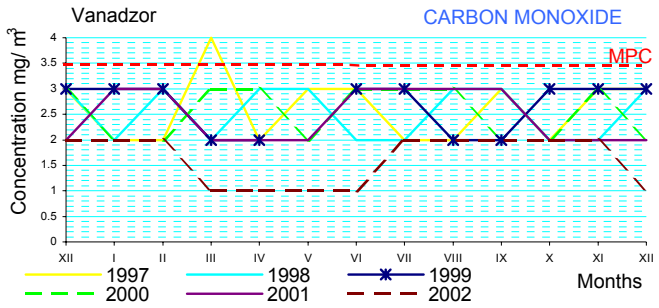
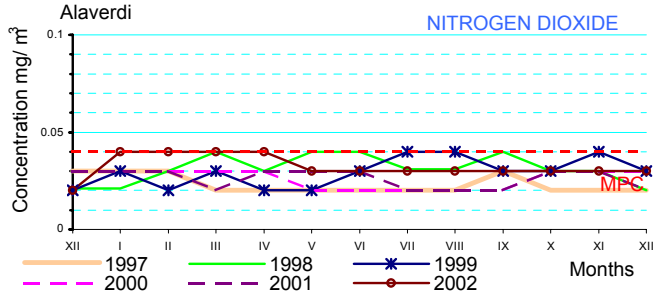


Figure 1.1.12

Nitrogen dioxide



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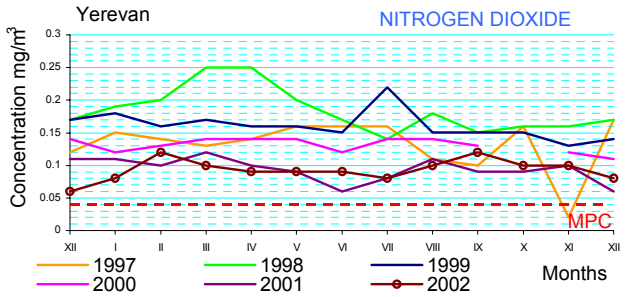


Figure 1.1.14

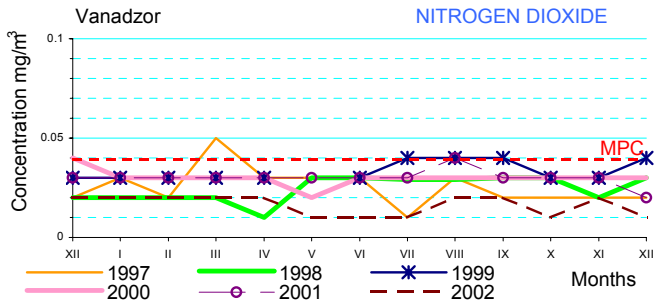


Figure 1.1.15

Source (Figures 1.1.1 to 1.1.15): Environmental Impact Monitoring Center State Non-Commercial Organization of the Ministry of Nature Protection of the Republic of Armenia

Figures 1.1.16 – 1.1.19 *Average Annual Concentrations of Pollutants, in Average Daily Concentration / MPC*

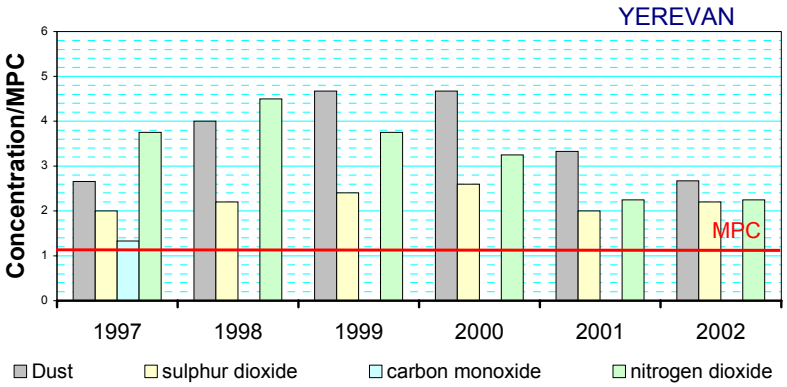
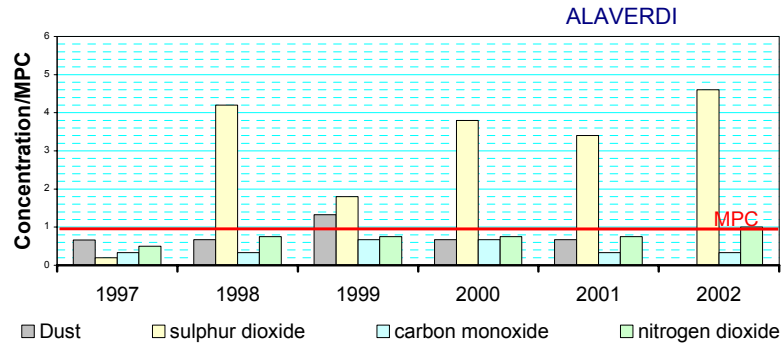


Figure 1.1.16



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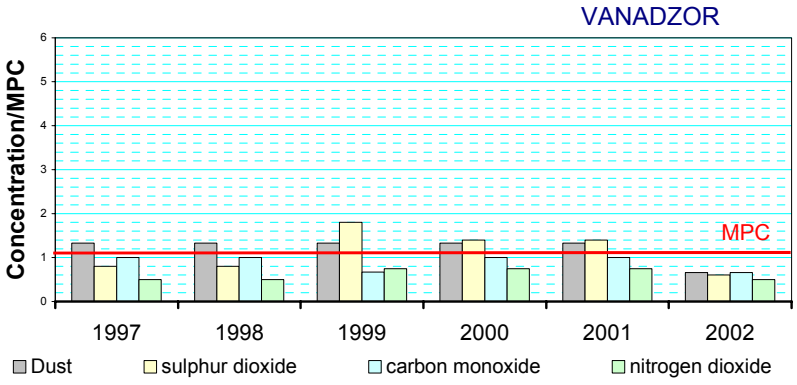


Figure 1.1.18

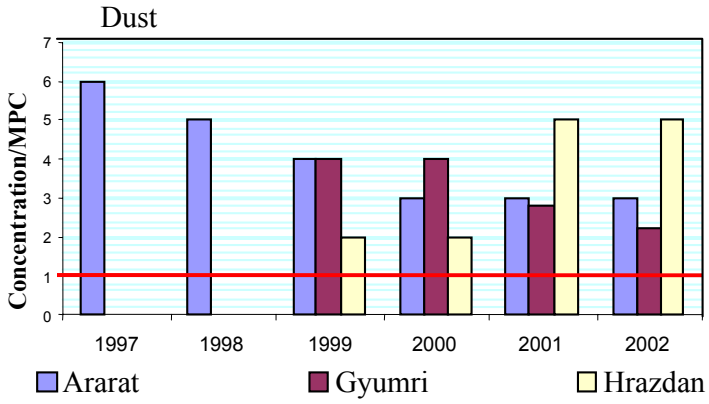


Figure 1.1.19

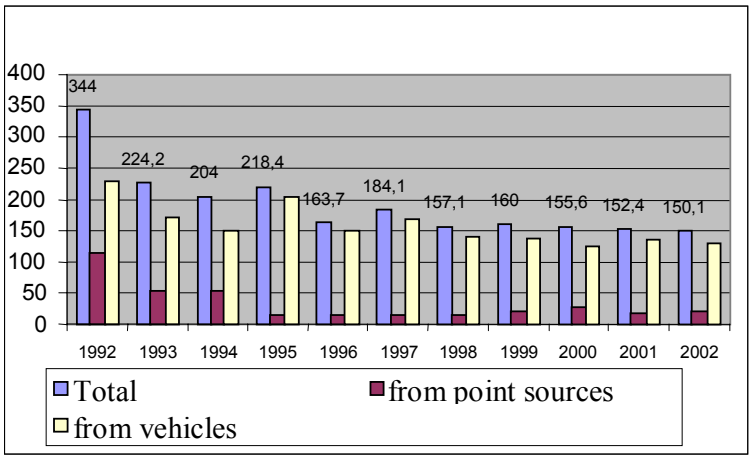
Source: Environmental Impact Monitoring Center State Non-Commercial Organization of the Ministry of Nature Protection of the Republic of Armenia

Among all types of anthropogenic impact on the environment, air pollution is the most tangible. Problems related to air pollution include problems of visibility, unpleasant smells and dust. Though human beings have a high adaptability to air quality change, nevertheless they are exposed to its impact as is the whole ecosystem.

The maximum total level of air pollutant emissions (736.1 thousand tons) was recorded in Armenia at the end of the 1980s and the beginning of the 1990s (before independence). After that, in parallel with the economic recession, a drastic reduction of air emissions was recorded (in 2002 the total emission was 150 000 tons). Main sources of pollution have changed as well. Previously, the energy and industrial sectors were among main sources of air pollution; now vehicles are the main sources. Among factors affecting air basin pollution are the unfavorable meteorological locations of some cities and lack of green areas.

Since 1998, a limited stabilization of economy has been recorded in the country; this can be seen from the levels of emissions (see Figure 1.1.20)

Figure 1.1.20 *Air Emission from Point Sources and Vehicles, 1992-2002, thousand tons*



Source: National Statistical Service of the Republic of Armenia.

The complete picture of air emissions from point sources in the Republic is shown in the form of map (see Annex 1. Air Emissions (kg) of Pollutants per person).

The analysis of the last 10 years of data shows that total air emissions have fallen by 56%. In comparison with the 1980s, the total emission in 2002 has fallen by 80%. This refers both to point sources (almost by 80% decline) and to vehicle emissions (35-40% decline). The reduction of air emissions from point sources results from the fact that former large enterprises either do not function at all or operate at below full capacity (at 10-15% of capacity). Another cause of the air emissions reduction is the decline in the population of the country and related economic activity. The picture is similar for the main pollutants (Charts 1.1.24 - 1.1.26). By 2002, sulphur dioxide emissions from point sources had fallen by 80-85%, amounting to 7243 tonnes; nitrogen oxide emissions amounted to 2416 tonnes (77% less), particulate matters emission fell from 47 600 tonnes to 1800 tonnes. Dust emission from point sources increased (Chart 1.1.21).

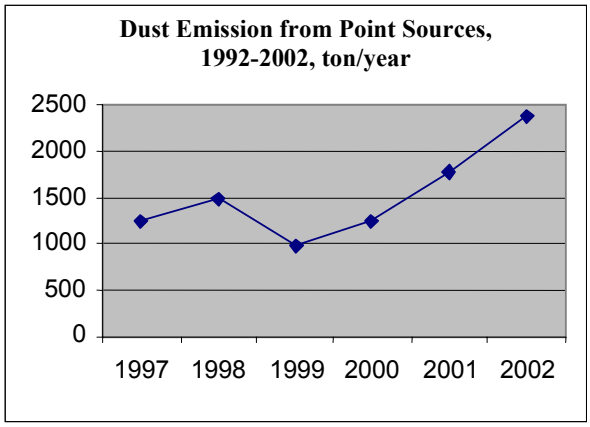


Figure 1.1.21

Source: National Statistical Service of the Republic of Armenia

There has been a two-fold increase in dust emissions in the Republic in general and in the main industrial cities. Heavy metals emissions have declined drastically, from 6.3 tonnes in the 1980s, to 1.9 tons in 1995-1997, and to 0.007 tons in 2002. Specific hazardous emissions from point sources in 2002 amounted to 126.7 tons, which accounts for less than 1% of all emissions. However, their impact on the air quality cannot be neglected, as they contain toxic substances.

The picture is similar for emissions from vehicles. The dynamics of emission changes are presented below in Figure 1.1.22.

Though the total amount of hazardous substances emission from vehicles has declined, vehicles still remain the main source of air pollution, especially in the urban capital of the Republic, where the population is more than 1.1 million and the density of population is the highest in the Republic. In 2002, air emissions from vehicles in the capital accounted for more than the half of the total emissions in the Republic. The following factors affect the level of air pollution from vehicle emissions: the intensity of traffic (amount and types of vehicles); technical factors (engine type and capacity, fuel used, technical state of vehicles); road factors (quality of road) and other factors.

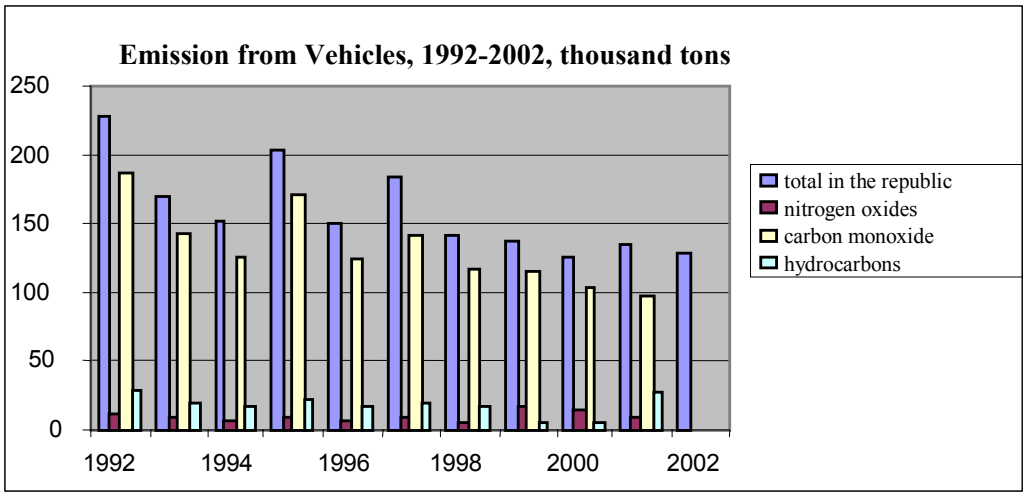


Figure 1.1.22

Source: National Statistics Service of the Republic of Armenia

It should be mentioned that the number of low environmental impacts means of public transport (trams and trolleys) has decreased in Yerevan. Microbuses have replaced other means of public transport, leading to an increase in emissions (for details, see Part II, Chapter 3).

The vehicle conditions are checked by the licensing and inspection department. This control, however, is not efficient and the appropriate level of good technical conditions cannot be assured.

The figures below show the shares of emission sources in the total emission of carbon monoxide, nitrogen oxides and hydrocarbons.

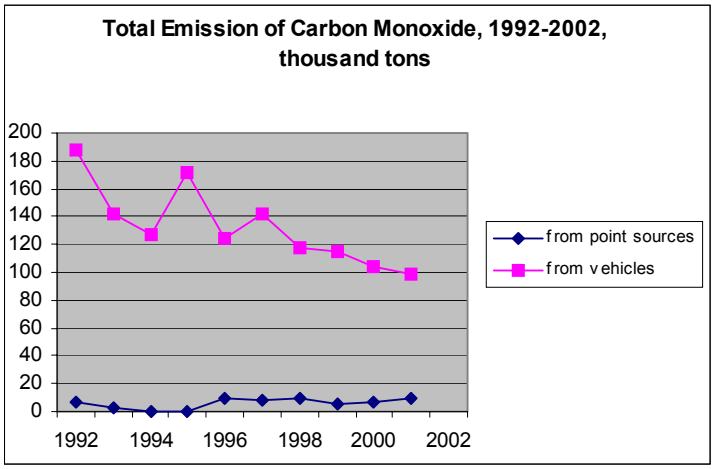


Figure 1.1.23

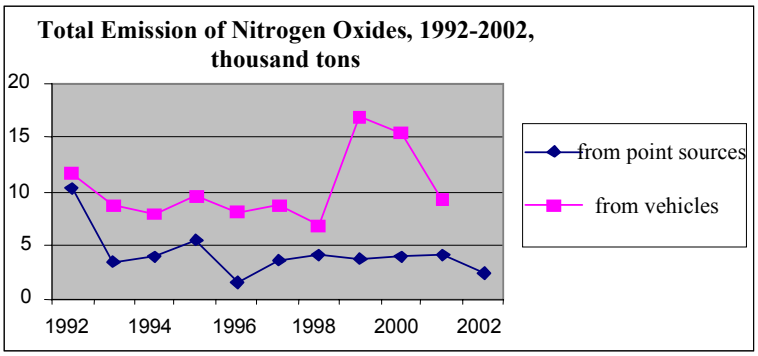


Figure 1.1.24

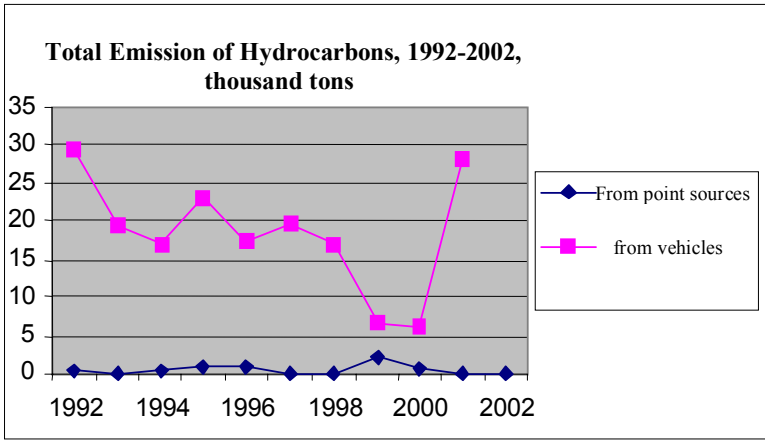


Figure 1.1.25

Source: National Statistical Service of the Republic of Armenia

Emissions from the household sector are not measured as well. Because of the collapse of centralized heating systems, the population in cities has to use alternative sources of energy, namely wood, kerosene, coal and others, which have increased emissions from the household sector. Essentially, information about such emissions are not available.

Monitoring and regulation of air pollutants emissions are done via maximum permissible emissions (MPE) standards. Planning of environmental measures and ecological expertise are based on MPEs. Another mechanism of environmental protection is the principle of natural resource use for payment: tariffs for air emissions, as well as fines and other administrative measures, are set up law.

The most often recorded violations in the sphere of air protection are the following: standards for maximum hazardous substance emissions are not followed, activities are implemented without permits, industrial control is not appropriate, regulations set by enforcement bodies are not followed. Inspections to check enterprise compliance with environmental requirements, various environmental violations have been discovered. Table 1.1.6 below presents these violations as well as measures undertaken.

Table 1.1.6 *Number of Environmental Violations Related to Air Emissions*

Year	Number of enterprises controlled	Number of violations	Elimin-ated	Fined	Total in 000 drams	Registered by protocols	Sum in 000 drams
1999	1852	515	162	176	436.6	19	851933
2000	1762	278	57	250	375.3	60	20073.34
2001	1882	334	60	301	370.6	46	10366.5
2002	1563	351	61	306	318	58	9898.98

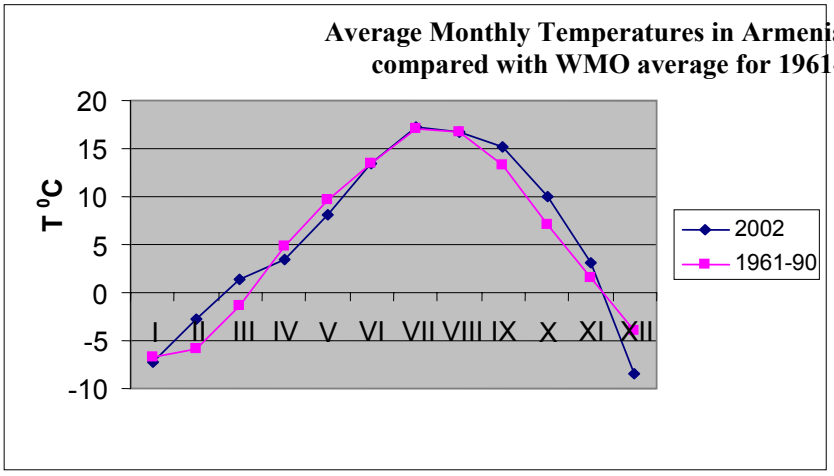
Source: Annual Report of the State Environmental Inspection of the Ministry of Nature Protection

Chapter 2 Climate Change and Ozone Layer

Climate change

Within the framework of Armhydromet, a Climate Change Center has been established to gather data on air temperature, precipitation and other parameters characterizing climate.

Figures 1.2.1 and 1.2.2 present an analysis of temperature and precipitation data from meteorological stations.



	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
2002	-7.2	-2.8	1.3	3.4	8.1	13.5	17.3	16.7	15.2	10.0	3.1	-8.4	5.9
1961-1990	-6.8	-5.8	-1.4	4.9	9.6	13.4	17.1	16.7	13.2	7.0	1.5	-3.9	5.5

Figure:1.2.1

Source: State Service of Armenia on Hydrometeorology and Monitoring SNCO

From the figure above, it can be seen that the average annual temperature in 2002 was 0.4 °C higher than the average for the WMO (World Meteorological Organization) standard period of 1961-1990.

Figure 1.2.2 shows that average annual precipitation in 2002 increased by 8 mm in comparison with the WMO average for 1961-1990.

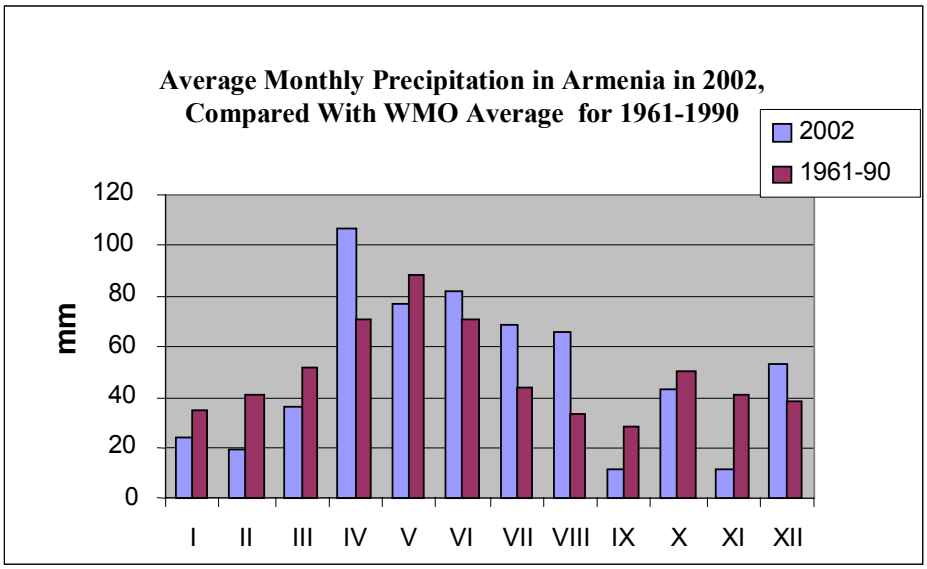


Figure 1.2.2

Source: State Service of Armenia on Hydrometeorology and Monitoring SNCO

In May 2003, Armenia ratified the UN Framework Convention on Climate Change. To fulfill its commitments under the Convention, since 1996 the Armenia Country Study on Climate Change has been underway, with the financial support of the Global Environment Facility (GEF). The first national report on climate change has been prepared; it includes the register of greenhouse gases, as well as climate change forecast data and possible consequences for Armenia. The report has been posted on the Internet (http://www.nature.am).

The second phase of the work for the study will be finalized soon. The first volume of a collection of articles entitled *Armenia. Climate Change Problems* presents the results of expert studies. A second volume of collected articles will be published. Results of these and other studies within the framework of the program are presented below.

Climate change in Armenia is mainly conditioned by global climate change, as well as by internal microclimatic processes of anthropogenic origin. For the assessment of recent temperature change, data gathered by 46 meteorological stations between 1930 and 1990 have been processed. For the assessment of expected temperature change in Armenia, estimates of global temperature change based on levels forecast of global greenhouse gas emissions were used. The calculations indicate that average temperature in Armenia will increase by 1.7% by the year 2100.

Data from 56 meteorological stations have been used for the assessment of precipitation change. Over the past 50-100 years, the average annual precipitation has dropped by 5.8% and if this trend continues average annual precipitation in Armenia will fall by a further 10% by the year 2100.

As was mentioned, within the framework of the program, the national register of greenhouse gases was developed. Greenhouse gas emissions were evaluated in accordance with the methodology and guidelines of the Intergovernmental Panel on Climate Change. The results of the study show that Armenia's contribution to global emissions of greenhouse gases was 0.1% in

1990 and 0.02% in 1995 (the population of Armenia accounts for 0.06% of the world's population).

The forecast of greenhouse gases emissions in Armenia is presented in Table 1.2.1.

In fact, CO^2 equivalent emissions per capita in 2002 were 1.7 tonnes instead of the 2.35 estimated, as the growth of the industrial and energy sectors did not reach the level planned.

***Table 1.2.1* Forecast of Greenhouse Gases Emissions in Armenia**

	1990	1995	2000	2005	2010
Total Emissions (CO^2 equivalents, Gg)	25312	6193	9161	12650	14726
Share of total emissions, %					
CO_2	87.0	72.5	78.0	80.4	81.2
CH_4	12.6	26.8	21.4	19.0	18.3
N_2O	0.4	0.7	0.6	0.6	0.5
Emissions per capita, (tonnes CO2 equiv./person)	7.0	1.6	2.35	3.26	3.74
Share of global emissions, %	0.1	0.02			

Source: "Armenia - Climate Change Study in the Country" Program

Ozone layer

Since 1992, regular monitoring of ozone levels has been carried out in the Republic. Ozone is measured in Yerevan (1113 m above sea level) and in the Lake Sevan area (1927 m above sea level). Since 2000, ozone has been measured also at an altitude of 2070 m above sea level on the slopes of Mount Aragats. Figure 1.2.3 presents average monthly ozone levels in Armenia. It can be seen from the figure that the maximum ozone level was recorded in 1998.

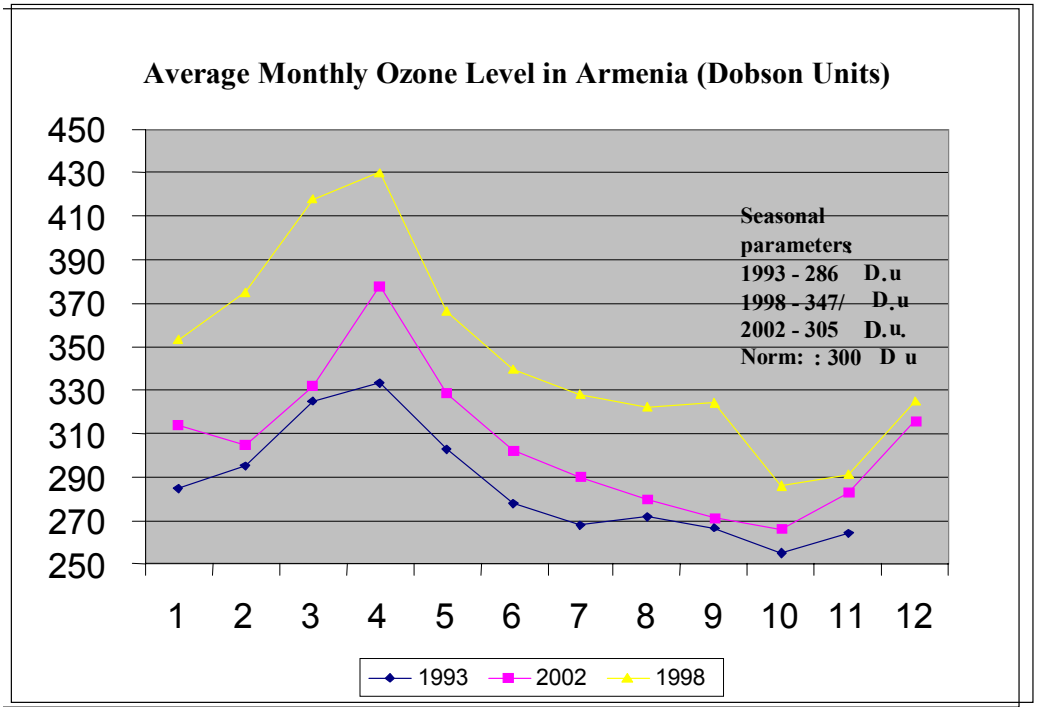


Figure 1.2.3

Source: "State Service of Armenia on Hydrometeorology and Monitoring" SNCO

A national program, developed with GEF (in cooperation with UNDP, UNEP, and World Bank) was implemented in 2001-2002 to fulfill commitments under the Vienna Convention on the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer. Data gathering and analysis of the use of ozone-depleting substances were carried out. In the framework of the program, a project for the replacement of ozone-depleting substances was developed.

Chapter 3 Surface Water and Groundwater

General information

The average annual flow volume of water in the Republic of Armenia is about 6.2 billion m^3, of which the average annual flow volume of groundwater is about 3 billion m^3.

Armenia is in a relatively favorable situation in terms of natural reserves of water resources. Taking into account all available water resources in the Republic, annual water resources per capita are about 2500-2700 m^3. According to recent calculations of the hydrological cycle, annually more than 17.6 m^3 of water come from precipitation, of which about 11.5 billion m^3 evaporate.

Rivers of the Republic of Armenia

Rivers of Armenia are tributaries of the major rivers of the South Caucasus, the Arax and the Kur. There are about 9480 small and large rivers in Armenia, with a total length of about 23 000 km. Of these, 379 rivers have a length of 10 km and more. Although Armenia is considered a country with an average reserve of water, the distribution of water resources in the country is extremely uneven. The density of the river network ranges from 0 to 2.5 km/km^2, and the average density is about 0.8 km/km^2.

Reservoirs of the Republic of Armenia

Reservoirs have been built for the use of river water resources, as well as to regulate river flows. The annual regulated river flow is 1272.5 million m^3.

There are 74 reservoirs in Armenia with a total capacity of 988 mln. m^3. Thirteen more reservoirs (832 mln.m3) are currently under construction. Of the 74 reservoirs, 35 have capacity of 1 mln.m^3 and more. The Akhuryan Reservoir is the largest, with a capacity of 535 mln. m^3. Reservoirs serve the needs of irrigation, the energy sector, fishing and recreation.

Quality and quantity of groundwater resources

In Armenia, groundwater resources play a very important role in the water balance. About 96% of water used for drinking comes from groundwater resources. This water is very clean. The quality of groundwater resources in Armenia is very high, though recent data on the quality of groundwater are not available. On most of the territory of Armenia, it is possible to use groundwater for drinking needs without additional treatment. Certainly, water quality in some springs deviates from chemical and biological standards; these springs cannot be used for drinking needs. About 25% of springs have high concentrations of nitrites, nitrates and fluorine compounds.

Lakes

There are more than 100 lakes on the territory of Armenia, some of which are without water during the dry season.

By size and economic significance, Lake Sevan and Lake Arpi are the most significant ones. The Hrazdan and Akhuryan Rivers originate from these two lakes. There are also lakes of smaller size and economic importance, with only local significance. Table 1.3.1 lists the main small lakes of Armenia.

Table 1.3.1 Main Small Lakes of Armenia

N	Name	River basin, mountainous range, use	Altitude above sea level (m)	Area (ha)	Capacity (thousand m^3)	Maximum depth (m)
1	Kari	Kasakh, Aragats, water supply	3190	30.0	357	8
2	Akna	Hrazdan, Geghama, irrigation	3030	80.0	2500	15
3	Arnot	Vedi, Geghama, irrigation	2350	4.0	206	12.6
4	Gazana	Vokhchi, Zangezur, irrigation	3590	25.0	360	10
5	Kaputan	Vokhchi, Zangezur, irrigation	3300	10.0	1500	22
7	Sev	Vorotan, Syunik, irrigation	2666	200.0	9000	7.5
8	Metsamor	Metsamor, Ararat valley, irrigation	860	30.0	310	9.4

Source: Ministry of Nature Protection of the Republic of Armenia

Water use

According to data for 2002, the total water abstraction in Armenia was 1735.5 mln.m^3, (on average, 580 l/ capita/day).

Table 1.3.2 Water Abstraction in Armenia, in 1990 and from 1993 to 2002, mln.m^3

Year	1990	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total water abstraction	3942	3198	2983	2531	227	1850	1994	1966	1871	1726	1735,5
From groundwater resources	1252	1121	1042	851	816	520	530	536	533	530	475
Total water use	3497	2089	1943	1478	1377	1683	1800	1172	1087	997	1312
By sector											
Irrigation and agriculture	2362	1252	1238	742	776	1343	1456	940	840	802	1115
Industry	501	286	237	209	165	120	120	75	83	94	87
Households	634	551	468	527	436	220	224	157	164	101	109

Data in the table are approximate.

Source: Ministry of Nature Protection of the Republic of Armenia.

Most of the water used in the Republic is for irrigation. The distribution of water use by sectors from 1990 to 2002 is shown in Table 1.3.2.

Until 1990, average annual water use in the Republic was 3.5 - 4 million m^3. During the last decade, water use ranged from 1.5 to 2 billion m^3, due to the reduction in irrigated areas and in industrial production.

After 1990, water abstraction for economic needs by mechanical pumps was reduced due to the energy crisis and the rise in electricity prices. Recently, there has been a trend to shift to gravity flow methods.

From 1999-2001, the Ministry of Nature Protection with the support of the World Bank implemented the Water Resource Management Planning Program, with the aim to systematize

the sphere of water resource management. Within the framework of this program, water resources of the republic were estimated and fundamentals of water policy were developed.

In 2002, a new Water Code of the Republic of Armenia was developed and adopted. Based on this Code, in 2002 the National Council on Water was established under the Prime Minister. The National Council on Water is considered the highest consultative body on issues of water resource management. Within this Council, a Commission on Settling Disputes on Water Use was established.

The establishment of basin management bodies is among main concepts of the new Water Code. In 2003, under a resolution of the Prime Minister of the Republic of Armenia, five water basin management bodies were established. These are the first such bodies in the South Caucasus. The establishment of basin management bodies will promote the rational use and integrated management of water resources.

In October 2002, under a resolution of the Prime Minister, the Commission on Transboundary Water Resources of the Republic of Armenia was established: its activities will promote the improvement of transboundary water resource protection and management.

For the effective management of water resources and their protection, as well as for the implementation of the new Water Code of RA, about 30 norms and methodological acts have been developed and adopted by the Government of the Republic of Armenia. They systematize the process of issuing permits for water use, the register of water resources, as well as the protection and use of water bodies, including natural monuments and others.

Untreated or insufficiently treated sewage is the main cause of the pollution of water bodies. In Soviet times, the level of pollution in Armenia's rivers was quite high, which led to worsening water quality. At present, data on the pollution levels of surface water of Armenia are not precise. The analysis of the scarce data available shows that an improvement of water quality in rivers in recent years, due to the decrease in the volume of irrigation as well as the fact that the majority of industrial enterprises have ceased to operate. At present, within the framework of the limited monitoring activities implemented, it can be assumed that the quality of surface water is sufficient, except for flows from Yerevan and other large cities. It should be mentioned also that without proper attention during the large-scale recovery of industrial activity, water quality could deteriorate. The problem is aggravated by the fact that none of the 19 existing waste water treatment plants in the Republic of Armenia functions. This is partly due to the earthquake in 1998, as well as the energy crisis at the beginning of the 1990s. According to technical and economic calculations, of the 19 waste water treatment plants it is possible to restore only 6 or 7. The other need to be reconstructed using modern treatment technologies.

In Armenia, all cities and about 20% of rural settlements have sewage systems.

All waste water treatment plants in the Republic were constructed before 1990. The technologies applied in the plants are not efficient and do not meet modern requirements. Moreover, the treatment technologies used were based on practically free energy (both natural gas and electricity). Under present conditions, their use is extremely expensive and the use of existing water treatment facilities cannot be justified.

There is a need for major investments to restore water treatment facilities or construct new ones.

The Environmental Monitoring Center of the Ministry of Nature Protection monitors the quality of water bodies in the republic.

The monitoring of surface water pollution includes regular observations made by hydrological and hydrochemical stations, study of the chemical composition of the water in rivers, lakes and reservoirs, considering pollution from industrial, household and other sources, as well as analysis and assessment of pollution levels.

The water monitoring system was established in 1964. Until 1990, monitoring was carried out in 54 water bodies. There were 111 observation sites. Since 1994, the number of observation sites has increased to 131, however it should be mentioned that monitoring of surface water is not systematic. Thus, in 2002 observations were carried out only in 34 water bodies at 81 observation sites.

From 1984 to 1990, surface water samples were taken from the transboundary rivers Debed, Aghstev, Araks and Vokhchi. Figure 1.3.1 below presents situation in the Debed river, where ammonium, nitrates, copper and oil products were in excess of MPC.

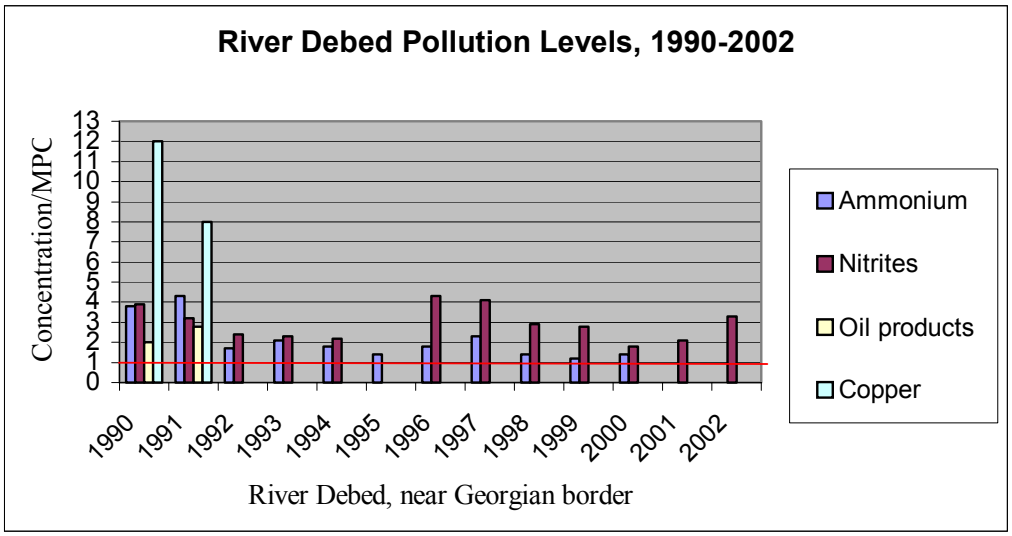


Figure 1.3.1

Source: "Environmental Impact Monitoring Center" State Non-Commercial Organization of the Ministry of Nature Protection of RA

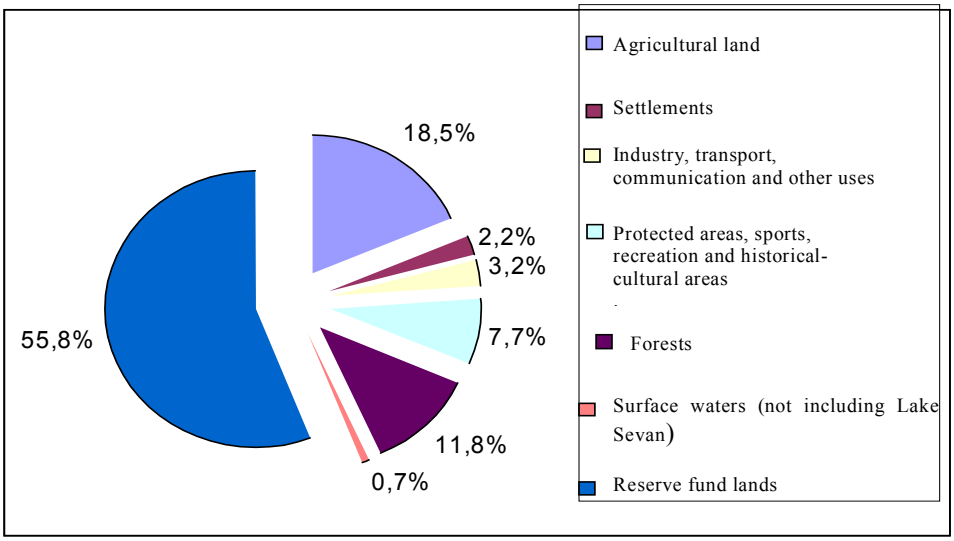
Chapter 4 Land and Soil Resources

Distribution of land in Armenia by category and use

The total land in Armenia, according to 1997 data, is 2 974 300 ha.

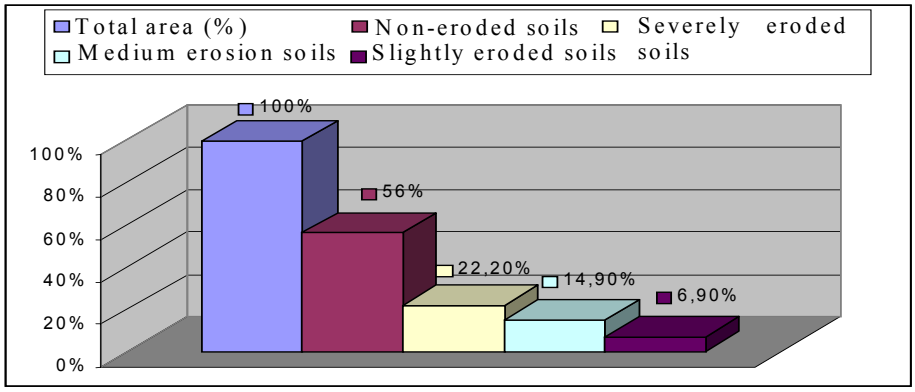
The area of specially protected areas of the republic is about 311 000 ha.

Figure 1.4.1 **Distribution of land in Armenia**



Source: National Statistical Service of RA

Figure 1.4.2 **Soil characteristics**



Source: Action Plan to Combat Desertification

Despite the scarcity of land, there is a diversity of soils in Armenia. The territory of the Republic of Armenia is divided to the following zones:

Semi-desert - total area 236 000 ha;

Dry steppe - 242 000 ha;

Forest - 712 000 ha;

Mountainous - meadows - 629 000 ha;

Soil quality

According to data from soil studies (1980-1985), about 44% of the lands of the Republic are to varying extents exposed to erosion. These lands are located mainly in the Marzes of Aragatsotn, Kotayk, Lori, Syunik and Vayots Dzor.

Both natural and artificial factors cause soil quality changes. Of the 464 300 ha of arable lands in Armenia, 94 000 ha (20.3%) are eroded.

Overgrazing results exposes land to erosion. Due to overgrazing, the area of natural meadowlands has decreased from 1.4 million ha in 1940 to 804 500 ha in 2002.

The following factors contribute to soil quality changes:

- Landslides, which occur on 2% of the territory of the Republic or 0.5 thousand km^2, mainly in the Akhuryan river valley and the basins of the Debed, Vedi, Getik and Vorotan rivers.
- Mud-flows: about 200 settlements in the Republic are affected by mud-flows. In the Ararat plain they affect 30% of the territory, most of which is agricultural land.
- Soil salinization occurs in the Ararat plain, where about 10% of lands are salinated.
- Deforestation reaches significant levels in Armenia.
- Earthquakes and other factors

According to the National Action Plan to Combat Desertification in Armenia, about 24 353 km^2 of the territory of the Republic, 81.9% (excluding the surfaces of Lake Sevan and water reservoirs), are to different extents exposed to desertification: 26.8% of the total territory of Armenia faces extremely severe desertification; 26.4%, severe desertification; 19.8%, moderate desertification; and 8.8%, slight desertification. Only 13.5% (400 km^2) of the territory is not exposed to desertification.

In the period between 1950 and 1999, the area of arable land in Armenia decreased by 166 600 ha: meadows by 15 600 ha and pastures by 136 500 ha.

Land degradation

Lands degraded due to mining activities are found in 281 communities of 11 Marzes of the Republic. According to inventory data, over the period 1978-1998 there were 640 tracts of land degraded by mining, with a total surface area of 7530 ha, of which 3780 ha were used as agricultural lands before degradation. Over the total surface area of these degraded tracts, mining activities have been halted on 3037 ha. These lands should be restored for agricultural use. The remaining 4493 ha are still being mined.

Soil pollution

Sources of soil pollution in Armenia include the agriculture, industry (mining, metallurgy, minerals processing, chemicals, agricultural industries and others), energy, transport, and municipal sectors.

Chemical fertilizers and chemical herbicides and pesticides, especially chlorine-organic compounds that remain in the soil for 15-20 years, have long been used in agriculture in Armenia.

Mining and metallurgy enterprises pollute the soil with heavy metals and chemical compounds.

The volume of accumulated industrial wastes reaches several hundred millions cubic meters.

Land surrounding the Alaverdi copper-molybdenum plant, in a radius of 3 km, is polluted by heavy metals, with concentrations 20-40 times above MPCs.

Land adjacent to the Ararat gold plant is polluted by heavy metals. Similar enterprises are located in Kadjaran, Kapan, Meghri and Agarak, and their surroundings are also polluted by heavy metals (statistical data are not available).

Table 1.4.2 **Land Requiring Improvement or Restoration**

Type of land according to purpose	Total surface area (ha)	Land, by type of degradation (ha)								
		Exposed to erosion		Salin-ated	Secon-dary salin-azation	De-graded	Over humid	Rocky and polluted by wastes	Water-logged	Deserti-fication
		Wind erosion	Water erosion							
1. Agricultural and forest lands (total)	1762438.7	4275	9170	864	700	1941	1163	33742	8080	3498
1.1 Arable lands	464261.6	1765	2816	790	700	119	528	3477	8060	1395
1.2. Perennial plantings	42896.0	-	-	-	-	-	-	-	-	450
1.3. Meadows	136892.4	2	1572	74	-	1356	620	5540	20	153
1.4. Pastures	633532.7	2412	4714	-	-	466	-	24660	-	1500
1.5. Other	484856.0	96	68	-	-	-	15	65	-	-
2. Irrigated agricultural lands	179209.0	440	186	270	-	-	80	-	2	-
3. Specially protected areas	233324.0	82	22	-	-	-	-	210	-	-
3.1. Nature protection lands	226518.0	82	22	-	-	-	-	210	-	-
3.2. Recreational lands	910.0	-	-	-	-	-	-	-	-	-
3.3 Historic-cultural lands	1912.0	-	-	-	-	-	-	-	-	-
3.4. Other	3984.0	-	-	-	-	-	-	-	-	-
4. Forest land	371326.0	116	68	-	-	-	15	65	-	-
4.1. Forested lands	222687.0	15	65	-	-	-	15	65	-	-
5. Water bodies	149114.0	-	5	-	-	-	-	-	-	-
6. Reserve lands	963343.0	155	12	-	-	331	-	1350	-	12

Source: National Statistics Service of RA

Emissions from vehicles using leaded petrol are among the main causes of soil pollution. The import of leaded petrol into the Republic is now prohibited by law.

Almost all settlements are polluted by industrial and household wastes.

Table 1.4.2 below presents 2001 data on the breakdown of land requiring improvement and restoration (data before 2001 are not available, 2002 data are under calculation).

Almost no measures for the protection and rehabilitation of soils have not been implemented in recent years, due to the blockade, as well as the economic and energy crises.

Table 1.4.3 **Soil Protection and Recovery Measures**

	Measure		Total	
			2001	2002
Agro-technical and hydro-technical measures, ha	Irrigation		75875	42514
	Drainage		2375	-
	Measures for mud-flow and erosion mitigation		225	722
	Cleaning of bushes, stones and wastes		11937	1347
	Restoration of vegetation		15.3	163
	Restoration of fertile layer		1020	-
	Soil desalination		-	-
Chemical and biological measures, kg/ha	Application of fertilizers	organic	9813.5	8950
		mineral	203.3	204,3
	Application of chemical weed-killers and pest-killers		4.5	3.6
Expenditures for the protection and recovery of soils, thousand drams	Hydro-technical constructions to prevent erosion		7000	75000
	Construction to prevent mud-flows		4200	8225
	Construction of terraces		600	25300
	Establishment of field-protective forest belts		200	200
	Restoring vegetation		-	6500

Source: National Statistical Service of RA

Chapter 5 Biodiversity

Flora

Armenia has a leading position in terms of diversity of flora, both in the South Caucasus and the Caucasus region in general. Armenia is characterized as well by a diversity of vegetation cover and landscapes. The richness of flora and vegetation cover of the Republic is conditioned by the phytogeographical location of the country, situated between two flora regions, and by a high variance of altitude (from 375 to 4095m) and resulting vertical zonation. Armenia has a leading position as well in terms of density of species (more than 100 species per km^2).

Armenia's flora includes about 3500 species from 150 genera of vascular plants. Comparison with the flora of the Caucasus (6000 species) shows that more than half of these are found on the small territory of Armenia (29.7 thousand km^2), which accounts for only 6.7% of the total territory of the Caucasus (Table 1.5.1).

Table 1.5.1 **Diversity of Vascular Plants in the Caucasus**

Region	Territory (thousand km^2)	Number of species
North Caucasus	254	3900
South Caucasus	186.0	
Azerbaijan	86.6	4300
Armenia	29.7	3500
Georgia	69.7	4000

Source: Conference on Problems of Drought and Desertification in the Countries of the South Caucasus 2002. Part 1: Report on REC Caucasus International Conferences.

The inventory of the flora of Armenia started in 1954 and is continuing. The tenth volume of the "Flora of Armenia" was published in 2001, and the eleventh and last volume is under preparation. Taxonomic studies of a number of major genera carried out before 1980 need to be updated in accordance with the criteria of modern taxonomic studies.

In the process of work on other taxonomic groups of plants, the composition of mosses on Mount Araler (60 species) has been classified. An inventory of algae and lichens has not been carried out. Table 1.5.2 below presents plant diversity in Armenia.

Armenia is rich in fruit and berry species, medicinal, oil bearing, melliferous and decorative plants, as well as species of economic significance containing tanning and resinous substances. The agrobiodiversity of Armenia has scientific and practical significance, especially wild relatives of crops – there are valuable genetic funds of wheat (*Triticum*), goatgrass (*Aegilops*), barley (*Hordeum*), rye (*Secale*) and others.

The Armenian plateau has a long history of farming, as shown by historical evidence and archeological excavations (5th century BC). Apart from wild relatives of crops, the agrobiodiversity of Armenia includes pulses (beans - *Phaseolus*, lentils - *Lens*, garden pea - *Pisum*, and others), fruit and berries (apple - *Malus*, pear - *Pyrus*, apricot - *Armeniaca*, almond - *Amygdalus*, blackcurrant - *Rigbes* and others), vegetable and salad crops (spinach - *Spinacia*,

carrot - *Daucus* and others), oil bearing plants (caraway - *Carum*, thyme - *Thymus* and others), fodder plants (alfalfa - *Medicago*, clover - *Trifolium* and others) and other plants.

Table 1.5.2 **Plant diversity in Armenia**

Taxonomic group	Number of species (approximate)
Algae	388
Lichens	290
Mosses	430
Vascular plants	3500
Peat mosses	2
Horse-tails	6
Ferns	38
Gymnosperms	9
Angiosperms	3445
Monocotyledons	800
Dicotyledons	2700

Source: Biodiversity of Armenia. First National Report, Yerevan 1999

Armenia is characterized as well by a diversity of vegetation cover. Different types of environments (including desert, semi-desert, steppe, forest, sub-alpine and alpine meadows, as well as azonal types of vegetation cover) occur along with transitional forms.

Protection of flora and habitats is carried out in protected areas, where about 60% of vascular plants of Armenia are found. The results of flora inventories of these territories have been published only for Erebuni Reserve and Dilijan National Park (see the section on Protected Areas, below). The inventories of vascular plants of Sevan National Park, Khosrov and Shikahogh Reserves and Sev Lich Reservation have not been completed and provide only partial information on the taxonomic composition of their flora.

Armenia is rich in endemic (about 106), relict (150-200) and rare plant species (154). A total of 387 species (12% of flora) are registered in the Red Data Book of Armenia (1998), of which 34 species were registered in the Red Data Book of the USSR (1984). A total of 57 endemic species are registered in the Red Data Book of Armenia; these are found mainly in the Daralegis (16), Meghri (10) and Yerevan (7) flora regions.

Table 1.5.3 below presents species registered in the Red Data Book of Armenia by category.

All data are out of date and need to be revised in accordance with current studies and new qualitative criteria proposed by the World Conservation Union (IUCN) in 1994.

Since 1998, there has been forest degradation, overexploitation of pastures, hayfields and plant populations. Anthropogenic pressure on flora and vegetation has been increasing due to their use for production.

Table 1.5.2 **Number of species listed in the Red Data Book of Armenia, by category**

Taxonomic group	Number of species					Total
	Extinct	Threatened	Rare	Declining	Indeterminate	
Ferns	1	5	2	0	0	8
Gymnosperms	0	1	1	2	0	4
Angiosperms	29	132	151	55	8	375
Monocotyledons	11	34	38	27	4	114
Dicotyledons	18	98	113	28	4	261
Total	30	138	154	57	8	387

Source: Red Data Book of Armenia, Plants, Yerevan 1988

Wild fruits (pear - *Pyrus*, plumb - *Prnus*, cherry - *Cerasus* and others), medicinal plants (mint - *Menta*, thyme - *Thymus* and others), oil bearing plants (sea-buckthorn - *Hyppophae*, dog-rose - *Rosa* and others), decorative plants (tulip - *Tulipa*, iris - *Iris* and others), and edible plants (*Falcaria*, *Malva* and others) are among those used for economic purposes.

Edible plants are collected and sold in large quantities. Due to the lack of surveys and planning, the use of wild edible species has had significant negative impact on vegetation.

The use of medicinal plants for production purposes has grown to large volumes in Armenia. A broader rage of species are collected, and their marketing has developed. However, the collection of several species of medicinal plants used for other purposes (for example, use of mint and thyme for soft drink production) has reduced the natural reserves of these species to critical levels.

The collection and marketing of decorative species (snowdrop - *Merendera*, crocus - *Crocus*, primrose - *Primula*, tulip - *Tulipa* and others) also affect flora and vegetation. Decorative species are mostly used in Yerevan (plants are also imported from neighboring regions).

The collection of wild species for production purposes is carried out both by private individuals (especially edible and decorative species) and by companies and organizations. The collection of medicinal plants is carried out under permits issued by the Ministry of Nature Protection. The collection of other species is not controlled by the state. It is necessary to introduce a common licensing system. It is necessary to determine permissible collection quantities for each species by region and by tariff, as well as to check methods of collection and the qualification of pickers, and organize training on a yearly basis.

Excessive anthropogenic pressure on meadows and uncontrolled grazing on pastures have negative impacts on the flora and vegetation of the Republic and lead to the deterioration of natural meadowlands.

The invasion of exotic species negatively affects the flora and vegetation of Armenia. Having high tolerance, exotic species replace native flora and cover significant areas, especially on pastures. The most aggressive species are *Ambrosia, Galinsoga, Xanthium, Cirsium* and others.

The attempt to grow 51 species of medicinal plants by the Kazaros enterprise (Tavush Marz) has not been followed elsewhere. The main reason is the social-economic situation, under which it is more convenient to collect naturally growing plants to receive maximum returns in a short periods of time. In this situation, environmental losses and environmental risks increase. It is necessary to introduce a system of incentives to promote the creation of nurseries and plantations.

As a result, the issues of flora and vegetation protection and natural landscape degradation are connected with the unsustainable use of nature and natural resources, in turn conditioned by the difficult social and unstable economic situation, the imperfection of the legislative framework, the lack of financial, material, technical and modern technological means, as well as by insufficient scientific research, environmental education and public awareness.

Forest resources

According to the Forest Code of the Republic of Armenia (1994), the forests of Armenia are classified as protected forests (for the water supply, prevention of erosion, protection of lands and other reasons), forests of social significance (recreational activities) and forests of special significance (specially protected areas).

During the 20th century, the forests of Armenia have twice been affected by negative anthropogenic impacts: in 1930-1950 and in 1992-1995. The anthropogenic impact at the end of the century was conditioned by the economic blockade, energy crisis and military events. Legal and illegal logging of oak (*Quercus*), beech (*Fagus*) and hornbeam (*Carpinus*) stands of economic importance resulted in significant reductions in the extent of forests, degradation of forest landscapes, decrease of forest productivity and biodiversity. The loss of forested areas had negative impact as well on the ecological situation and environmental functions.

The characteristics of the forests of the Republic are presented, according to 1993 data. According to this inventory data, the forest fund covered 459 900 ha, of which 334 100 ha were covered by forest (11.2% of the territory of Armenia). Average standing stock was 125 m^3/ha; average annual increment, 1.3 m^3/ha; and total standing stock, 38.00 million m^3. Table 1.5.4 below presents data from the Annual Collection of the National Statistical Service of the Republic of Armenia (1999-2003).

Table 1.5.4 **Forest fund**

	1998	1999	2000	2001	2002
Forest fund (thousand ha)	459.9	367.6	450.3	447.2	452.6
Forested areas (% of forest fund)	72.6	77	71.3	72.6	73.1

Source: Environment and Natural Resources. Statistical Collections. Yerevan, 1999-2003.

In 1998, the forest fund covered 11.2% of the total territory of the Republic (0.11 ha of forest area per capita).

Table 1.5.5 below presents the dynamics of measures on forest resource recovery.

Table 1.5.5 **Forest Recovery Measures**

Measure	1998	1999	2000	2001	2002
Planting of trees (ha)	432	360.2	421.9	322.8	278
Support for natural regeneration (ha)	852.2	390	620	800	448
Total (ha)	1284.2	750.2	1041.9	1122.8	726

Source: Environment and Natural Resources. Statistical Collections. Yerevan, 1999-2003.

Since 1998, clearing logging operations have prevailed (Table 1.5.6)

Table 1.5.6 **Logging (ha), by type**

Logging	1998	1999	2000	2001	2002
Clearing logging	2125	2706	2264	2270	2686
Final logging	45	65	469	355	173
Thinning	131	306	115	202	180
Transitional logging (last phase of thinning)	229	182	248	300	274
Cleaning	56	2002	102	127	34
Total	2586	3461	3198	3264	3366

Source: Environment and Natural Resources. Statistical Collections. Yerevan, 1999-2003.

The annual legal logging was 62 900 m^3 in 1998 , 41 800 m^3 in 1999, 72 600 m3 in 2000, 58 600 m^3 in 2001, and 68 900 m^3 in 2002.

The annual illegal logging was 5700 m^3 in 1998, 6200 m^3 in 1999, 2700 m^3 in 2000, 2700 m3 in 2001 and 3400 m^3 in 2002 .

Forest fires, pest and diseases, rodents as well as illegal grazing in forests have had significant impacts on forest ecosystems and their productivity.

Table 1.5.7 **Forest Fires, Pests and Diseases**

	1998	1999	2000	2001	2002
Number of forest fire cases	32	15	38	13	6
Damaged forest area (thousand ha)	302.5	52.1	26.9	126.8	5.7
Total area of forests affected by pests and diseases (thousand ha)	26.2	35.5	29.2	22.2	11.0
Area of forests rehabilitated as a result of pest control (thousand ha)	3.9	0.9	0.4	0.3	0.04

Source: Environment and Natural Resources. Statistical Collections. Yerevan, 1999-2003.

At present, the recovery of the Armenia's forests is of strategic national importance. A new Forest Policy is under development: it will include the principle of sustainable forest use and the recovery of degraded forest ecosystems. Based on this Forest Policy, the National Forest Program will be developed, which will include legislative, institutional, social-economic, financial and other mechanisms, taking into account the requirements of a market economy and the international commitments of Armenia.

Fauna

General description

The altitude zonation of Armenia leads to a diversity of landscapes and biological species. The geographical location and relief of the country have supported the development of a diversity of species and biological resources, as well as high level of endemic species and rich agrobiodiversity.

Armenia is one the most important centers of origin for a number of plant and animal species. Most bioresources have been traditionally used by local communities and have had important cultural-economic significance. Recently, the use of biological resources in Armenia has become unstable due to increasing anthropogenic impacts. As a result, animal habitats have been significantly degraded, placing a number of species under the threat of extinction.

Thus, at present 490 species of animals are on the edge of extinction, including 66 species of birds and 18 species of mammals. The economic situation in the country hampers the implementation of adequate nature protection measures for the conservation and rehabilitation of threatened animal species.

Endemic, disappearing and declining species

As a result of the diversity of climatic conditions, on the relatively small territory of Armenia more than 17 500 species of animals have been documented, including more than 500 species of vertebrates. Biodiversity in Armenia includes endemic, relict and rare animal species.

Table 1.5.8 **Number of Animal Species, Including Endemic Species, by Taxonomic Group**

Taxonomic group	Number of species	Number of endemic species
Invertebrates	**17 000**	**316**
Mollusca	155	-
Anthropoda	5 830	-
Others	11 015	-
Vertebrates	**532**	**23**
Fish	39*	9
Amphibians	8	1
Reptiles	53	6
Birds	349	1
Mammals	83	6
Total	**17 532**	**339**

***** New, corrected data (2001)

Source: Ministry of Nature Protection of RA

At present, out of a total 17 000 species of invertebrates and 532 species of vertebrates in Armenia, more than 300 animal species are considered to be declining or rare.

Red Data Book of Armenia – Animals

A total of 48 invertebrates in Armenia were registered in the Red Data Book of the USSR. A total of 99 vertebrate species were registered in the Red Data Book of Armenia, of which 39 in the Red Data Book of the USSR and 8 in the International Red Data Book. At present, 97 other species of vertebrates need to be registered in the Red Data Book of Armenia.

Red Data Book of Armenia for invertebrates is still not available, though it is already clear that about 100 species of invertebrates need special protection.

The total of 99 species of vertebrates registered in the Red Data Book of Armenia includes 67 species of birds, 12 of amphibians and reptiles, 18 of mammals and 2 of fish. At present, most of these are in danger of extinction, and the number of threatened species in the near future could double. These are the results of the economic crisis in the country and recent natural disasters, as well as inadequate nature protection legislation.

Of the 18 orders of mammals, representatives of six orders are found on the territory of Armenia. The following species are the most endangered: Armenian mouflon (*Ovis orientalis gmelinii*), wild goat (*Capra aegagrus*), European otter (*Lutra lutra*), marbled polecat (*Vormela peregusna*), brown bear (*Ursus arctos*), manul (*Felis manul*) and others. The striped hyena (*Hyaena hyaena*) and the Caucasian birch mouse (*Sicista caucasica*) can be considered extinct in Armenia.

Table 1.5.9 **Vertebrates Listed in the Red Data Books, by Taxonomic Group and Category**

Taxonomic group	Total number of species in the Red Data Book of Armenia	Number of species by category					Number of species in the Red Data Book of the USSR	Number of species in the International Red Data Book
		Extinct	Threatened	Rare	Declining	Indeterminate		
Fish	2	–	2	1	–	–	1	2
Amphibians	1	–	–	–	1	–	1	–
Reptiles	11	–	6	4	1	–	7	2
Birds	67	–	20	34	13	–	19	3
Mammals	18	2	3	6	6	3	11	1

Source: Ministry of Nature Protection of RA

Factors affecting biodiversity of Armenia

The main factors affecting biodiversity of Armenia are linked directly or indirectly with anthropogenic impacts. These are the following:

1. Habitat loss and transformation
2. Bioresource overexploitation
3. Environmental pollution
4. Impact of introduced and alien species
5. Climate change

All the above factors reduce populations of plants and animals, as well as bring about ecosystem degradation and loss of species.

Main causes of biodiversity loss

Many factors with direct impacts on biodiversity have common causes, such as:

- current economic difficulties;
- social problems;
- imperfect legislation;
- overexploitation of natural resources;
- lack of alternative, environmentally sustainable sources of income for the population.

Agrobiodiversity

Armenia is one of the most ancient centers of origin and selection for endemic species and valuable varieties of agricultural animals, as well as their wild ancestors. As long ago as the 9th century BC, endemic varieties of sheep were known in the state of Urartu. The Armenian mouflon is considered their ancestor. At present, wild populations of Armenian mouflon are found in the southern regions of Armenia, particularly in Khosrov Reserve and adjacent territories. However, populations of this unique species are declining due to increased pouching and reduction of its natural habitat.

The Armenian plateau is a center of goat breeding (the Kilikian semifine-wool goat is one of the most known endemic species of goats). The Karabaghian race of horse is among the native species of the Armenian plateau.

On the basis of rich genetic pool, during the last 50-60 years numerous valuable varieties of rabbits, chickens, pigs, sheep and cows have been developed through breeding.

Measures for biodiversity protection currently being undertaken by the Government of Armenia are not sufficient and often inadequate. In this regard, it is necessary to take urgent action to protect biodiversity in Armenia. Among the main measures it is necessary to:

- develop mechanisms for the reduction of negative impacts of economic activities on biodiversity, ensuring rational use of biological resources;
- increase investments (including international investments) for the improvement of the protection system, as well as for the conservation and recovery of flora and fauna diversity;
- ensure conservation and recovery of threatened plant and animal species;
- improve nature protection legislation and its implementation;
- ensure wide public participation in biodiversity protection and the use of biological resources; and
- improve the system of ecological education and training.

The current state of the fishing industry in Armenia

Fish resources and fishery

Not long ago, almost all rivers and lakes of Armenia, with rare exceptions, had rich fish resources and to some extent satisfied the population's needs in terms of fresh fish. However, due to the development of the irrigation system, which withdraws more and more water from rivers during the summer, the development of mining and chemical industries that pollute rivers,

and the increase in poaching with the use of methods that destroy fish populations, fish resources in many rivers have declined drastically and many species are in threat of extinction.

At present, only Lake Sevan has commercial significance in terms of fishing. The fish reserves of Arpilich Reservoir are at the edge of complete depletion, and other water bodies have lost their commercial significance. Special efforts will be needed for their recovery.

Lake Sevan. The total area of the lake is 1240 km^2. Fish productivity in the recent years is estimated at 25-30 kg/ha. At present, the main marketable species in the lake is whitefish, introduced in the lake in 1920-1930s. The whitefish catch accounts for more than 80% of the total fish catch in the lake. However, due to increased poaching the whitefish catch and its reserves have recently decreased drastically (Table 1.5.10).

Table 1.5.10 **Dynamics of Whitefish Catch and Non-registered Catch (Poaching) by Years**

Year	Catch (tonnes)	Coefficient of non-registered catch	Total catch including poaching (tonnes)
1997	2100	3.2	6800
1998	1800	2.7	4800
1999*	-	-	2800
2002	600	3.6	2200

Note: in 1999 whitefish catch was banned.

Source: Institute of Hydroecology and Ichthyology of the National Academy of Science of the Republic of Armenia

At present, the catch of other valuable commercial species of Lake Sevan fish – trout and khramulya – is banned due to the poor situation of their populations. The only species whose catch is not limited is goldfish, which was introduced in the lake at the beginnings of 1980s. Its catch has recently reached on average 300-500 tonnes/year.

Lake Arpilich. Lake Arpilich used to be the second largest water body in Armenia in terms of fish catch. Sazan was the main commercial species with catches approaching 500 tonnes a year.

During the first years after the flow of the River Akhuryan was regulated and the lake turned into reservoir, the sazan catch sharply increased and reached 1000 tonnes. However, due to significant changes in the hydrological regime of the lake, the forage reserve dropped drastically, natural regeneration decreased and as a result fish reserves and catch fell. At present the Arpilich reservoir, as well as all the other reservoirs of Armenia, does not have commercial significance.

Kechut Reservoir. The total area is 145 ha, average depth 20 m, and estimated fish productivity, 150-200 tonnes a year of whitefish, trout, and khramulya.

Rivers. In spite of the potential significance of rivers for fishing, they are not paid proper attention. Fish reserves in rivers are not protected at all or their protection is insufficient. Repopulation measures are completely missing. River regimes are often disturbed without taking into consideration fishing industry needs. Rivers are polluted by household and agricultural wastes. Even rivers of the Lake Sevan basin are not spared, in spite of the fact that the condition of the lake's commercial fishing to great extent depends on the purity and normal regime of these rivers.

Fish-breeding plants

At present in Armenia, six fish-breeding plants are functioning (Jermuk, Angeghakot, Sevan, Lich, Kapckaghbyur and Gavar) for the artificial reproduction of fish species from the genera

Salmonidae, *Coregonidae* and *Cyprinidae,* and for the recovery of their reserves. All but the two first breeding plants are located on the territory of the Lake Sevan basin.

Trout-breeding in Lake Sevan started in the 1920s. At the beginning, work on artificial reproduction of Sevan trout was experimental, but in the 1940-1950s it already had significant importance, and starting in the 1960s, the artificial reproduction of trout became the only source of maintaining trout reserves in the lake.

The total planned capacity of all four fish-breeding plants for trout spawn incubation does not exceed 75 million. In the 1970s, on average a total of 65 million spawns were collected yearly for incubation from the Lake. Since, there has been a decline in artificial reproduction of trout in the lake, and by the end of the 1980s the amount of spawn incubated in all fish-breeding plants ranged from 4.7 to 6.2 million, on average about 7% of the total planned capacity of the fish-breeding plants.

Thus, the efficiency of artificial trout reproduction in Lake Sevan is dropping year to year. It is necessary to take urgent measures for the radical restructuring of not only the biotechnology of Sevan trout artificial breeding, but also the existing fish protection and management systems.

Fish-breeding enterprises

For many years, commercial trout breeding was not developed extensively due to a lack of high quality and relatively cheap feed, as well as a lack of confidence that bred trout could compete with the valuable Lake Sevan species of natural trout and whitefish.

Until recently, several large enterprises for commercial rainbow trout breeding have been in operation (Aknalich, Angeghakot, Jermuk, Masis and Hrazdan). The Aknalich and Jermuk fish-breeding enterprises were constructed in 1966. The Aknalich enterprise was one of the largest, with a production capacity of about 300-350 tonnes of marketable trout a year.

After privatization, the majority of these enterprises were divided into smaller ones.

At present, among functioning carp-breeding enterprises, the Armash and Eghegnadzor enterprises are considered to be the largest. The Armash enterprise used to be the biggest in the South Caucasus, with a total capacity of several thousand tonnes a year. At present, it produces only 400-500 tonnes of fish annually.

In recent years, many Armenian fish-breeding enterprises have lost their cost-effectiveness due to the high primary costs of fish being raised, conditioned mainly by the high prices of feed, electricity and water. In comparison with fish grown in fish-breeding enterprises, valuable marketable fish from Lake Sevan has higher quality and lower primary costs, leading to a growth in the catch of fish from the lake and a drastic reduction in the reserves of the main marketable species: trout, khromulya and whitefish.

To reduce the pressure on populations of the valuable Lake Sevan species, it is necessary to find alternatives to increase the productivity of fish-breeding enterprises in Armenia.

Specially Protected Areas

Specially protected areas (SPA) are natural areas that have environmental, scientific, cultural, aesthetic significance due to their unique landscape, flora and fauna. SPAs are designed to protect selected surface water and groundwater areas, soils, ecosystems, flora and fauna, as well as to carry out scientific research, environmental monitoring, education, training and recreational activities. Consequently, they are excluded (partly or completely, temporarily or permanently) as areas of economic use. Areas adjacent to SPAs are recognized as buffer zones. SPAs are taken into consideration while developing social-economic programs, integrated plans and other plans.

The current network of SPAs was founded in 1958 with the establishment of three state reserves and six reservations. All of them were established to protect forest landscapes. At present, forests cover about 72% of the territory of all protected areas.

According to the Law on Specially Protected Areas of the Republic of Armenia, SPAs fall into four types of status:

- state reserves;
- national parks;
- state reservations;
- natural monuments.

Since 1998, the total area of SPAs has not changed: they cover 3100 km^2 (about 10% of the territory of Armenia). The status of two SPAs has been changed, though the total number remains the same (28).

Table 1.5.11 **Specially Protected Areas of Armenia**

Status	Number	Total area (km^2)	% of national territory
State reserves	3	392.89	1.32
National parks	2	1790	6.02
State reservations	23	942.5	2.73
Natural monuments	data not available	-	-

Source: Data on SPA are given mainly according to Annex 1 of the Governmental Resolution N 472 of June 6, 1995.

SPAs are regulated by the Law on Principles of Environmental Protection (9 June 1991), Law on Specially Protected Areas (17 December 1991), Law on Flora (23 November 1999), Law on Fauna (3 April 2000), as well as by other laws and regulations and by the SPA charters.

The State Strategy and National Action Plan for the Development of Specially Protected Areas of Armenia, developed in 2002 by the Ministry of Nature Protection, was approved by the Government of the Republic of Armenia by Resolution No. 54 of December 26, 2002.

State reserves

According to legislation, state reserves are designated to protect the natural dynamic processes in specially selected natural areas, as well as rare species of flora and fauna. State reserves are under a strict regime of protection. In terms of IUCN's classification (1994), these are protected areas of category Ia.

At present in Armenia, there are three state reserves (Table 1.5.12) instead of the previous five. The status of two reserves was changed by Governmental Resolution No. 976 (12 October 2001), under which Sev Lich Reserve was given the status of reservation, and Governmental Resolution No. 165 (21 February 2002), by which Dilijan Reserve was given a status of national park.

Table 1.5.12 State Reserves of Armenia

Name	Date of establishment and relevant government resolution	Territory (km^2)	Location (Marz)
Erebuni	27.05.1981, Resolution No. 324, Council of Ministers of ArmSSR	0.89	Kotayk
Khosrov	13.09.1958, Resolution No. 341 Council of Ministers of ArmSSR	292	Ararat
Shikahogh	13.09.1958, Resolution No. 341 Council of Ministers of ArmSSR, annulled 02.01.1961, Resolution No. 20 Council of Ministers of ArmSSR, restored 27.10.1975, Resolution No. 728 Council of Ministers of ArmSSR	100	Syunik

Source: Data on SPA are given mainly according to Annex 1 of the Government Resolution No. 472 of the Government of Armenia of June 6, 1995, as well as the Government Resolutions cited in the Table.

Up to 2002, state reserves were under the supervision of the Ministry of Nature Protection as separate sub-units, each with the rights of a legal entity. Since 2002, according to the Law on State Non-Commercial Organization (SNCO) of the Republic of Armenia, state reserves were given a status of SNCO in accordance with the charters approved by the Government.

The Erebuni Reserve, however, has neither its own administrative body according to acting legislation nor the rights of a legal entity. It is within the framework of the reserve-park complex of the Ministry of Nature Protection of the Republic of Armenia.

Erebuni Reserve

Erebuni Reserve was established in the vicinity of Yerevan to protect a unique genetic pool of wild relatives of crops including wheat (*Triticum*). It can be considered a protected area of international significance. Three out of four known species of wild wheat grow in the reserve (*T. boeticum, T. urartu, T. araraticum*). The last two species were first identified in Armenia. Different species of rye and barley occur in the reserve. According to the published data of flora studies, 278 species of vascular plants grow in the reserve. The fauna of the reserve has not been specially studied, though it is known that rare species of beetles occur in the reserve. Seven species of the reserve's fauna are registered in the Red Data Book of Armenia, and the same number in the Red Data Book of the USSR.

Khosrov Reserve

Khosrov Reserve was established on the site of the Khosrov Forest, established by the Armenian King Khosrov III (330-338) for hunting purposes. The reserve was established to protect the water resources of the Azat River, as well as relict juniper (*Juniper*) forests, oak stands, mountainous dry landscapes as well as rare plants and animals. The inventory of the flora of the reserve has not been completed. According to preliminary data, about 1800 species of vascular plants grow in the reserve (more than half of the flora of Armenia). Among these there are numerous fruit, oil bearing, medicinal and other species, as well as endemic and relict species. The vegetation of the reserve is diverse. The rich fauna of the reserve includes a diversity of fish, mollusks, reptiles, birds and mammals. Among endemic mammal species of the Caucasus, the wild goat and Armenian mouflon found in the reserve are of special importance.

Shikahogh Reserve

Shikahogh reserve was established to protect oak (*Quercus*), beech (*Fagus*) and mixed oak-beech forests, as well as hornbeam (*Carpinus Orientalis*), yew (*Taxus baccata*) and plane (*Platanus orientalis*) trees and rare animals. The flora of the reserve includes about 1100 species of vascular plants (the inventory has not been completed). A total of 70 species of plants are registered in the Red Data Book of Armenia, and 18 in the Red Data Book of the USSR. There are many wild fruit species in the reserve, such as walnut (*Juglans regia*), apple (*Malus orientalis*), plum (*Prunus*), endemic species of pear (*Pirus*) and others. The fauna of the reserve is diverse. The wild goat and Armenian mouflon are among the mammals found in the reserve.

National Parks

According to legislation, national parks are areas of ecological, historical-cultural and aesthetic significance with protection regimes determined by functional zones. In international practice, three special zones are recognized in national parks: reserves (with a strict protection regime), economic zones (areas of economic use) and recreational zone (areas for recreation).

By the IUCN (1994) classification, national parks are protected areas of category II.

Since 1958, the number of national parks has changed: in addition to Sevan National Park, Dilijan National Park was established on the basis of Dilijan Reserve (Table 1.5.13).

Table 1.5.13 **National Parks of Armenia**

Name	Date of establishment and relevant government resolution	Territory (km2)	Location (Marz)
Sevan	14.03.1978 Resolution No. 125 341, Council of Ministers of ArmSSR	1500	Gegharkunik
Dilijan	Reserve, 13.09.1958, Resolution No. 341 341, Council of Ministers of ArmSSR National Park, 21.02.2002, Republic of Armenia Government Resolution No. 165	290	Tavush

Source: Data on SPA are given mainly according to Annex 1 of the Governmental Resolution N 472 of the Government of Armenia of June 6, 1995 as well as other Governmental Resolutions mentioned in the table

The national parks are under the supervision of the Ministry of Nature Protection. In 2002 they also became SNCOs, with charters approved by the Government of the Republic of Armenia.

Sevan National Park includes unique the mountainous freshwater Lake Sevan (1252 km^2) and its littoral areas (249 km^2). It was established to protect a valuable reserve of fresh water, the surrounding ecosystems (the buffer zone around the national park is 3400 km^2) and endemic and rare species, to reproduce the fish stock of the lake, as well as to organize recreational and tourism activities.

Dilijan National Park was established on the basis of Dilijan State Reserve. At present, the following activities are carried out in the national park: identification of different functional zones (reserve, economic and recreational zones), definition of the boundaries of protected areas as well as cartographic work for the development of the national park's general plan.

State Reservations

By legislation, reservations can be protected areas of national or local significance with protection regimes set up in accordance with their purpose.

Reservations do not match with any category of the international IUCN classification of Protected Areas, though they approach category IV. There are 23 reservations in Armenia (Table 1.5.14).

The reservations of Armenia are mainly under the supervision of the Ministry of Nature Protection of the Republic of Armenia, except for five reservations: Aragats Alpine Reservation is under the supervision of the Institute of Physics of the National Academy of Sciences of RA; the remaining four 4 (the Margahovit, Juniper forests, Sands of Goravan and Caucasian Rose-bay Reservations) are under the supervision of the Ministry of Agriculture of RA.

Natural Monuments

By legislation, natural monuments are unique natural sites of special scientific or cultural-historical significance. By the IUCN (1994) classification, natural monuments are protected areas of category III.

Table 1.5.14 **State Reservations of Armenia**

No.	Name	Date of establishment and government resolution	Area (km^2)	Location (Marz)	Protected object
1	Yew of Akhnabad	29.01.1959 Resolution No. 20 Council of Ministers of ArmSSR	0.25	Tavush	Relict yew
2	Aragats (alpine)	29.01.1959 Resolution No. 20 Council of Ministers of ArmSSR	3	Aragatsotn	Stone Lake and alpine meadows
3	Arzakan and Meghradzor	16.11.1971 Resolution No. 375 Council of Ministers of ArmSSR	145	Kotayk	Forest animals
4	Hazel-nut	13.09.1958 Resolution No. 341 Council of Ministers of ArmSSR	0.4	Tavush	Relict hazel-nut and yew
5	Pine of Banx	29.01.1959 Resolution No. 20 Council of Ministers of ArmSSR	0.04	Kotayk	American pine of Banx
6	Boghakar	10.08.1989 Resolution No. 400 Council of Ministers of ArmSSR	27.28	Syunik	Endemic and rare species of flora and fauna
7	Ghandzakar	16.11.1971 Resolution No. 375 Council of Ministers of ArmSSR	68	Tavush	Forest animals
8	Getik	16.11.1971 Resolution No. 375 Council of Ministers of ArmSSR	60	Gegharkunik	Forest animals
9	Juniper forests	13.09.1958 Resolution No. 341 Council of Ministers of ArmSSR	33.12	Gegharkunik	Different species of relict juniper
10	Goris	1972	19	Syunik	Forest animals
11	Sands of Goravan	29.01.1959 Resolution N 20 Council of Ministers of ArmSSR	2	Ararat	Residual sands with unique species
12	Pine of Gyulagarak	13.09.1958 Resolution N 341 Council of Ministers of ArmSSR	25.86	Lori	Relict pine forests
13	Eghegnadzor	1972	42	Vayots Dzor	Forest animals
14	Idjevan	16.11.1971 Resolution N 375 Council of Ministers of ArmSSR	78	Tavush	Forest animals
15	Hankavan	1981	93.50	Kotayk	Mineral water “Hankavan”
16	Juniper forest of Her-Her	13.09.1958 Resolution N 341 Council of Ministers of ArmSSR	61.40	Vayots Dzor	Relict juniper forest

17	Margahovit	16.11.1971 Resolution N 375 Council of Ministers of ArmSSR	50	Lori	Forest animals
18	Rose-bay	29.01.1959 Resolution N 20 Council of Ministers of ArmSSR	10	Lori	Relict Caucasian rose-bay
19	Vordan Karmir	03.02.1987 Resolution N 61 Council of Ministers of ArmSSR	2	Armavir	Unique insect *Porphyrophora hamelii*
20	Jermuk	13.09.1958 Resolution N 341 Council of Ministers of ArmSSR	38.65	Vayots Dzor	Mountainous stands of oak and rare animals
21	Jermuk (hydrological)	1981	180	Vayots Dzor	Jermuk Mineral water
22	Sev Lich	Reserve - 15.10.1987 Resolution N 683 Council of Ministers of ArmSSR; Reservation - 12.10.2001 Resolution of the Government of RA N 976	2.4	Syunik	Unique lake of volcanic origin and surrounding ecosystems
23	Plane grove	13.09.1958 Resolution N 341 Council of Ministers of ArmSSR	0.6	Syunik	The only natural grove of plane in the Caucasus

Source: Data on SPA are given mainly according to Annex 1 of the Governmental Resolution N 472 of the Government of Armenia of June 6. 1995 as well as other Governmental Resolutions mentioned in the table

At present, the network of specially protected areas has a number of overall problems. The management of state reserves and national parks does not meet modern requirements for environmental protection. Regimes of protection are not respected. Due to the lack of financial means, the material and technical base for protection is not available (vehicles and communications equipment, laboratory facilities, technical and other equipment). The elimination of scientific departments and reduction of scientific staff, as well as the lack of qualified specialists, hinders implementation of scientific research, monitoring and inventory activities and has a negative impact on overall management.

The state of reservations and natural monuments remains the same as before 1998. In general, the borders of reservations are not clearly defined. Management bodies and their responsibilities are not well identified. The detailed legislative basis (regulations, normative and other documents) and management plans are missing. Inventories of natural monuments have never been carried out. Management and protection mechanisms are missing. Up to now there has not been a list of natural monuments.

During the 45 years of that the network of specially protected areas has been in existence, activities carried out have included classification work, scientific studies, the protection of flora, fauna and ecosystems, the identification of endemic, rare and endangered species, and the improvement of management systems.

For the development of specially protected areas, it is necessary to:

- develop new policies, taking into consideration market economy conditions and the international commitments of Armenia;
- improve the legislative framework (make amendments to the Law on Specially Protected Areas of the Republic of Armenia, adopt respective regulations, especially regarding reservations, natural monuments, Red Data Books and other issues);
- revise the status of existing SPAs, clarify borders and buffer zones, establish new SPAs as well as a network of SPAs (in accordance with international criteria);
- improve management and planning systems;

- provide the material and technical base;
- carry out scientific research activities (inventories, monitoring, database establishment and other work);
- train and retrain staff and establish educational centers;
- organize recreational and ecotourism activities; and
- ensure information flows (establish information centers and networks) and raise public awareness.

Chapter 6 Minerals and Underground Resources

On the territory of Armenia there are 565 deposits containing 60 types of minerals.

Their estimated gross value is more than US$ 120 billion, of which US$ 24 billion are metal ores: iron, copper, molybdenum, lead, zinc, gold (also in polymetallic ores), and aluminum, including large deposits. The total value of metals accounts for 30% of overall potential reserves of mineral raw resources of the Republic.

Non-metallic minerals – in particular building stone – account for more than 60% of total potential mineral reserves; geological explorations have investigated 475 deposits.

The territory of Armenia can be divided into three zones in terms of mineral resources – Alaverdi-Kapan, Pambak-Zangezur and Sevan-Amasia – characterized by different histories in terms of geological evolution and current deposits.

- Alaverdi-Kapan zone – copper, lead, zinc, iron
- Pambak-Zangezur zone – copper, molybdenum, rarely lead, zinc, antimony, gold, silver
- Sevan-Amasia zone – chromium, gold, rarely mercury, silver, antimony

In terms of molybdenum reserves, Armenia can compete with large countries. The extraction of minerals has had great importance for the development of the economy of any country. Minerals are among main criteria of national wealth, power and independence. It is interesting to mention that as long ago as the 8^{th} and 9^{th} centuries, Armenia was processing bronze, brass, iron and steel.

In general, more than 50 types of metals are used; these can be grouped in the following groups:

- Black metals - Fe, Mn, Cr….
- Rare metals - Ti, Ni, W, Re, Mo…
- Scattered metals - Bi, Hg…
- Non-ferrous metals - Cu, Pb, Zn, Al, Mg…
- Precious metals - Au, Pt, Ag…

All the above mentioned metals are found in the underground resources of Armenia.

Several copper-molybdenum deposits on the border with Iran – in Kajaran, Dastakert and Agarak – are located at an altitude of 2000-2500 m. This zone is known as the Pambak-Zangezur copper-molybdenum zone. The Kapan copper deposit, with a total area of 25 km^2, has been exploited for more than 150 years. Until 1950-1951, the perspectives for gold deposit mining were estimated as relatively low, and gold deposits were not sought. However, as a result of focused work, a number of deposits have been explored: Zod, Meghradzor, Hamzachiman, Tandzut, Hankavan, Gearchi, Armanis, Terterasar, Tukhmanuk, and Lichkvaz. In the Pambak-Zangezur zone, the Kajaran, Agarak, Jindara, Dastakert and Hankavan deposits contain considerable amounts of silver.

Armenia is rich in mineral water. The mineral waters of Jermuk, Arzni, Dilijan, Hankavan, Sevan, Bjni are well-known for their medicinal and organoleptic qualities.

Recent investigations have shown that coal deposits in Armenia (Jermanis, Nor Arevik, Shamut, Jajur) contain gold, silver and platinum in concentrations of industrial significance. Coal from the Jajur deposit can be used for regional purposes.

Known reserves of building and other stones in the Republic are 2.25 billion m^3, of which about 0.74 billion m^3 or 32.9% are quarried on a lease basis. The reserves of multipurpose raw materials (lime, tuff, clay, gypsum and others) is 2.04 billion tonnes, of which 0.82 billion tonnes or about 40% of the total reserve are being quarried. Of all the countries' non-metallic mineral deposits, 230 are exploited at present.

Colorful tuffs, Armenian pumice-stone, basalt as well as marble are well-known. The territory of Armenia is rich in pearlite and obsidian. There are extensive reserves of rock-salt in the vicinity of Yerevan.

In different regions of Armenia, there are a significant number of abandoned stone quarries. Open-pit mines and their tailings cover significant surface area in different regions of Armenia.

In the past, the mining of major deposits – including stone quarries – led to the deterioration of extensive agricultural land areas.

Due to the change of economic system, at present private entrepreneurs are the main source of financing for geological exploration in Armenia, and the volume of exploration financed by the state budget has changed (figure 1.6.1).

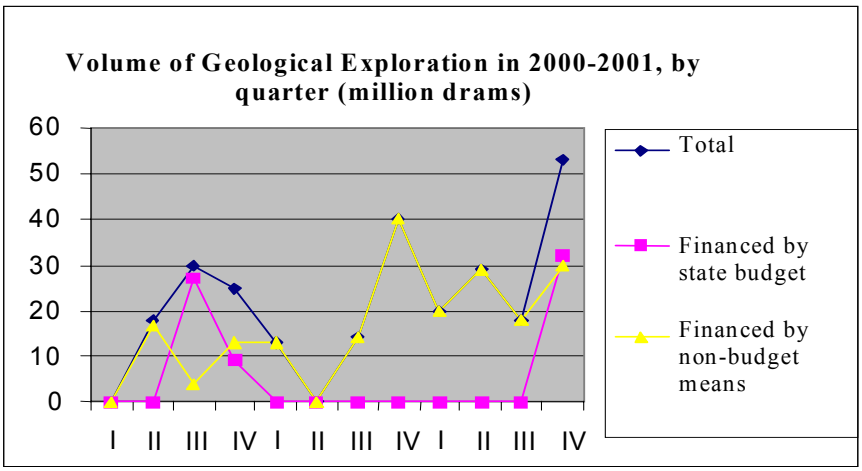


Figure 1.6.1

Source: National Statistical Service RA

Due to its significant reserves of natural building materials, Armenia has been exporting them to other former Soviet republics, which has resulted in the intensive development of the building materials industry and negative impacts on the environment. Wastes from the mining industry are among the causes of land desertification. This is one of the main environmental problems for Armenia, which has scarce land resources. Armenia alone cannot solve this problem, and international support is needed.

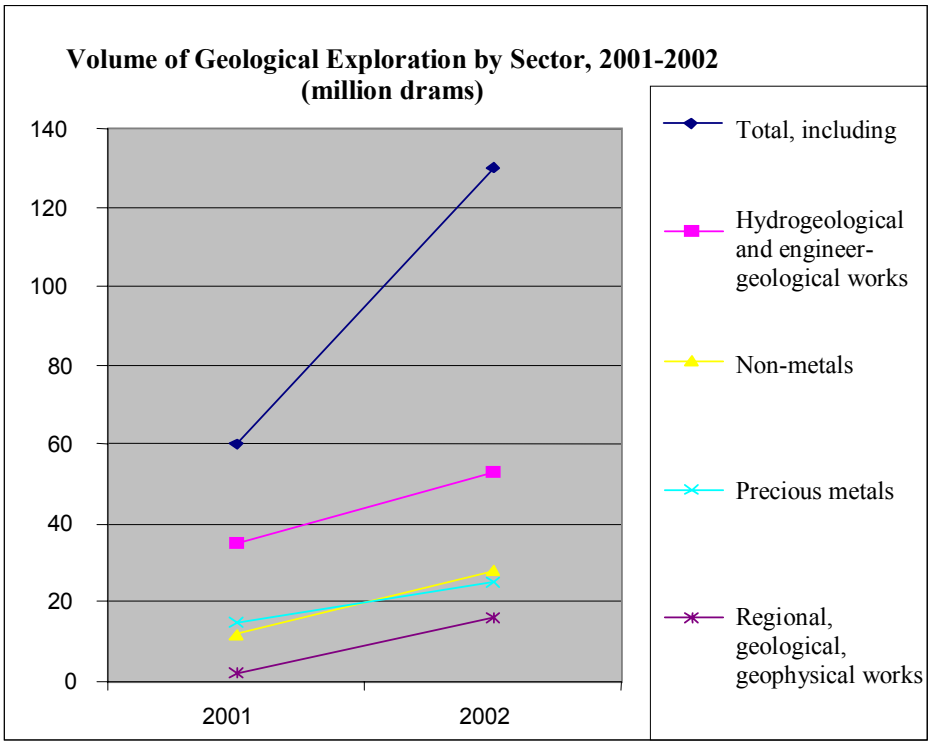
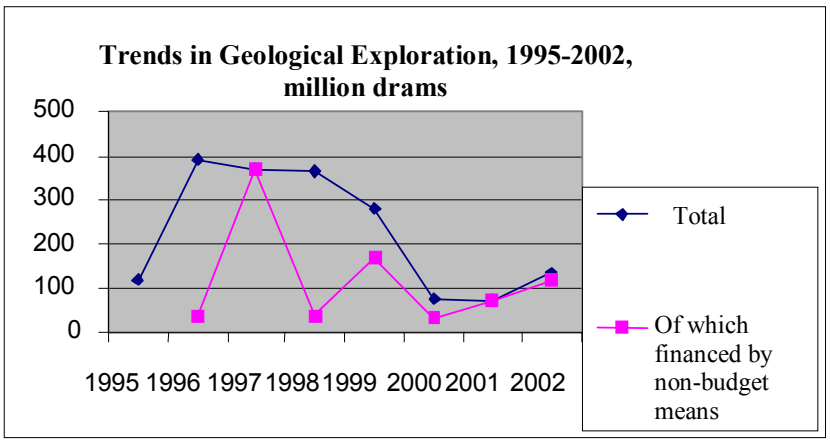


Figure 1.6.2

Source: National Statistical Service RA

Provisions of the Law on Underground Resources are not followed during the closure of mining enterprises. Numerous gold mining enterprises use ore processing methods that cannot yield a high level of gold extraction and use equipment that does not correspond properly to the geological-mineralogical and technological processes.



Source: National Statistical Service RA

Open-pit mines and their wastes degrade land and lead to various environmental problems, such as the pollution of soil, groundwater and air, and cause various non-typical diseases. Recovery of the vegetation of these areas would restore natural landscapes and solve these problems.

Figure 1.6.1 **Volume and Losses of Solid Minerals during Exploitation, 2001-2002**

	Extraction	Losses in % from used reserve
Clay-gypsum, thousand m^3	42.9	58.9
Building stone, thousand m^3	4.3	59.1
Basalt, thousand m^3	79.4	34.8
Tuff, thousand m^3	58.5	59.9
Lithoidite pumice-stone, thousand m^3	2.4	44.4
Sand, thousand m^3	45.0	1.2
Detritus, thousand m^3	6.3	-
Gravel, thousand m^3	34.4	-
Limestone, thousand m^3	268.7	8.6
Travertine, thousand m^3	2.4	21.4
Scoria, thousand m^3	8.4	3.0
Basalt detritus, thousand m^3	27.6	11.9
Sand-gravel mixture, thousand m^3	94.7	-
Granite, m^3	485.3	81.6
Marble, m^3	1111.4	82.4
Felsite, m^3	1213.4	77.8
Porphyrite, m^3	321.9	71.4
Coal, m^3	992.5	3.9
Salt, thousand m^3	29.6	76.2
Betonite clay, thousand tons	130.5	2.7
Copper, thousand m^3	3.3	11.3
Gypsum clay, thousand tons	10.7	3.3
Gold ore, thousand tons	10.3	1.5
Travertine, thousand tons	11.0	0.6
Copper ore, thousand tons	381.1	4.3
Polymetallic ore, thousand tons	87.5	5.6
Clay, tons	2684	2.0
Obsidian, tons	5.0	-
Zinc, tons	2122.2	6.8
Gold, kg	550.3	6.8
Silver, tons	3.6	6.7

Source: National Statistical Service RA

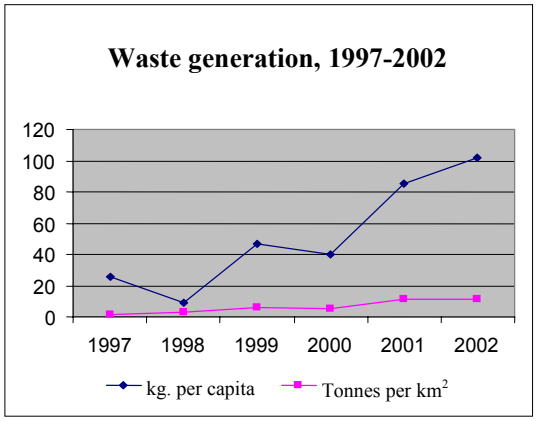
Chapter 7 Hazardous Substances and Waste

Industrial waste. The treatment and storage of industrial and household wastes are important problems in Armenia.

Data on the volumes of production, use, treatment and storage of wastes in the period from 1997 to 2002 are presented in the figures and table below (in 1997, the National Statistical Service started regular registration of this data).

Mining and metallurgical industries are the main sources of industrial wastes. Housing and community services produce 1 512 600 m^3 (about 430 000 tonnes).

Agricultural wastes are not calculated, and the system for reporting wastes from transportation sector is imperfect.



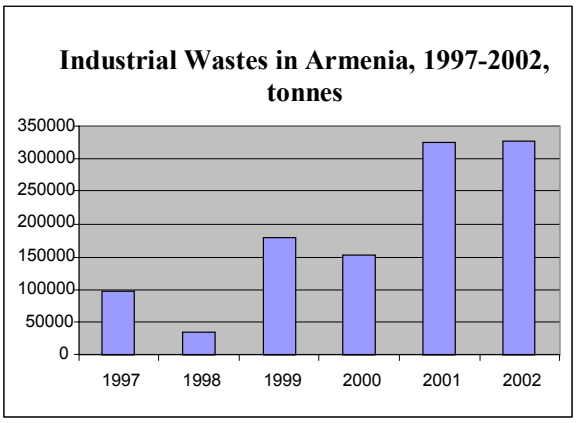


Figure 1.7.1

Source: National Statistical Service of the Republic of Armenia

At the beginning of 2002, the total amount of wastes stored at enterprises was 389 900 tonnes (mainly of hazard class V); and by the end of 2002, 680 200 tonnes.

In 2002, the enterprises of Armenia produced 327 857 tonnes of waste, of which 1200 tonnes (0.4%) of hazard classes I through IV, 318 600 tonnes (97.2%) of class V, and 8000 tonnes (2.4%) of household wastes.

The amount of wastes per capita was 102.1 kg; per km^2, 11.5 tonnes (excluding the surface area of Lake Sevan, 1240.5 km^2) – see Figure 1.7.1.

The analysis of the map of waste distribution presented in Annex 1 shows that the maximum amount of waste per capita is produced by the industrial enterprises of Syunik Marz (mining and metallurgical industry, including Kajaran copper-molybdenum group of enterprises and Kapan copper group of enterprises) and Kotayk Marz (Meghradzor gold mines and plant). It should be emphasized that in Yerevan city in 2002, only 7645.1 tonnes of industrial wastes were produced (6.9 kg per capita). It should be mentioned that significant amounts of debris have been accumulated as a result of construction work carried out in the Republic.

Figure 1.7.1 **Dynamics of Waste Production, Treatment, Use and Landfill Accumulation, 1997-2002**

Class of Hazard	Generated annually, tonnes					
	1997	**1998**	**1999**	**2000**	**2001**	**2002**
I	0.3	-	-	-	-	0.492
II	466.2	388.5	700.0	1636.5	1280.2	834
III	180.3	132.1	172.1	277.1	153.4	108.136
IV	74.2	393.5	40.3	53.8	117.5	261.88
V	94442.8	32129.8	169543.6	145304.7	316986.1	318644.9
Household wastes	847.6	1877.5	7193.4	5455.9	6325.6	8008.22
Total	96011.4	34921.4	177649.4	152728	324862.8	327857.63
Class of Hazard	**Sent to landfills and other storage sites, tonnes**					
	1997	**1998**	**1999**	**2000**	**2001**	**2002**
I		-	-	-	-	0.5
II		-	-	-	-	-
III		131.6	172.1	277.1	153.4	0.02
IV		374.1	39.1	51.1	107.6	3.6
V		1152.4	1736.3	2352.0	137.8	27271.8
Household wastes		1575.2	106550.2	1636.8	1757.4	3307.8
Total		3233.3	108497.7	4317.0	2756.2	30583.7
Class of Hazard	**Treated and eliminated, tonnes**					
I						
II	283.2	435.0			1264.3	805.5
III						
IV	1.2	2.2			8.4	0.5
V	9.1	0.3	18.2	49.5	88.0	49.9
Class of Hazard	**Used, tonnes**					
I						
II			536.1	1629.4		
III						
IV	1.0	15.6	0.3	2.0	0.5	
V	374.3	172.7	501.7	319.2	3251.7	1091.6

Source: National Statistical Service of the Republic of Armenia

As can be seen from the table above, in Armenia from 1997 to 2001, waste of hazard class I was not registered, the proportion of waste of classes II-IV was very low, and industrial wastes were mainly of class V, namely non-toxic wastes.

In 2002, a total of 855.9 tonnes of waste were eliminated or treated in enterprises, of which 811 tonnes in the enterprises of Yerevan city; 1091.6 tonnes of waste were used.

According to the Department on Hazardous Substances and Wastes of the Ministry of Nature Protection, there are no special landfills for the disposal of industrial waste. At present, according to data of the Ministry of Public Health, there are 45 municipal and 429 rural landfills, most of which do not meet health requirements (for details see Part II, Chapter 4).

Household solid waste. Figure 1.7.2 below shows the dynamics of household solid waste production in the Republic.

In 2002, solid waste removal was carried out across an area of 4 388 000 m^2; in 2001, 3 542 000 m^2.

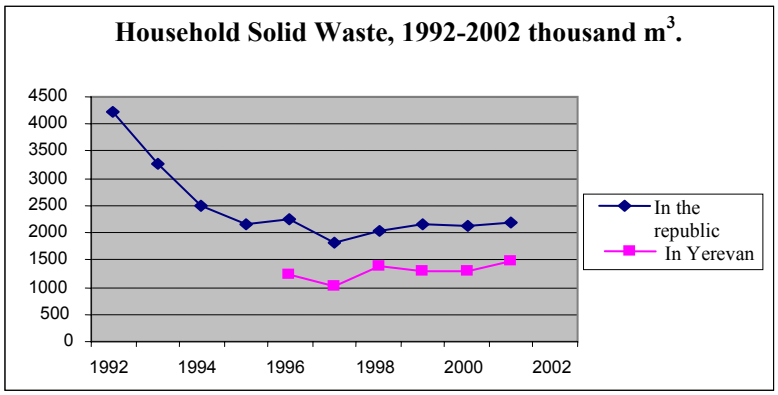


Figure 1.7.2

Source: National Statistical Service of the Republic of Armenia

In total, 1 511 600 m^3 of household solid waste was transported by special vehicles. In comparison with 2001, the amount of waste transported decreased by 690 400 m^2.

In 1999, Armenia ratified the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal. In accordance with commitments under the Convention, the registration and control of waste produced, exported, imported and in transit, as well as enterprises dealing with wastes, are carried out in the Republic.

The issue of expired medicines and outdated pesticides is a problem for Armenia. According to 1999 data, there are about 100 tonnes of expired medicines in Armenia. The Ministry of Nature Protection has developed a Regulation on Elimination of Useless Medicines, to manage the issue of their disposal. At present, the import of expired medicines in the Republic is strictly controlled. According to preliminary data from the Ministry of Agriculture, about 20-22 tonnes of out-dated pesticides have accumulated in the Republic, and the issue of their elimination remains unresolved.

At present, waste management is conditioned by the deficiencies of current legislation. A new draft Law on Waste has been developed, but a new Law on Chemical Substances has not been developed.

Policy, procedures, laws and rules on the management of chemical substances and wastes are under development in Armenia. They will ensure transparency in the decision making process and provide opportunities for the public to take part in monitoring as well as in decision-making.

Radioactive waste

According to Gosatomnadzor data, the radioactive wastes generated by the Armenian Nuclear Power Station are of the following types:

1. Radioactive solid wastes

1.1 Low level radioactive solid wastes

a) Total waste volume - 4939.1 m^3

b) Amounts of organic and non-organic substances in waste, including:

- paper. wood. heat-insulating substances - 1661.9 m^3
- metallic shave - 649.8 m^3;
- debris - 1887.8 m^3;
- other substances - 739.6 m^3.

c) Planned storage capacity for low level radioactive wastes – 17 051 m^3

d) Proportion of storage capacity used - 29%.

1.2 Medium level radioactive solid wastes:
a) Total waste volume – 1659.2 m^3, including:
   - paper, wood, rubber items, clothes etc. – 1146.0 m^3;
   - solid wastes produced by liquid waste concentration - 513,2 m^3;
b) Total activity of waste- ≅3.1 x 10^6 Bq/kg
c) Specific activity of beta and gamma radioisotopes
   - ^{137}Cs and ^{137m}Be - ≅ 1.5 x 10^6 Bq/kg
   - ^{60}Co - ≅ 1.2 x 10^6 Bq/kg
   - ^{110m}Ag - ≅ 3.7 x 10^6 Bq/kg
d) Planned storage capacity for medium level radioactive wastes - 1001.2 m^3;
e) Proportion of storage capacity used - 100%;
f) Number of special tanks with medium level radioactive solid wastes - 2566.

1.3 High level radioactive solid wastes
a) Total volume - 27.1m^3;
b) Planned storage capacity for high level radioactive solid wastes - 78.3 m^3;
c) Proportion of storage capacity used - 28.43 m^3 (36.3%).

2. **Radioactive liquid wastes.**
2.1 Low level radioactive liquid wastes are not produced in the Armenian NPS.
2.2 Medium level radioactive liquid wastes
a) Total volume - 2097 m^3;
b) Planned storage capacity for medium level radioactive liquid wastes - 3617 m^3;
c) Proportion of used storage capacity - 58 %;

2.3 High level radioactive liquid wastes
a) Total volume - 350 m^3
b) Total β-activity of waste - more than 3.4 x 10^6 Bq/kg
c) Specific activity of beta and gamma radioisotopes
   - ^{137}Cs / ^{137m}Be - 1.2 x 10^6 Bq/kg
   - ^{60}Co - 5.7 x 10^6 Bq/kg
   - ^{241}Pu - absent
   - ^{110m}Ag - absent
   - ^{134}Cs - 1.2 x 10^5 Bq/kg
d) Planned storage capacity for high level radioactive liquid wastes - 700 m^3;
e) Proportion of storage capacity used - 50 %.

Mine Tailing Sites

About 300 million m^3 wastes of the mining industry have accumulated at 12 tailing storage sites constructed on the territory of Armenia. The economic situation during the last decade has not allowed the implementation of complete technical controls for tailing storage sites. Due to natural and climatic conditions, mine tailings can be weathered, transported and dispersed over surrounding territories and have an impact on human health, the environment, flora and fauna.

The management of mine tailing storage sites should be based not only on the fact that it is necessary to decrease their negative impact on the environment and human health, but also on the issue of the rational use of natural resources, since tailings contain significant amounts of useful and rare metals, whose recovery can stimulate the development of the economy. However, processing of tailings is not carried out, due to a lack of technology. Tailing storage sites (Table

1.7.3) as hydrotechnical facilities can be dangerous for human health and environment. They are classified by factors and impacts, listed in Table 1.7.2 below.

Table 1.7.2 **Classification of Tailing Storage Sites by Key Factors and Impacts**

	Factors and impact	**Evaluation unit (mark)**
1.	Capacity	1-3
2.	Population in the impact zone	1-5
3.	Lands in the impact zone (quality, category)	1-5
4.	Functioning	1-2
5.	Conserved	1-4
6.	Construction pattern - Reinforced concrete construction	1
7.	Earth dam	2
8.	Proportion of hazardous substances, elements (%m^3)	1-5
9.	Proportion of useful metals (% m^3)	1-5
10.	Dispersion rate	1-2
11.	Possibility to implement measures to prevent hazardous impact	1-5

Source: National Action Programme to Combat Desertification in Armenia

Table 1.7.3 **Classification of Tailing Storage Sites on the Territory of Armenia**

	Tailing storage site name and location	Year operations started	Year of conservation	Capacity, mln m3	Average diameter of particles (mm)	Waste content
1	Right tributary of the river Vokhchi, village Darazami	1953	1961	3	0.067	
2	Right tributary of the river Vokhchi, village Pkhrut	1958	1969	3.2	---..---	
3	On the river Vokhchi	1962	1977	30	---..---	Mo, Cu
4	On the river Artsvanik	1978	functioning	210	---..---	SiO_2,, Al_2O_3 MgO
5	On the river Geghanush	1961	1989	4.6	0.084	CaO, TiO_2 FeO
6	On the river Davazami	1957	1977	30	0.087	Na_2O+K_2O, P_2O_5, S, Zn
7	In the gorge N 1 of Agarak	1978	functioning	9	---..---	Pb, rare metals
8	In the gorge N 2 of Agarak	1979	functioning	17	---..---	
9	In the gorge N 3 of Agarak					
10	On the river Nahatak near Akhtala	1971	1988	3.2	0.082	
11	Near Arazap (Ararat Marz)	1982	functioning	20	0.085	
12	On the right tributary of the river Nazik near Dastakert	1960	1968	3.1	---..---	

Source: National Action Programme to Combat Desertification in Armenia

The classification of tailing storage sites based on these criteria in Armenia is shown in Table 1.7.4.

Table 1.7.4 **Hazardous Impact Assessment of Tailing Storage Sites**

Tailing storage site name and geographic location / Characteristic features (marks)	Right tributary of the river Vokhchi, village Darazami	Right tributary of the river Vokhchi, village [illegible]	On the river [illegible]	On the river Artsvanik	On the river Geghanush	On the river Davazami	In the gorge N 1 of Agarak	In the gorge N 2 of Agarak	On the river Nahatak near Akhtala	Near village Arazap (Ararat marz)	On the right tributary of the river Nazik near Dastakert
Capacity	1	1	2	3	1	2	1	2	1	2	1
Population in the impact zone	2	2	2	2	5	1	1	2	5	5	1
Lands in the impact zone	2	2	2	4	5	2	2	2	4	5	2
Functioning/non-functioning	3	3	3	1	3	1	1	1	3	1	3
Construction pattern	1	2	2	1	4	2	1	1	4	1	2
Presence of hazardous substances	2	2	3	3	5	2	2	2	5	5	1
Presence of useful metals	2	2	3	3	5	2	3	3	4	1	4
Dispersion rate	2	2	2	2	1	1	1	1	1	2	1
Possibility to implement measures to prevent hazardous impact	2	2	3	1	5	2	1	1	4	3	3
Total	17	18	20	20	34	15	13	15	31	25	18
Degree of hazard	2	2	2	2	1	3	3	3	1	1	2

Source: National Action Programme to Combat Desertification in Armenia

Chapter 8 Environment and Human Health

The overall demographic processes in Armenia in recent years have seen the following developments: the natural population growth rate has continued to decline, from 4.3 per 1000 in 1998 to 2.12 per 1000 in 2001; the birth rate during this period has declined from 10.4 per 1000 in 1998 to 8.44 per 1000 in 2001. Life expectancy for women has remained stable, whereas life expectancy for men has increased (Table 1.8.1).

Table 1.8.1 **Life Expectancy at Birth in Armenia**

	Total	Men	Women
1998	74.7	70.8	78.1
1999	74.7	70.8	78.1
2000	72.5	70.5	74.5
2001	73.5	71.0	75.9

Source: National Statistical Service of RA

The death rate in Armenia in 1999 slightly increased (per 100 000 population), but it has since stabilized: 1998, 611.64; 1999, 631.75; 2001, 631.46; 2002, 795.68 (the increase in 2002 was affected by the decrease in total population).

Cardiovascular diseases remain the main cause of death (54.9% of total deaths); neoplasms are in the second place (16.6%); disorders of the endocrine system, nutrition, metabolism and immune system are in third place (6.2%); respiratory system diseases, fourth place (5.7%); and external causes, fifth place (4.1%). (Source: National Statistical Service of RA).

There are differences between trends in the overall morbidity rate and the female morbidity rate. Thus, the overall cancer morbidity rate in the period 1998 to 2002 was relatively stable, whereas the female cancer morbidity rate steadily increased from 124.9 in 1998 to 166.3 in 2002 (calculations based on the female population of fertile age); the breast cancer morbidity rate increased from 33.1 in 1998 to 49.6 in 2002. The infectious diseases morbidity rate recently has been decreasing for all infectious diseases. (Source: National Statistical Service of RA)

Drinking water quality recently has undergone a steady trend towards deterioration. Rural drinking water supply is in the most unfavorable condition: 64% does not meet sanitary requirements. One feature in Armenia is that 95.5% of the drinking water supply is fed by groundwater, of stable quality, that largely meets the requirements of both national and WHO norms in terms of toxicological and microbiological parameters.

In general, drinking water in Armenia is characterized by low mineral content, softness, stable chemical composition, and low content of fluorine and its compounds.

In practically all cities and rural settlements, water is supplied for a scheduled 2-6 hours per day, in spite of its availability in sufficient amounts where it is abstracted. The main reason for this pattern of supply is the extremely poor condition of the water supply network. Thus, annually several thousands of accidents are registered; these result in secondary pollution of drinking water on its way from source to consumer. Consequently, the main human health risk comes

from outbreaks of infectious diseases, rather than an increase in the total intestinal infections morbidity rate.

In the period from 1999 to 2002, 18 outbreaks of infectious diseases caused by drinking water were registered in Armenia, with a total number of 5690 people affected (source: Ministry of Public Health of RA).

Air pollution from vehicles in the Republic has increased significantly due to the higher number of vehicles, deterioration of roads, prevalence out-dated vehicles, and problems with fuel quality (which cannot be always guaranteed).

The availability of heating in houses is a problem as well. In spite of the fact that the energy crisis has been overcome and electricity is available, due to its high price the public, especially in rural areas, has to use other, cheaper and lower quality fuels, including dung (Table 1.8.2).

***Table 1.8.2* Distribution of Households by Heating System (in %)**

	Total number of households	**of which:**	
		urban	**rural**
Total number of households, of which	100	100	100
those heated, using:	94.2	91.5	99.8
- centralized heating	7.0	9.7	1.2
- own heating system	1.7	1.9	1.4
- other (electrical devices, ovens etc.)	85.5	79.9	97.2
those not heated	5.8	8.5	0.2

Source: National Statistical Service of RA

The main sources of fuel for heating of houses (for those that do not have centralized heating systems) are wood (56.5% of population), electricity (17.9%), natural gas (7.2%), light and heavy oil (1.7%) and other types of available fuel (waste lubricant oils, polymer materials and others – 16.7%). The use of these types of fuel has negative impact on air in general as well as in the premises.

About 30% of the adult population of Armenia smokes, and 60% of the total adult male population smokes regularly. Smoking adds to the poor indoor air quality.

Noise is another external factor having a negative impact on human health. Recently, the number of sources of noise has increased drastically. Noise produced by different types of equipment and its impact on health conditions is a new problem. The population often complains about noise produced by means of transportation, facilities for leisure, industrial facilities, alarm signals and other sources of noise. In planning new construction and roads, it is necessary to take into account possible noise generated, though in reality the noise mitigation measures are not envisaged in projects.

Recently, the issue of noise produced by entertainment facilities in cities has become quite problematic. Noise produced by restaurants, cafés, concert halls and other facilities is not sufficiently regulated by the administrative code; consequently it is difficult to prevent.

There are some types of equipment that should not be installed in houses due to high level of noise they produce. Internal structures of buildings do not have sufficient acoustic insulation and

people suffer from noise coming both from outside and from public facilities located in the buildings as well as neighbor apartments.

In 1997, malaria cases started to be registered in Armenia. A special program to combat malaria has been developed. As a result, the number of cases of malaria has decreased drastically (Table 1.8.3).

Table 1.8.3 **Cases of Malaria in Armenia**

	1998	1999	2000	2001	2002
No. of cases	1167	616	141	79	52

Source: Ministry of Public Health of RA

During recent years a few cases of anthrax have been registered in Armenia (Table 1.8.4).

Table 1.8.4 **Cases of Anthrax in Armenia**

	1999	2000	2001	2002
No. of cases	17	2	18	3

Source: Ministry of Public Health of RA

To reduce the impact of unfavorable environmental factors on human health, a National Environmental Health Action Plan (NEHAP) has been developed by the Ministry of Public Health of Armenia in close collaboration with other ministries. It was adopted by the Government of the Republic of Armenia on August 1st, 2002, and approved by the President of the Republic of Armenia on August 21st 2002. The national plan includes a list of priority measures (approved by the Government), identifying ministries responsible for their implementation and concrete deadlines for implementation. Thus, implementation involves practical actions to be carried out by different ministries. However, the issue of financing of these measures probably will be among the main problems for implementation.

In Armenia, the State Health and Epidemiology Inspectorate of the Ministry of Public Health is responsible for environmental health, including prevention of environmental impacts on human health. Moreover, the standards for the assessment of the state of the environment are based on health protection (maximal permissible concentrations, other hygienic norms). By law, only the Health and Epidemiology Inspectorate is responsible for carrying out health impact assessments, risk assessments as well as all functions in the sphere of environmental health.

In 2000 to 2001, some normative documents were revised to comply with the existing legislative framework and to meet modern requirements and approaches. As a result, the majority of normative documents (sanitary rules and norms) – including Health Norms for Drinking Water Quality, Health Rules on Noise and Other Physical Factors, and Health Rules on the Provision of Radiation Safety – have been revised and adopted.

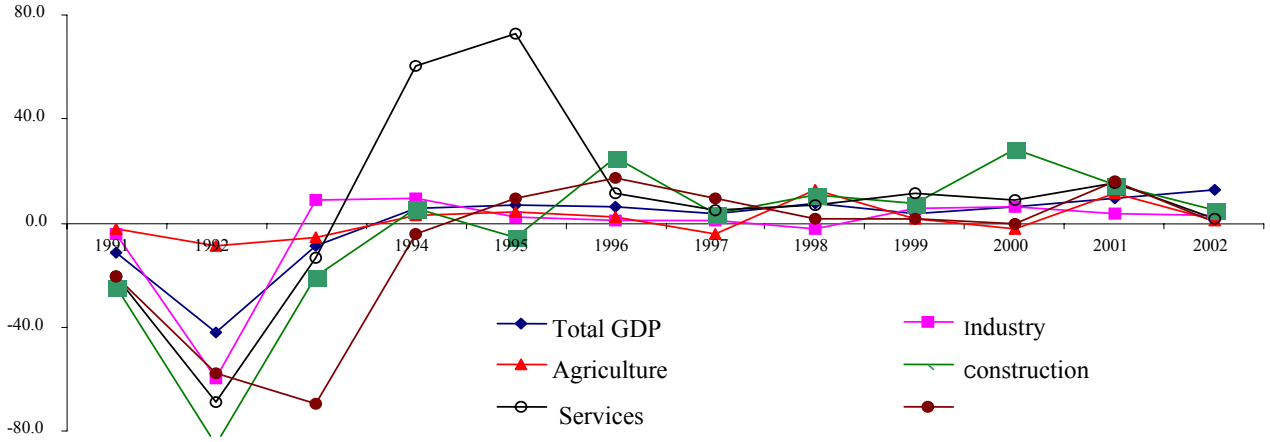
Part II

Environmental Impacts

Chapter 1 Industry and Energy Sectors

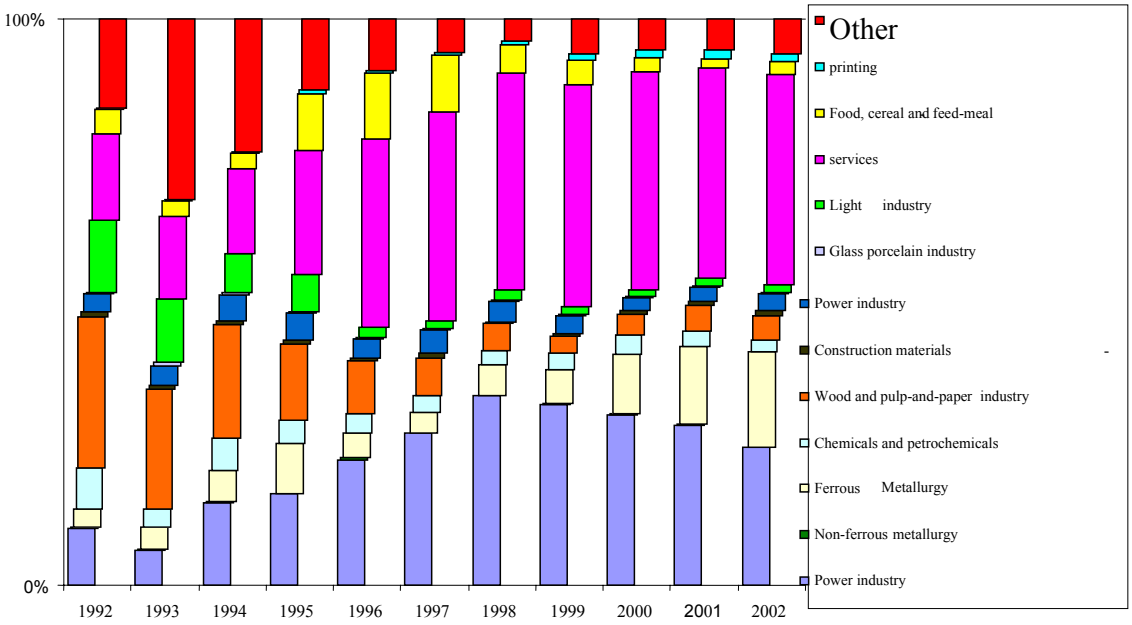
The economic reforms implemented in Armenia up to 1994 occurred in conditions of severe economic recession. From 1990-1993, the average yearly decrease of GDP was 18%.

Figure 2.1.1 **Dynamics GDP and its components**



Source: National Statistics Agency of RA

Figure 1.2.1 **Breakdown of industrial branches**



Source of Information: National Statistics Agency of RA;

From 1994, it was possible to halt the economic recession of the country and to provide, to some extent, macroeconomic stability. Naturally, industry was exposed to these changes. In

comparison with 1990, in 2000 industry as a whole, as well as its separate sectors, was still in a significant recession. Especially significant was the period of 1992 and 1993, when volumes of production fell by 50% times compared with 1991 levels. From 1994, due to foreign investments, a small revival of industrial production has occurred, which created a situation of strict dependence on foreign markets and investments.

The process of renewal of industry, the bases of which were laid in 1994, led to tangible results in 1996. This was stimulated by the adoption of a number of legislative and other normative documents, increasing volume of foreign investments and exports. These processes have been especially effective in the extractive branches (especially building materials and mining), as well as in the sphere of precious stones manufacturing, where it is possible to use the existing technological potential and natural materials found in the Republic. Special attention was paid to development of competitive industries connected with the processing of domestic resources. A certain vitality was seen in the activity of small and medium sized enterprises that functioned on the basis of local raw materials.

Nevertheless, in certain way the 1990s were characterized as period of partial restoration and restart of industrial capacities. In the situation of the scarce domestic energy resource base, an enormous excess in the labor force, and the absence of long-term, multi-purpose programs for the development of production, industry had a very strictly oriented direction, mainly dictated by programs implemented by international organizations, where environmental problems were stated as declarative ones. In the area of situational and temporary characteristics, such kinds of approaches were also dictated by the following objective elements:

- The lack of energy and resource saving technologies, a heritage from the previous system, do not provide an opportunity for the development of high quality and competitive industry. Of course, in such conditions foreign investors paid greater attention to extraction of raw materials. The complex system that formed induced the leaders of the Republic of Armenia to compromise and accept this kind of approach, often to the prejudice of the interests of the country.
- Given the imperfect legislative conditions, privatization led to dilapidated conditions (mainly purposeful) of productive facilities, and as in a consequence of the lack of financial resources, the activities of new owners have not been effective. To a great extent, this unfavorable situation affected the environmental activity of these enterprises.
- Faced with the population's growing poverty, the social economic policy implemented by the government naturally focused on providing employment and reducing poverty. Even so, unfortunately, nature conservative problems dropped out of the list of priority problems.

The main feature of the heating and energy system is that, with the exception of hydroelectric power, it is completely based on imported goods.

In the blockade and in the absence of domestic energy resources, the constant fall in the electricity production lasted until 1995, when only 53.7% of the level in 1990 was generated. From 1999 to 2000, there was a certain steady level of yearly domestic use averaging 5.5 billion kilowatts per hour. In 2001, 46.8% of the volumes of electricity was generated by thermal power plants, 34.6% by the nuclear power plant, and 16.8% by hydroelectric power plants. It is important to mention that the volume of electricity generated by thermal plants increased by 3.7%, and the volumes generated by atomic and hydroelectric plants decreased, respectively by 0.9% and 23.3%. The fall in production at the nuclear power plant resulted from precautionary safety measures implemented with the oversight of international organizations. For hydroelectric plants, the reduction was affected by the halt in the drawdown of Lake Sevan for energy purposes, under the requirements of the State Program for the Conservation of Lake Sevan.

From point of view of policy integration, hydro energy can be of interest, as well as alternative energy sources, such as solar, wind and underground thermal sources. From point of view of the protection of the environment, other energy resources (natural gas and nuclear

resources) rate as sources of additional pressure on the environment, and in general emphasis is placed on the maximum efficiency of energy consumption. Activities in this direction face a number of difficulties. In particular:

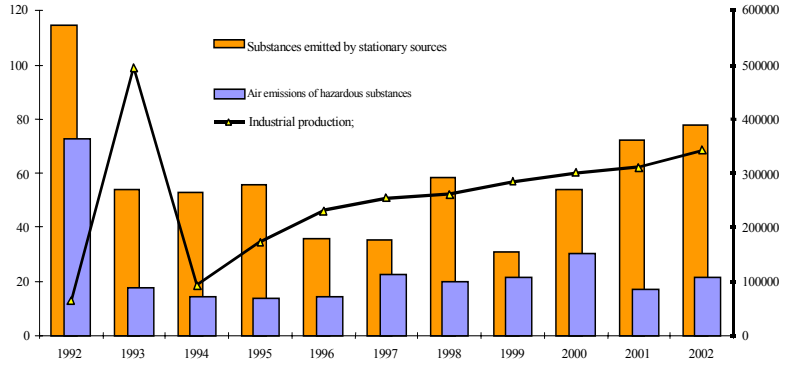
- Certain supplies of available fossil fuels do not have any industrial significance and can be used to satisfy limited demand;
- Opportunities for solar and wind energy are at the stage of study, and they have low potential and cannot play a leading role;
- Small hydro plants, due to their small production and isolation, will have a strictly regional character and will not have a major impact on the energy balance of the Republic.

Let us consider in more detail the impact of the industry sector on the environment.

Air Emissions

There was a very sharp reduction of atmospheric emissions from stationary sources of manufacturing enterprises until 1995; this changed in the following years with a slight increase. Emissions in 2002 were about 30% of the level of emissions in 1992. In general, this is explained by the cessation of activities or partial operations of industrial plants (especially in the chemical branch) that had a dominant role in total emissions. Despite the high level of abatement of hazardous pollutants in recent years, which is separate from stationary sources of emissions (more than 70%), the effectiveness of gas abatement systems of most plants is very low. Special attention should be paid to the equipment of the most hazardous plants (coal fueled plants and welding and dyeing processes , which are connected with aerosol substances). A very serious problem regards the incorporation of real-time monitoring equipment for controlled substances in emissions (more detailed Part I, chapter I).

Figure 2.1.3 **Air pollution emissions from industry**



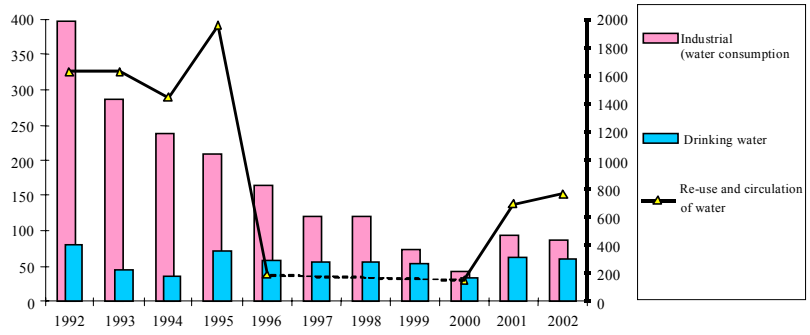
Source: National Statistics Agency of RA

Water Consumption

The information presented reflects indicators in agreements with water utilities. The reduction in the volumes of industrial consumption of fresh water is the result of falling industrial production volumes and an imperfect system of reporting: the absence of monitoring facilities (or facilities that have stopped functioning), lack of implementation of continuous monitoring and absence of registers for primary reporting. There is also a question of concern with regard to the increase in the volumes of drinking water used for industry purposes: 69.3% in 2002 compared with 20.1% in 1992. Also, there is an increase in the circulation and re-use of water: 89.7% in 2002, in comparison with 80.4% in 1992.

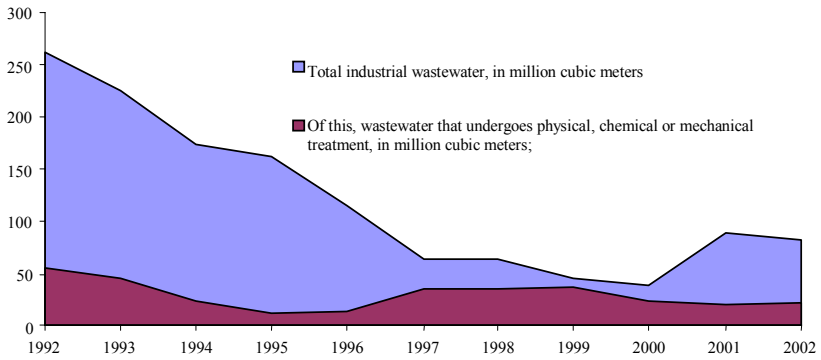
For the same reasons, reporting of actual discharges of wastewaters is not accurate.

Figure 2.1.4 **Water consumption, 1992-2002, in millions of cubic meters**



Source: National Statistics Agency of RA

Figure 2.1.5 **Wastewater from industrial plants**



Source: National Statistics Agency of RA

Extraction and consumption of non-metallic minerals

Table 2.1.1 **Losses of useful non-metallic minerals during mining in %, from liquid supplies.**

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Tuff	61.8	60.1	65.0	59.8	62.1	62.0				58.4	59.9
Basalt	82.1	79.9	73.9	40.4	32.1	20.1				29.0	34.8
Granite	0	80.8	78.2	81.6	79.5	68.7				81.2	81.6
Marble	50.0	90.0	66.7	72.4	70.1	85.8				85.2	82.4
Travertine	67.5	66.7	70.6	73.5	73.5	74.5				15.0	6.4
Limestone	5.0	5.8	2.1	5.0	2.4	2.4				5.0	3.6
Loam	2.1	2.9	2.3	1.1	2.7	2.7				0	2.7

Source: National Statistics Agency of RA;

Pollution abatement expenditures

Records of emissions are recorded from 1997. Information about emissions is presented in the chapter 7 of Part I of the Report.

Table 2.1.2 **Enterprise investment in pollution abatement**

1994 to 2002, in mln. AMD

	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Protection and efficient use of water resources	279.6	2826.3	397.1	363.5	580.6	840.9	1136.1	922.5	1467.9
Air Protection	87.8	145.7	57.0	49.2	136.7	167.8	841.6	963.5	514.9
Solid waste	2.1	6.6	6.5	11.0	54.3	11.2	10.5	10.9	213.5

Source of Information: National Statistics Agency of RA

Table 2.1.3 **Current environmental protection expenses**

1994 to 2002, in mln AMD

	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Protection and efficient use of water resources	607.0	574.4	832.0	510.9	943.7	571.5	607.1	437.4	1174.0
Of this, for sewage collection and treatment	238.4	41.0	73.4	54.7	91.3	109.0	160.9	156.5	207.9
Air protection	130.9	180.2	179.9	79.2	146.0	98.0	175.7	62.2	182.3
Conservation of lands from industry emissions and other hazardous materials	73.7	71.3	108.9	102.4	62.3	65.9	121.6	141.1	101.5
Of this, acceptance, protection, neutralizing and/or liquidation of emissions	41.4	41.6	2.0	0.7	15.4	50.7	104.5	81.3	94.7

Source: National Statistics Agency of RA

The Armenian Nuclear Power Plant

Impacts on the environment

Since it was restarted in 1995, the nuclear power plant station has not had any events that, based on international standards, could be qualified as accidents.

At the nuclear power plant, eight events occurred in 2002. They all were deviations from the normal regime of use, did not affect safety, and were estimated at the 0 level on the 7-point INES scale:

The estimates of these events were based on the following:

- there were no deviations from the requirements under technical specifications;
- there was no radiation impact in the area or outside the plant; and
- all security systems were in working condition and were implementing all functions.

Radioactive air emissions and wastewater discharges

Gas and aerosol radioactive emissions from the nuclear power plant are controlled by monitoring devices established in the plant's ventilation shaft (the shaft is 150m high), and radioactive emissions from the plant are measured by laboratory analyses of samples from industrial storm water and sewage discharged into wells near the plant.

Figure 2.1.6 presents the composition of radionuclide gas and aerosol emissions from the plant. The main elements in the emissions are the radioactive isotopes ^{137}Cs and ^{131}J, as well as those induced by corrosion activity: ^{60}Co, ^{110}Ag, ^{54}Mn, ^{65}Zn and ^{59}Fe. The share of the radioisotope ^{90}Sr is insignificant.

Figure 2.1.7 shows the radioactivity of gas aerosol emissions. The levels are significantly lower than the maximum admissible emissions, and are on the same level as those from other reactors of this kind.

Figure 2.1.8 shows an overview of discharges through the industrial storm drains and sewerage waters of the nuclear power plant. As shown, amounts are smaller than fixed permissible danger levels.

The low quantity of radioisotopes in the air emissions and wastewater discharges of the plant is required for the reliability of the first three barriers of security, especially activation of first barrier of water maintained on safe level, due to the high level of gas cleaning blowing.

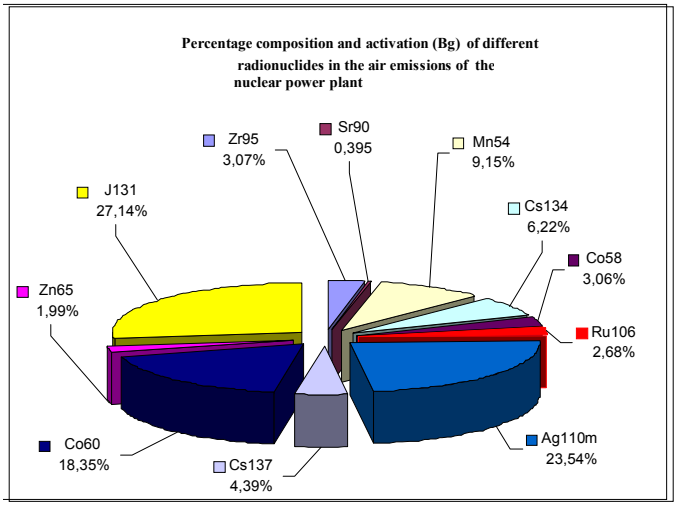


Figure 2.1.6

Source: State Atomic Inspection

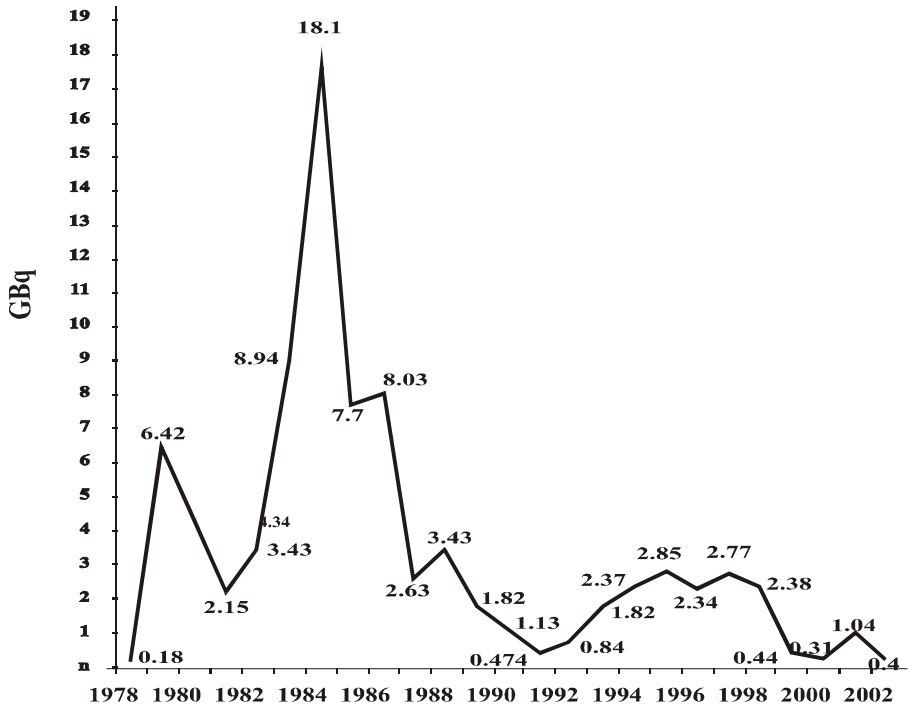


Figure 2.1.7 **Radioactivity of air emissions, 1978 – 2002 (maximum permissible = 203GBq).**

Source: State Atomic Inspection

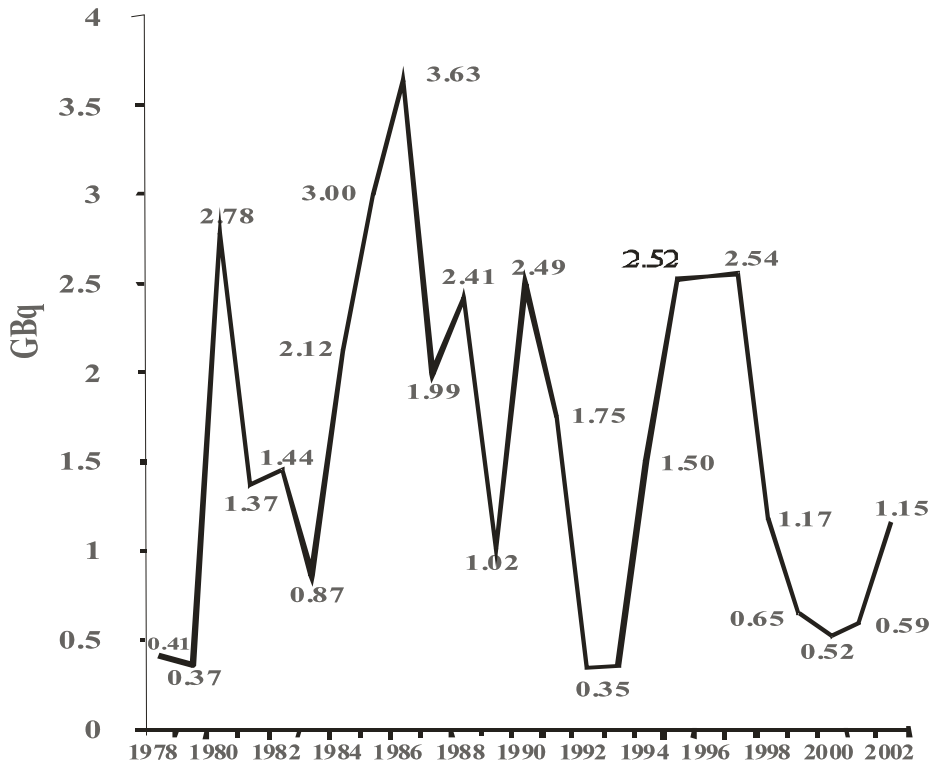


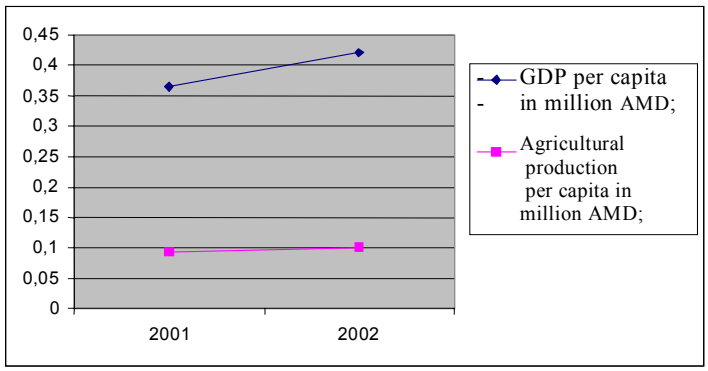
Figure 2.1.8 **Radioactivity of wastewater discharges from the Nuclear Power Plant (maximum permissible level = 207.5 GBq).**

Source of information: State Atomic Inspection

Chapter 2 Agriculture

Agriculture is one of the most important sectors of Armenia's economy. Between 1998 and 2002, the share of agriculture and food industries in GDP averaged in 35%, with the agriculture sector itself between 23 and 26%.

Figure 2.2.1 **GDP and agricultural production per capita, in million AMD.**

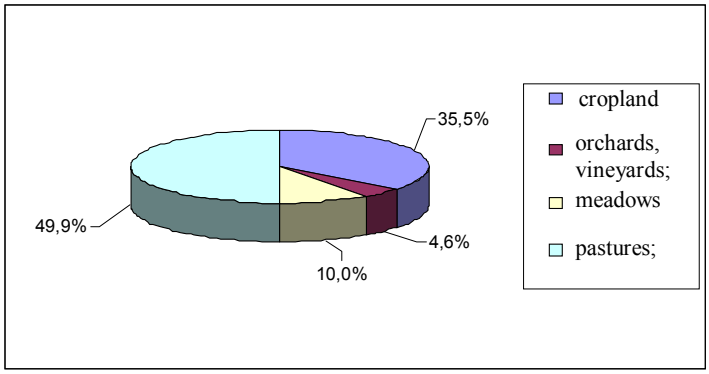


Source: National Statistics Agency of RA

Gross agricultural production in 2002 was 377.6 billion AMD, of which crop cultivation was 226.6 billion AMD and animal husbandry, 151.0 billion AMD. About 98% of total agricultural production was produced by private enterprises and trade organizations. Based on information for January 1st, 2002, 460 400 ha of cropland were privatized (71.6% of total overall area of cropland), as well as 39 100 ha of orchards and vineyards (61.3% of total) and 676 000 ha of meadows making (48.7%). As a result of privatization, about 335 000 agricultural enterprises have been formed, and each has an average 1.4 ha of agricultural land, including 1.05 ha of cropland, 0.12 ha of orchards and vineyards and 0.24 ha of meadows.

In the total land area of the Republic, 2 974 300 ha, agricultural land covers are 46.8%, or 1 391 400 ha, and of this the surface area of ploughed cropland is 494 300 thousand ha; orchards and vineyards, 63 800 ha; , meadows, 138 900 ha; pastures, 494 000 ha; and unused land, 400 ha.

Figure 2.2.2 **Breakdown of agricultural land**



Source of Information: Ministry of Agriculture of RA

Each year, 350 000 to 370 000 ha are cultivated out of the existing 494 000 ha of cropland, meaning that despite the shortage of land in Armenia, on average 120 000 to 140 000 ha are not used. Reasons include the danger of cultivation in border regions, the remoteness of unused land, as well as difficulties created by rapid privatization.

Impacts of agriculture on the environment include the pollution, degradation and desertification of land, and erosion processes. These are produced mainly by:

- use of improper agricultural techniques;
- plowing of land near slopes, which renders thousands of hectares useless;
- improper usage of crop rotation;
- unsatisfactory conditions of irrigation systems;
- over irrigation of land;
- use of fertilizers and insecticides in improper doses;

Based on research data for in 1980 to 1985, 44% of land in the Republic is eroded. (see Map 3).

Croplands use 464 300 ha, of which 20.3% are to a varying extent eroded. Strongly and average eroded lands are found throughout the District of Aragacotn; the total eroded surface area is 4429 ha, or 80% of the district's cropland. In Syunik District, eroded lands cover 1873 ha, or 36% of all croplands in the district. Overall in the Republic, there is a very low level of eroded land, 78 900 ha of cropland, 17% of the total. The least eroded lands are found in the Shirak District, 12 183 ha; Syunik District, 1213 ha; and Gegarkunik District, 1848 ha.

Improvement of land is not very widespread now in the Republic. Methods elaborated by the Scientific Center for Soil, Agrochemistry and Land Improvement in 1990 restored and returned to agricultural production 5400 ha of alkali soil in the Ararat Valley.

Since 1997, the humus content of the soil has declined (figures are not available).

Irrigated land covers 284 000 ha of the Republic, but due to the poor engineering and technical conditions of irrigation systems, 56 000 ha of these are not currently irrigated, and 13 000 ha have been completely removed from the register of irrigated land. Only 38.5% of cropland and orchards and vineyards are irrigated. From 1991 to 1998, maintenance and repair of the drainage collection system of Ararat Valley was halted. These works were renewed in 1999, and as a result up to 10 000 ha of waterlogged land were drained. Irrigation in the republic is not at the desired level, leading to the outbreak of new areas of erosion and waterlogging of land. Land that suffers from secondary salinity and waterlogging reaches 50 000 ha.

In addition, the use of unauthorized pesticides and fertilizers has a negative impact on the environment.

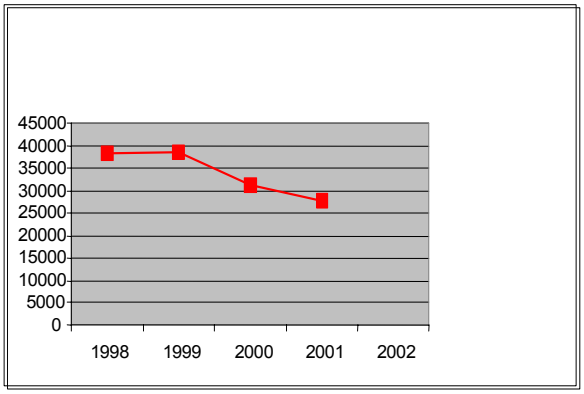
From 2000 to 2002, 108 types of mineral and chemical fertilizers were imported into Armenia.

The overloading of pesticides per hectare in 1990 was 4.4 kg, which was 30 to 40 times higher than overloading in the period 2000 to 2002. In 1995 and 1996, previously imported pesticides were warehoused centrally in the districts of Gagarin Village, and the cities of Echmiadzin and Masis, a cost-effective approach. Now, these warehouses are empty. According to information from the Ministry of Agriculture, the transportation and storage of pesticides by state structures is not regulated and does not comply with norms. As a result, farmers use invalid, expired pesticides, leading to higher soil pollution. The disposal of pesticide containers either is not done, or done improperly. A site for the burial of expired pesticides was built in 1982 near Artashat. So far, 500 tones of pesticides and empty packages have been buried there. In 30 to 40% of tests made in 1970-1977, MPCs were exceeded. In 1985 to 1988, the concentration of pesticides in the soil fell only by 0.5%. In 3.9% of tests, pesticides were found.

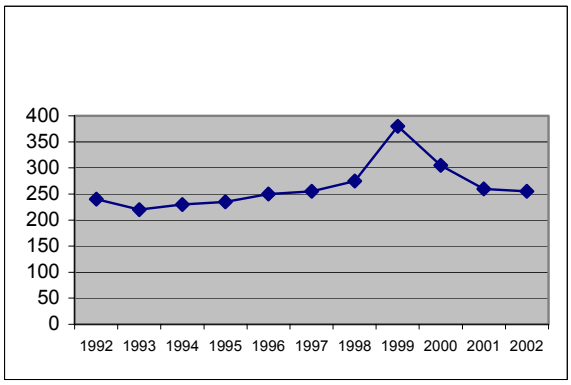
Figure 2.2.3 below presents the dynamics pesticide use and fertilizer imports.

Figure 2.2.3

Quantity of fertilizer imported, based on Customs information



Quantity of pesticides used, based on information of the Ministry of Agriculture



Source of Information: Ministry of Agriculture of RA;

Information on the use of mineral and organic fertilizers are not presented due to the lack of data.

Analyses of the presence of nitrates and pesticide in agricultural products were made selectively from 1992 to 2002 in trading centers: the quantity of pollutants found was insignificant.

Table 2.2.1 **Provision of mobile forms of nutrients in cropland**

Total cropland, 000 ha	Cropland surveyed, 000 ha	Presence of					
		phosphorus, in 000 ha			potassium, in 000 ha		
492.1	306.2	Weak	Average	Strong	Weak	Average	Strong
		195.2	70.0	40.0	41.0	128.5	136.2

Source: Statistics State Agency of RA;

Animal husbandry.

According to the licenses received from 1998 to 2001, animal husbandry is carried out at about 4000 enterprises. In these, as a rule, water and waste treatment devices are absent or do not work properly, and for this reason land pollution is high.

Among negative impacts it is possible to mention overgrazing of small cattle, which promotes erosion. The surface area of natural pastures, which in 1940 was about 14.0 million ha, has fallen to 804 500 ha. In recent years, the number of small cattle livestock fell.

According to the records, in 2002 per every head of small cattle, there was 1.33 ha of pasture. In comparison, in 1992 this figure was 0.78 ha.

Water Supply and Overflow

Table 2.2.2 below presents data on the use of water in agriculture, for drinking water supply, for irrigation and for other agricultural needs, as well as water returned to surface water bodies from irrigation, in million cubic meters for the period 1993 to 2002.

***Table 2.2.2* Water use in agriculture**

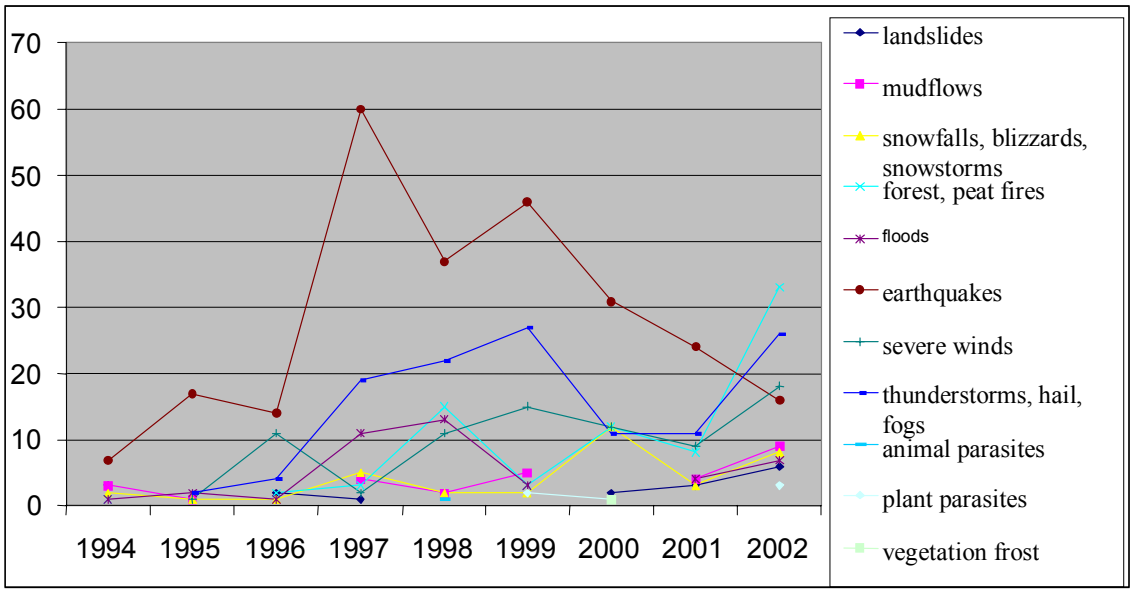
	1993	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Irrigation and other agricultural needs										
Total water abstraction	1252	1238	742	776	1343	1456	940	840	808	1115
Drinking water supply (without treatment)	30	29	17	19	32	35	23	20	19	26
Irrigation water returned to surface water bodies	206	204	122	128	221	240	155	138	133	182

Source: National Statistics Agency of RA;

Accidents

Figure 2.2.4 shows, for the period 1994 to 2002, emergencies and other events connected with the agriculture sector that occurred, according to the records of the Department of Emergency Situations of the Government of Armenia,.

***Figure 2.2.4* Accidents connected with the agriculture sector**



Source: Department of Emergency Situations

Chapter 3 Transport

The transport sector is one of the main sources of environmental pollution, in particular air pollution (for further information see Part I, Chapter 1). Unlike emissions from **mobile sources** of the transport system, reporting of emissions from stationary sources is more difficult because of small number of primary reporting documents. The is also the case for volumes of waste water and solid waste generated by the transport system.

The transport sector's share of air emissions increased from 65% (1993 First National Report) to 85.8% in 2002. The share of automobile transport in total emissions of carbon oxides is more than 90%; of nitric oxides, 79.5%; and hydrocarbons, 99%. It should be mentioned that in Yerevan city, where most cars are concentrated, since 1997 – because facilities no longer are in operation – monitoring of ambient carbon monoxide (CO) levels in the atmosphere is no longer performed, and this was the last main indicator of air pollution tracked. In the analyses made in 1997, ambient concentrations exceeded MPC for CO by 1.5 to 2 times.

Emissions from the transport sector were calculated on the basis of standard emissions of working vehicles, used in normal conditions. Considering the quality of fuel consumed and the age and obsolete technical condition of vehicles, it can be said that real emissions in fact exceed the levels reported.

In Armenia, emissions requirements were set by all-Union State Standard 17.2.2.03-87; in 1998, changes to the standards were adopted, fixing the maximum permissible concentrations of carbon oxides and hydrocarbons for petrol car emissions. All-Union State Standard 17.2.02.06-99 specify emissions requirements for cars powered by natural gas. In European countries, the standards for transport vehicles are stated in different – g/kWh.

Emissions from stationary sources of the transport system are partly considered in the reporting. It should be mentioned that not every privatized transport enterprise is actually reported.

In Table 2.3.1 below, you can see the records for reporting enterprises of Yerevan city.

On the impact of exhaust gases, mentioned earlier, for unknown reasons the use of large and medium-sized buses has been stopped, and instead minibuses are used, leading to an increase in air pollution. This kind of policy is myopic. In addition, a sharp decrease of electrical transport is observed.

Based on the records of State Auto Inspectorate of Armenia, 249 000 transport vehicles are registered with national numbers. In 2002, 185 000 transport vehicles passed their checkup. Last year, out of the total number of automobiles, about 12 000 were not passed, either due to technical reasons, or because they were no longer in the Republic, or because they were not used because of the absence of the owners. One more problem should be mentioned: abandoned automobiles, for which unpaid ownership tax has accumulated, a tremendous sum. This kind of situation can be eliminated by adopting an "amnesty" for past unpaid taxes, giving owners the right to decide the future of their "dead goods".

The exact quantity of waste water from transport sector is not available, nor is it possible to separate the solid wastes from the transport sector from total solid waste generated in the Republic.

Table 2.3.1. **Air emissions, waste water, and solid wastes generated by stationary facilities of the transport system in Yerevan city.**

Years	Emissions on atmosphere, tone per year	Waste water, in thousands of cubic meters	Pollution in waste water, in tones		Wastes, in tones
			Suspended substances	Mineral oil	
Transport (city minibus fleets, long-distance minibus fleets, SCJSC Taxi fleets, SCJSC cargo transport vehicles 12, autocade 2983);					
1999	0.383	55.35	2.36	0.93	15.62
2000	0.167	29.32	3.15	0.09	48.7
2001	0.545	33.7	3.26	0.128	45
2002	0.34	26.4	2.89	0.027	41
Electrically powered transport (Yerevan Electrotransport, SCJSC, Metro, Railways)					
1999	5.47	181.5	8.88	0.032	257.7
2000	2.86	406.8	19.98	1.05	304.7
2001	0.75	326.5	53.3	2.56	439
2002		317	13.65	1.46	306.5
Zvartnic Airport, Armenian Airlines, SCJSC					
1999	32.288	803.15	28.74	24.1	132.2
2000	61.99	666.3	28.92	13.97	155
2001	22.98	568.9	24.74	12.17	120
2002	0.534	99	10.83	2.46	

In 2002, Zvartnoc Airport did not report pollution levels.

Source: Nature Conservative Inspection of the Ministry of Nature Protection of RA, Yerevan branch

The impact of the transport sector on human health and the ecosystem in the Republic has not been studied, but it is known that exhaust gases pollute the air, leading to an increase in upper respiratory disease, lung emphysema, asthma, allergies, and also, considering that transport is a source of dangerous wastes and carcinogenic substances, it is possible to add to this list oncological diseases.

It should be mentioned that to reduce emissions from automotive transport, the government of Armenia has adopted number of decisions, including one on banning of producing, usage and import of ethylated (leaded) petrol. By this decision, the Republic is step by step complying with its obligations to gradually phase-out the usage of petrol containing lead.

According to the expert estimates, the quantity of gases emitted by internal combustion engines burning natural gas, compared to those consuming petrol, is 2 times lower; CO emissions are 2.6 times less; and nitric oxides, 1.4 times. The Government of the Republic Armenia charged the Ministry of Energy with the elaboration of a draft law on the use of alternative types of motor fuels. The measures identified for the complete transfer of automobiles and other transport vehicles to natural gas are in accordance with the UNECE Blue Way Programme. At present, according to the State Auto Inspectorate, 12 000 cars use condensed natural gas. It is anticipated that in 2-3 years, about 50 000 cars will use natural gas, which will improve air quality.

Unfortunately, the noise impact of aviation and other transport on human health is not considered. It is estimated that the inhabitants of the village of Parakar (5000 – 6000 people) are affected by this noise, as well as inhabitants of certain districts in Yerevan, as the airport is

located not far from the capital (6-8 km). Emissions from airplanes on takeoff also are not considered. There is no information about soil pollution on the airport's land. The quantity of solid wastes from the airport is 120 tonnes per year of non-hazardous wastes.

Chapter 4 Housing and Public Services

Population and settlement

In Armenia, according to the Law on the Administrative Territorial Division of the Republic of Armenia, there are 48 cities and 917 villages. According to statistical data, the size of the population is about 3.7 to 3.8 million people. In fact, due to emigration from the Republic, a topic on which there are no official reports, the actual population is about 3.0 million people.

Water supply, Sewage collection and treatment

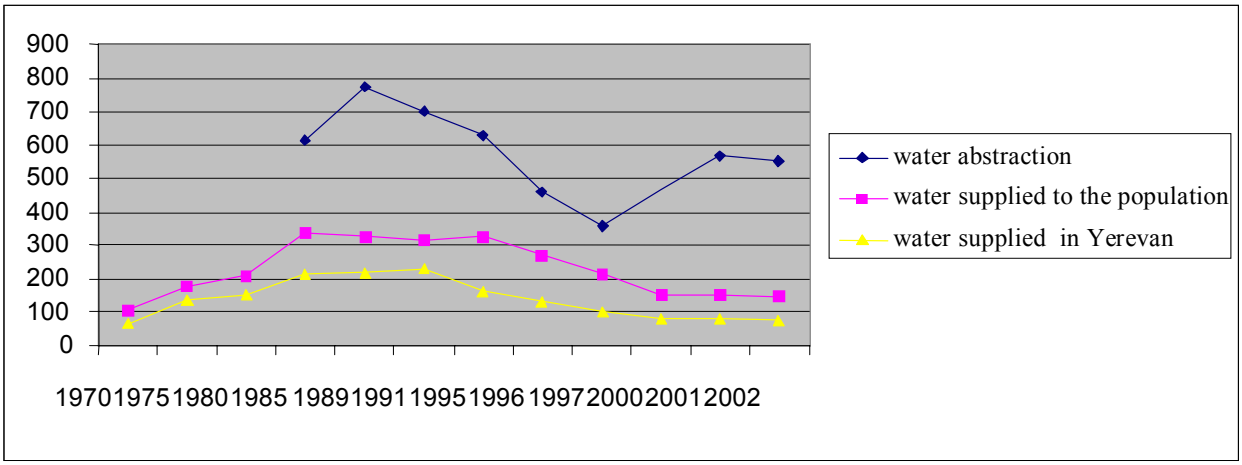
Water supply

About 91% of the population are connected to systems for central water supply, though only 80% of the rural (village) population; the remainder receive water from local, autonomous systems. All inhabitants in Yerevan, Aparan, Ashtarak and Tsakhadzor are connected to water supply systems; the least connected city is Dilijan (56%). Approximately the half of the water supply is provided with the help of pumping stations. It is notable that 95.5% of water abstraction is of high quality groundwater.

The total length of the water supply system in 2002 was 5055 km, street networks are 7327 km long, and neighborhood and housing complex nets are 1050 km. In the network, there are 1037 water pipelines, 123 chlorination stations, 76 pumping stations, 475 basins for daily regulation and 29 laboratories of water quality control.

Figure 2.4.1, below, shows the dynamics of trends water abstraction for drinking water, and actual water volumes supplied to the population.

Figure 2.4.1 **Trends in abstraction for drinking water and actual supply to the population**



Source of Information: National Statistics Agency of RA;

In 2002 water was distributed among users along the following lines: households, 82.9%; community facilities 1.1%; industry, 16%.

As can be seen from figure 2.4.1, water sources provide a sufficient quantity of water (average water abstraction in 1997 was 642 liters per day per person). But because of the poor

conditions of sluices, networks and facilities, the level of leakages in 2002 reached 67%, and as a consequence water in many settlements was provided from 2 to 8 hours per day, and in some cases, only once every 2 days. In fact, the average water supply delivered per inhabitant has constantly fallen (for example from 1995 till 2002, the average across the Republic fell from 240 to 110 liters per day, and for Yerevan from 360 to 180 liters).

Sewage collection

The level of sewerage attachment in cities is on average 55.5% (the lowest attachment rate is in Dilijan, 33%, and the highest is 100% in Ashtarak).

Only 20% of villages are equipped with sewerage systems. Total sewer length in 2002 was 1114 km; urban networks, 2526km; and intercity networks, 626km. Sewer systems work mainly by gravity, as there are only eight pumping stations.

Treatment facilities

Only an insignificant share of drinking water passes through treatment facilities. These have total power of 120 liters per second, and service 170 thousand inhabitants in Vanadzor, Kapan, Artik, Razdan, Dilijan, Kadjaran, Berd, Chambarak, Meghri and Agarak. In fact all city water facilities are provided by chlorination. In the 883 village water supply systems, chlorination is provided only for 40% of water supply.

In the Republic there are 20 urban wastewater treatment facilities capable of full biological treatment and disinfection, with a total throughput of 1.12 million cubic meters per year, where there is also industry sewage. These are found in the cities of Yerevan, Gyumri, Vanadzor, Kakhsi, Kapan, Ararat, Dilijan, Alaverdi, Echmiadzin, Ashtarak, Masis, Sisian, Berd, Martuni, Vardenis, Kadjaran, Aparan, Artashat, as well as at the Armenian Atomic Power Station. There are also 18 laboratories for the monitoring of wastewater treatment discharge quality.

Technical condition of water supply systems, water overflows and cleaning

While the condition of facilities for drinking water are more or less satisfactory, the condition of networks of water pipes is completely unsatisfactory. About 60% of these systems are more than 20 years old, and about 27% of water pipes and 22% of sewage networks urgently need to be refurbished.

Worse are the conditions of wastewater treatment plants. Some are completely out of order; others at best only perform incomplete mechanic cleaning. From an economic point of view, it is reasonable to repair only six of them, and the rest should be rebuilt with new technologies. The consequence of these bad technical conditions are frequent accidents of water pipe canalization systems, which have been increasing (in 2002, for water pipes networks there were 20 068 accidents; and for canalization, 18 571).

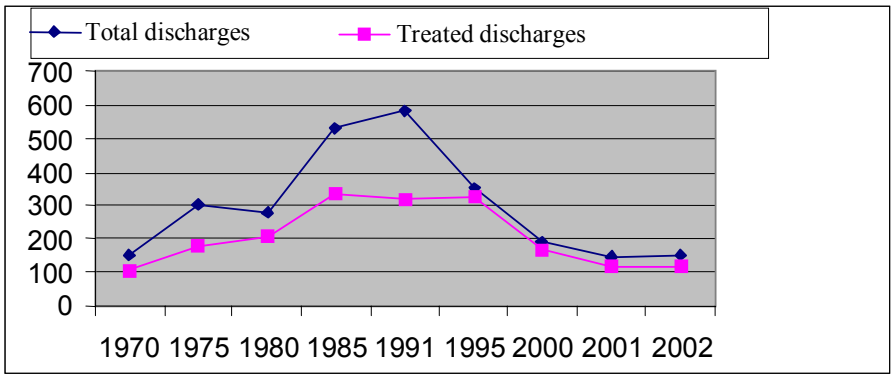
Impact on the environment and human health

Consequences of the bad technical condition of drinking water pipes, which is also worsen by the 1\3 part of necessary sanitary zones for their protection, include the decline in quality of drinking water and the seepage of pollution, in particular microbiological pollution, into the networks. The number of water pipes that do not meet health norms are increasing from year to year (in 1990, 21%; in 1993, 39,3%; in 1996, 52%; and in 1998, 57%). This indicates the increasing risk of epidemics. According to the records of Ministry of Health, from 1984 to 1991 there were no jumps in mortality connected with the quality of drinking water, but beginning with 1992, these kinds of events were regularly registered.

Housing and public services have had a significant impact on the environment and particularly on water resources due to their sewage discharges. According to the Statistical Agency, in 2002 150.3 million cubic meters were abstracted from surface waters, and 97.7 million cubic meters of sewer waters were discharged, of which 18.5 million cubic meters were not cleaned

according to the norms. At present, work for the repair of water pipes and sewage networks is being carried out with the help of external financing.

Figure 2.4.2 **Dynamics of sewage discharge volumes (total and through treatment plants), in million cubic meters.**



Source: National Statistical Agency of RA;

As there is an absence of laboratory measurements of wastewater discharges, an expert estimation of the quantity of pollution discharged in surface waters of the Republic is presented. It is understood that in the Republic today there are about 2.0 million urban and 1.0 million rural inhabitants. Taking into consideration that 55,5% of the urban and 20% of rural population are connected to sewage systems, sewage is gathered only for 1.3 million people (of whom, 200 000 are rural). On average, every day each person produces 40 grammes of organic pollutants in terms of biochemical oxygen demand (BOD), and thus, for one year the total is 19 126 tonnes. Taking into consideration that most sewage from urban inhabitants passes through treatment systems and in the process of chemical cleaning up to 25% of pollutants are removed – 4052 tonnes per year – it is possible to estimate the approximate yearly discharge of organic pollutants as 15 074 tonnes in terms of BOD. The result is water pollution, containing discharges of ammonia, nitrates and other pollutants.

Gas and heating systems

In 2002, natural gas (from the Russian Federation) supplied 83.3% of the cities and 71% of the villages of the Republic. The length of active gas pipeline networks in the cities is 2108 km, and in the villages 2454 km, or approximately half of all active nets. Throughout the Republic, 947 million cubic meters of natural gas were supplied, of which households directly consumed 101 million cubic meters (64.6% in urban areas, 35.4% rural); housing and community facilities, 38 million cubic meters; and industry, 808 million cubic meters (see Table 2.4.1).

Table 2.4.1 **Dynamics of natural gas supply in the Republic**

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Quantity of natural gas supplied to all users, in cubic meters	759	786	1340	1030	1313	1406	1125	1270	1266	947

Source: National Statistical Agency of RA;

In 2002, according to the Customs Inspectorate of the Republic of Armenia, 6282 tonnes of liquid gas were consumed. There are no records on firewood consumption.

In Armenia there are 277 district heating plants. From them in 2002 acted only 18 (14 from them in Yerevan), with a total power 1091 of faeces per hour. The quantity of gas consumed was 30.2 million cubic meters (19.5 in Yerevan) and 545 thousand faeces of heating energy were produced. The length of working district heating networks is 872 km, of which 47% needs to be rebuilt, and 35% needs to be repaired. The length of the networks is 48km. The loss of energy in the networks is equivalent to 100.4 feaces (or 18%). Energy was distributed in the following shares: directly to households, 46.1%; housing and community facilities, 13.6%; industry, 40.3%.

Table 2.4.2 **Dynamics of district heating supply (thousand feaces)**

Sector	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Households	308.4	363.4	577.7	492.4	474.3	574.3	383.8	515.8	303.2	204.4
Community services	73.7	88.5	89.0	43.2	150.9	53.9	54.5	62.7	52.7	60.3
Industry	458.4	369.6	373.3	304.8	340.4	413.4	356.4	411.8	280.2	178.6
Total	840.5	821.5	1040.0	840.0	965.6	1041.8	794.7	990.3	636.1	443.3

Source of Information: National Statistical Agency of RA;

The impact of these district heating plants on the environment is characterized by their emissions in the atmosphere, which are not measured. By expert calculations, based on the emissions predicted for the combustion of 1000 cubic meters of gas, 2001 emissions of carbon oxides are estimated on the order of 8900 tonnes, and nitric oxide, 3000 tonnes. Reporting on emissions from burning of liquid gases and woods is not available.

Domestic solid waste

In the process of domestic activities, each inhabitant in Armenia generates on average 219 kg per year of solid domestic waste (SDW); urban inhabitants generate 4 times more than rural inhabitants. Approximately one quarter of SDW is composed of organic materials, one tenth of wood, and one 20^{th} of glass; plastic and metals are present in about 1-5%; and the remainder consists of building wastes, rags, rubber and other wastes. The specific volume of SDW is about 290kg per cubic meter.

With varying effectiveness, in the 1990s SDW was collected in 48 cities and 31 villages of the Republic. In more than 900 villages SDW is not generated at all. Vehicles for SDW collection are quite old, and as a result only half are working. Carts compose about 36% of the vehicles. Collected wastes are taken to landfills, of which are about 100. There are many unauthorized and uncounted landfills, especially in rural areas, where they appear spontaneously. The total territory of landfills is about 250 ha, and the average distance of transportation is 8.5 km. At the landfills, there are practically no measures for the treatment of solid wastes or the protection of the environment. Only some landfills consolidate solid wastes and cover them with the earth, and not always fully.

Table 2.4.3 **Dynamics of solid waste collection**

Years	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Number of specialized vehicles	1081	1002	877	952	843	780	790	622	562	482
Volume of SDW transported, in thousand cubic meters	3255	2491	2153	2253	1807	2046	2154	2126	2202	1512

The impact of landfills on the environment and human health unfortunately is not monitored (issues include pollution of atmosphere during combustion of SDW, pollution of groundwater, and other problems).

Urban green areas

According to the 2002 data of organizations responsible for urban green areas, the total size of these areas in the Republic is 59 980 ha. The total surface area of urban green areas is 12 195 ha. This includes: green areas for public use, 1421 ha; forests and other protected zones in cities, 2708 ha; sports facilities, 132 ha; and other areas, 1641 ha. The average per person is 56 square meters of green area, of which 30 square meters are green areas for public use.

It should be mentioned that according to the expert estimates, the actual size of green areas should be much less, due to the extensive tree cutting that began in the years of blockade and crisis and continues, as well as the construction of new buildings on these areas in recent years.

Road infrastructure

According to the records of the road infrastructure organization, the total length of city streets (including those underground) in 2002 was 3067 km. The length of all paved streets was 2579 km, and of these streets with modern paving, 1857 km. The total surface area of all streets, underground streets and squares was 39 051 million cubic meters; paved streets and squares, 32 758 million cubic meters; and those with modern paving, 25 079 million cubic meters. In connection with this unsatisfactory situation concerning road infrastructure works, the figures are falling each year.

The conditions of the roads affects transport and its emissions, but there are insufficient data for the estimation of environmental impacts.

At present, road infrastructure in the Republic does not receive outside financial support.

Chapter 5 Urban Development

The aim of this chapter is to identify opportunities and propose avenues in the framework of urban development and territorial planning. This is directed not only at providing better public health conditions for inhabitants, but also at improving environmental management as much as possible and integrating environmental considerations in all major socio-economic processes in regional, urban, city and district frameworks.

This chapter presents an investigation of the interrelationships between urban and environment fields, as well as a discussion of urban construction, and is focused on the protection of health in cities and other settlements (protection of the lithosphere, hydrosphere, atmosphere, and biota from negative impacts of urban areas and urban buildings).

In modern conditions, the ecological factor in urban development – i.e. analyses, forecasts, and synthesis of all components of the urban environment – should be stronger. A new approach should be elaborated for a rational approach to nature protection and urbanization, taking into consideration the conservation of potential capacities of the ecosystem.

Environmental impacts in Armenia are mainly determined not by the increase of the population, but rather by territorial dislocation. Armenia is characterized by a high level of urbanization – 66.8% of the population in 1998. For example, in the Ararat Valley the density of population exceeds 190 inhabitants per square kilometer, and in districts of urban agglomerations and in some densely populated villages it is 100 to 500 inhabitants and more per square kilometer. The city of Yerevan has a population of 1.2 million.

Table 2.5.1 **Urban population as a percentage of total**

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
68.1	67.7	67.5	67.3	67.0	66.9	66.8	66.7	66.6	66.6	64.2

Source: National Statistical Agency of RA;

Urban areas are not a large share of total national territory.

Research shows, however, that large cities, especially urban agglomerations, have an impact on the environment extending 50 times more their own radius. Especially strong are urban impacts on soils, reservoirs, air basins, and growth. The main factors in the level of the anthropogenic pressure on the environment in the framework of urban areas are: the size of the urban agglomeration, the density of the population or of buildings, the economic characteristics of the urban area (industrial branches, level of development of public health functions), and the microclimate.

While providing a high level of housing and cultural and welfare facilities, large cities and urban agglomerations at the same time are notable for their high concentrations of industry and high densities of population, which lead to considerable pollution of the environment, imbalances in the labor force, irrational commuter movements, construction on valuable natural landscapes, etc.

City growth leads to higher vehicle numbers, polluting the urban-industrial environment even more and raising the noise level of surrounding settlements.

Increasing building densities (typical for large cities) not only significantly lower dweller comfort but also lead to overcrowding and epidemiologically unsafe contacts.

Microclimate. The key description of the urban environment is the microclimate, whose conditions are mostly determined by anthropogenic impacts and first of all by pollution; effects include the level of illumination, quantity of solar ultraviolet radiation, humidity, and frequency of fog.

One of the important components of the microclimate, with a significant influence on human organisms, is the temperature of the air. Average annual air temperature in a city is several degrees higher than outside. Overall, heat energy released by a large city like Yerevan is significant and reaches up to 5% of solar energy flowing into the city.

The level of ultraviolet radiation decreases in cities (this has a negative impact on people – heightened tiredness, irritability, metabolic diseases and so on). Bacterial air pollution rises. The relative humidity goes down. There are more windless days, atmospheric pressure and wind velocity is lower in cities, which leads to stagnation, severe contamination of the urban-industrial environment and increased morbidity of population with respiratory diseases.

The main pollution centers in Armenia are found in several cities, particularly industrial centers (Yerevan, Alaverdi, Hrazdan, Vanadzor, Ararat, etc.). Important sources of urban pollution in Armenian cities include motor vehicles, old municipal infrastructure, and low capacity (or lack of) sewage treatment plants.

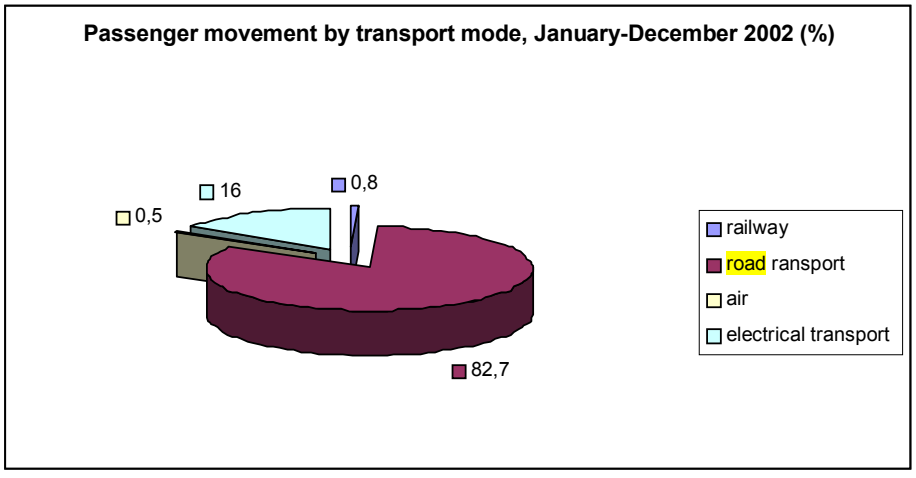
Without proper organization, in city centers automobiles create additional noise and pollution. The location of industrial enterprises within cities, including poor locations with respect to prevalent winds, has a significant impact. Cities situated in ravines with bad ventilation and frequent low temperature inversions suffer the most. Such conditions are found in Yerevan, Vanadzor and some other Armenian cities.

Motor vehicles are the main source of air pollution. Their growing numbers and the increasing mobility of the population opens zones of natural landscape available for citizens but these processes promote road construction and rising recreational loads on the natural environment.

Transport. The transport system of Yerevan and its agglomeration includes railways and roads for local and intercity passengers travel and cargo transportation. International, Republican, city, and local roads connect Yerevan with its agglomeration, with the Republic and with foreign countries.

103.6% of passengers have to travel on motor transport. The road network in the agglomeration most likely will not undergo major changes in the future. The section of highway between Yerevan and Edchmiadzin is extremely overloaded (more than 3000 passengers per hour). It has been proposed to build an additional 13 km of high category highway in this stretch.

Figure 2.5.1



Source: National Statistics Agency of RA;

After the earthquake in 1988, and with the independence and blockade of Armenia, the importance of air transport increased and it played a major role in the vital functions of the Republic.

Government Resolution No. 610 of 10.04.2003 confirmed the General Project of Settlement of the Republic of Armenia, under which a rational transportation network is elaborated with an improved index of transport settlement availability. Current conditions and the future development of roads, railways and air transport are examined. In the mountainous conditions of Armenia, however, road transport for external and internal travel is considered primary. In addition, for the first time an experiment was carried out for the creation of new communications network and its economic feasibility (productivity of capital investments).

The new network consists of a North-South artery, composed of a northern and southern junctions, and East-West branches. Total length of network would be 1249 km. The average cost per kilometer of the network is 1.016 million US dollars.

The section Aparan – Yerevan – Vedi – Eghegnadzor – Sisian – Dastakert – Kajaran – Megri – Iranian border of the North-South artery would be especially productive, and for its construction the return on capital investment would be 10-14%. The segment Sisian - Dastakert – Kajaran is very important for the Republic of Armenia, as construction of this road will shorten travel by 100 km in comparison with the existing one, and the problem of going around the towns of Goris and Kapan will be resolved.

If later the road network exhausts its carrying capacity, there will be a need to build a railway. A new railway line is projected parallel to the North-South road. For the success of this railway, it would be necessary to connect it with Ninotsminda or Akhaltskha in the north and with the town of Soufyan in Iran to the south, here joining the Central Asia-Europe railway. In this case, it has also been proposed to build the 35 km Vanadzor – Fioletovo railway line. The project also includes a provision for the reconstruction of the local airports of Megri, Kapan, Goris, Sisian, Germuk, and the building of new ones in Berd and Noyemberyan.

Under the project, the road network would connect towns and cities, covering all settlements of low density zones, based on the road availability level and provide resources for their use.

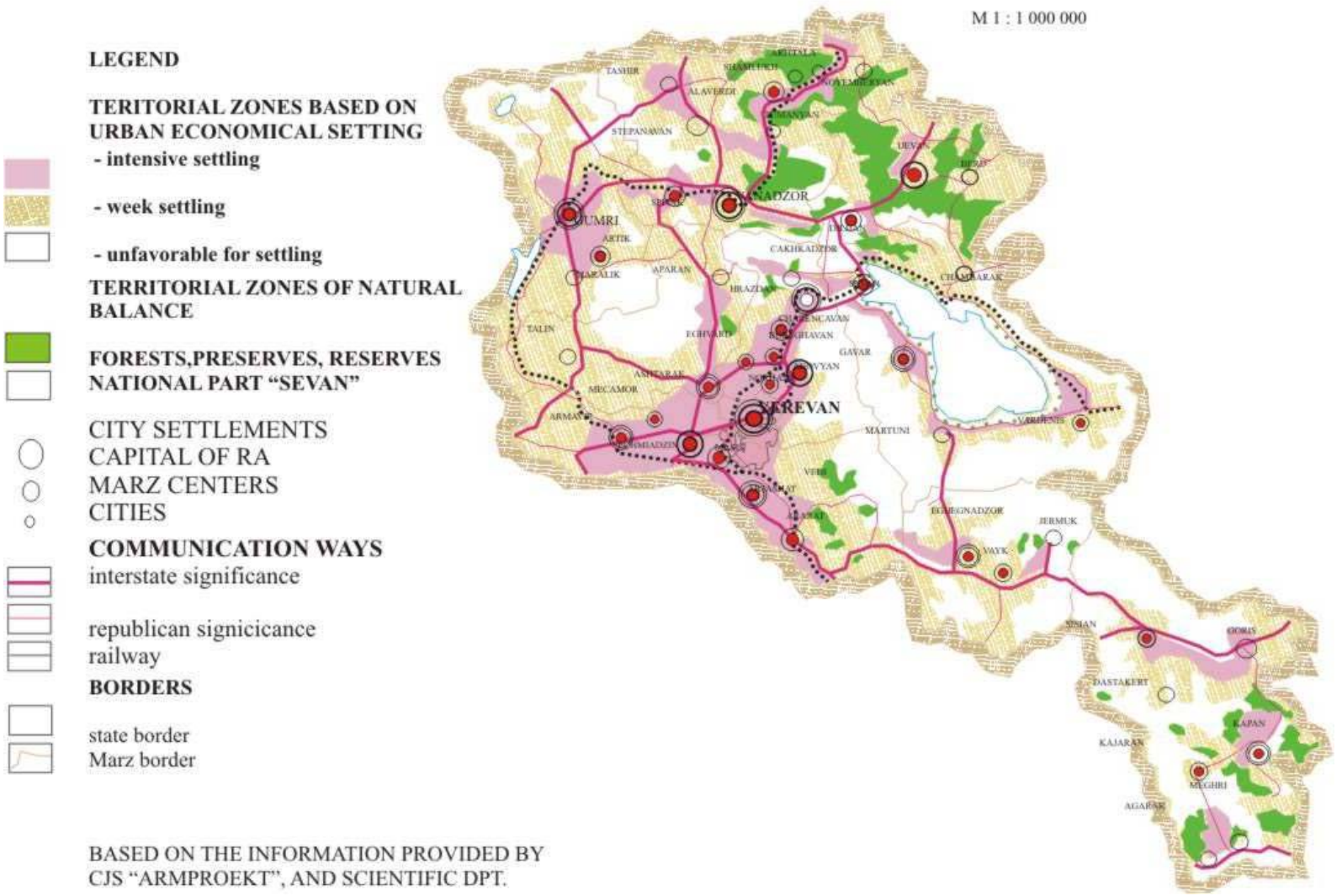
The proposed North-South transport communications corridor (motorway and railway) would be crossed by East-West branches on three levels, thereby increasing the accessibility and core importance of Marz-center towns.

Interurban transport of Yerevan and city roads. The historical structure of Yerevan, located in complex topography that includes in particular the Hrazdan Ravine, which passes through the whole city from north to the south, has established city districts (with faltering nature) that in turn have determined the road network: both radial-circular roads and, within several areas, more complex patterns (rectangular, radial, circular and other planning forms). Transport between city districts occurs through the main radial roads. Travel between diametrically opposite areas goes through the city center. Existing roads and the absence of parallel, redundant motorways have led to significant traffic congestion, generated by inter-district as well as intra-district travel.

The existing main roads have, in fact, exhausted their normal carrying capacities: if Azatutiun Avenue has a load that is 92% of carrying capacity (the least congested road), Baghramyan Avenue has one at 165% (the highest loading). The average index of functioning capacity on city roads is about 115%, which is inadmissible. Taking into account current economic reforms, in the near future the transport conditions will be more complicated.

Buses, minibuses, trams, trolleys, and the Metro provide city transportation. Currently, significant changes are occurring in the structure of public transport: namely, there is a rapid reduction in electrically powered transport (such as trams) and an increase in the number of minibuses. The reduction in electrically powered transport is undesirable both from environmental and social points of view.

URBAN- ECONOMICAL SETTLING OF RA TERRITORIES



BASED ON THE INFORMATION PROVIDED BY CJS "ARMPROEKT", AND SCIENTIFIC DPT.

Transport system planning foresees a network of routes that will relieve congestion in the central part of the city by means of a ring road, from which radial routes will connect outlying districts with the center. The details of ring and other roads will be defined more precisely, naturally, in the work for the new General Plan of the City.

Functional zoning. Cities and urban agglomerations, industry and population are located irregularly across the territory of Armenia, which in some cases leads to excessive anthropogenic burdens (Yerevan agglomeration, the Valley of Ararat), breaking the environmental balance in quite vast regions.

Yerevan agglomeration has already greatly exceeded its demographic capacity; thus, the development of systematic actions for the improvement of the environmental situation is especially pressing.

The existing planning structure and functional zoning of Yerevan agglomeration, Yerevan city and other big cities of Armenia already do not correspond to the objectives of the sustainable development of natural and urbanized landscapes; they need radical regulation. The network of protected territories in the region is insufficient to preserve the biosphere's gene pool and the most valuable natural landscapes, and also to satisfy the public's growing recreational demand. The solution to this problem requires a review of the methods and directions of urban planning and development, as well as the development of sustainable agriculture and forestry in the central and other parts of the region with high density of population.

These problems can be resolved, through both the General Scheme and the Settlement Plan for the Republic of Armenia, via different economic, technological, ecological and architectural planning actions; among these, proposals for regional urban-ecological macro-zoning have great importance. The main elements of these macro-zoning proposals are the following:

- step-by-step elimination of irregular settlement;
- improvement and development of city and rural settlement networks, taking into account prospects of economic development and population growth;
- rational use of natural resources;
- allocation of industrial and civil construction, agriculture, transport and recreation; and
- resolution of environmental conflict situations.

An important arrangement in the process of town-planning and economic zoning is the regulation of all types of economic activity, taking as a basis environmental problem solving and the preservation of the ecological balance.

For urban planning and economic settlement, the territory of Republic Armenia is divided into the following zones:

- high-density settlement,
- low-density settlement,
- recreational and environmental areas;
- areas unfavorable for settlement.

Areas unfavorable for settlement comprise 16.7% of Armenia's territory.

In urban planning activities directed at the gradual elimination of irregular settlement, the primary objective is the organization of boundary zone areas, development of poorly settled zones, improvement of road and engineering infrastructure, and the protection of natural resources.

These proposals (contained in the Scheme for Project Settlement of the Republic Armenia) are important not only for the maintenance of the ecological balance of the region but also for more active functioning of local, natural town complexes and their natural zones. So, for example, the environmental effectiveness of branch system of squares and boulevards in the central part of Yerevan city is directly related to the state of the recreation area in Hrazdan River

Ravine, which passes through the city, Tcitsernakaberd Park, Yerevan Lake Park, forested park belts on the Nork and Saritagh Plateaus, and the green massifs of the Botanical Park. In turn, the suburban forest massifs – buffer green zones (which in the concept for the General Plan of Yerevan City will, possibly, be created in the southwest, south and northwest parts of Yerevan) – and other open territories must be connected to more extensive zones of stable ecosystems. This is necessary for a better distribution of anthropogenic burdens, for the conservation of water reservoirs and flows, for the free migration of animals, and so on.

Historically, many environmental problems of urbanized territories occurred because of the imperfect system of land tenure zoning and poor urban architectural planning. Very often during the process of planning and construction, environmental considerations were disregarded. An even more uncontrollable situation can be observed now. Violation of the national General Plan – the main planning document – through the illegal construction of housing blocks, commercial buildings and cafés, often at the expense of green zones, is a common occurrence for Armenian cities and especially for Yerevan.

Tree cutting in parks, squares, and gardens has ended the main functions of green zones – air quality improvement and acoustic insulation, as well as recreational use by citizens.

As a result, the system of trees and plants in Yerevan, in which the continuity and harmony of planting with landscape features of the city could be observed, has been severely broken.

Before the energy crisis, public green areas of Yerevan city (not including micro areas) covered 1193 hectares. It was planned to enlarge this to 2215 hectares by 2010; the area per citizen would increase from 9.6 m^2 to 17.1 m^2. Massive trees cutting in cities in winter periods over the past 10 to 12 years has also led to a significant worsening of recreational areas.

Today, as a result of these problems, the public green area per citizen has decreased to 4-5 m^2 (based on expert evaluations). Nevertheless, there has been a slight increase in private green areas.

Table 2.5.2 **Public green areas in cities, including micro districts, per person (m^2/per inhabitant)**

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Yerevan	87,2	87,4	87,5	87,4	86,4	86,4	85,0	85,0	85,1	85,1	64,1
Vanadzor	43,1	43,2	43,1	43,2	43,2	43,1	43,2	14,7	14,7	14,8	23,7
Gyumri	8,4	39,9	39,9	39,8	39,8	39,8	39,7	39,7	39,9	39,9	16,2
Kapan	18,0	37,8	25,5	25,5	25,4	25,4	46,8	104,7	104,9	104,9	107,2
Alaverdi	27,6	27,8	27,9	27,9	28,0	28,3	42,0	42,3	42,5	42,7	61,4
Diligan	59,7	60,2	59,9	60,7	60,9	60,7	60,7	36,0	36,1	36,1	57,1
Gavar	52,4	52,2	51,9	51,9	51,8	63,8	63,8	63,8	64,0	64,2	82,6
Hrazdan	47,9	47,9	48,0	48,3	48,1	48,1	48,2	48,4	48,5	48,5	5,9
Abovyan	10,8	10,8	10,8	10,9	10,9	11,0	27,0	27,1	27,2	27,2	37,7

Source: National Statistics Agency of RA;

The violation of functional zoning and the reduction in green areas are becoming an irreversible process. The restoration of green areas, especially in the central part of Yerevan, is not realistic, because all possible green areas were planned in the city's structure a long time ago under the previous general plan.

For local areas – settlement regions, urban agglomerations, cities and urbanized regions – the loss of the ecological balance can become a real disaster, consequences of which will inflict huge damage not only to nature but also to the economic and social sphere.

In forecasting city development, it is necessary not only to consider all that has happened due to myopic urban planning, but also to consider social, cultural and environmental criteria, as

well as urgent economic needs, reaching rational co-ordination in accordance with the principles of sustainable development.

Page 89, Picture **Urban – economical settling of RA territories**

Legend

Territorial zones based on urban/economic settlement

- high-density settlement
- low-density settlement
- unfavorable for settlement

Territorial zones of natural balance

- forests, preserves, reserves
- Sevan National Park;

City settlements

- capital of RA
- Marz centers
- Cities

Transportation network

- roads of interstate significance
- roads of Republican significance
- railway

Borders

- national border
- Marz boundaries

Based on information provided by CJS Armproekt, and scientific dpt.

Part III

Cultural Heritage

Environmental Impacts on Historical and Cultural Monuments. Measures to Protect Cultural Heritage

Armenia is a country with a rich cultural heritage whose roots rise through the depth of the centuries. About 33 000 historical and cultural monuments are found in 4 500 complexes with a total territory of 20 000 hectares.

The protected monuments in the Republic are defined as local or Republican. Especially important and significant are monuments of historical, architectural, scientific, artistic and cultural value, of which there are 80 complexes (with about 400 architectural monuments). In the past, these were included in the USSR's list of cultural and historical significance of all-Union value.

The UNESCO World Heritage List, which since 1963 has identified more than 630 historical monuments and natural areas all over the world, includes several sites on the territory of Armenia: Hakhpat Abbey complex, Sanain Abbey and old bridge, and the historical centers of Echniadzin, Zvartnoc and Gegardavank. Other Armenian sites have been proposed for the UNESCO List: the Noravank Abbey complex, the Persian Blue Mosque and the historical capital of Armenia, Dvin.

The main and permanent factors of risk for the country's cultural heritage include numerous natural and anthropogenic environmental factors.

Earthquakes, landslides, rising groundwater levels, the environmental crisis with alarming pollution emissions and deposition, formation of smog in cities, pollution of streams, catchment basins and lakes, degradation of soils, and the absence of drainage systems leads to the destruction of cultural, historical, archeological and religious monuments, as well as more recent engineering works (e.g., bridges, aqueducts).

The most destructive is the impact of natural catastrophes such as earthquakes, which occur frequently in the country. There are many bibliographic notes and graphic images of these events. For example, part of the city wall of Ani fell in 1064; during the earthquake of 1319 the drum and dome of the main cathedral in Ani collapsed. The most destructive was the earthquake in 1679: it destroyed the cathedral in Garni, numerous churches in Yerevan, Kanaker, Nork, the Ararat valley and Gokhtan village, as well as the cathedral in Echniadzin, the churches of St. Hripsime and the Abbey of Gayane.

The architectural monuments of northern Armenia suffered during the destructive earthquake in 1988 in Spitak. Almost all churches in the Akhuryan, Artik, Ani, and Ashot districts were partly damaged. To a lesser degree the churches of Gugark, Stepanavan and Tallin districts were damaged.

Humidity also causes major damage to monuments, which can be noted very often near the base of construction.

To isolate monuments from humidity, it is necessary to protect rooves and walls, drain surface waters from the surrounding territory, and block the expansion and intrusion of humidity into the foundations and walls from the ground surrounding the monument.

Irrigation and watering in fields, gardens and vegetable gardens near monuments can lead to waterlogged ground and the intrusion of humidity.

Extremely damaging is the intrusion of humidity in the walls and roofing structures through damaged coverings. Accumulated humidity can form in holes in the walls, freezing in the winter, melting in the spring, and destroying mortar, thus separating internal and external layers and weakening the structure of buildings. This mainly causes damage to the south and in part the western walls of monuments, whereas northern and eastern faces usually remain less damaged as a consequence of smaller temperature fluctuations.

A useful measure for the removal of the underground waters from the area surrounding a monument is the creation of drainage systems. Irrigation canals near monuments are another cause of humidity.

During the centuries, the penetration of groundwater in the stone buildings of Gegardavank has had a destructive impact, especially near the bottom of stone walls. This impact has been to a great extent addressed through the construction of a drainage system, directing underground water from the northern part of the protective wall towards the Azat River. Such measures can possibly also address problems of underground water level increase.

A major problem is the prevention of high humidity levels in the monuments of the city of Echmiadzin. Most buildings in the city are cultural and historical monuments, and the lower parts of their walls, up to a height of 1.5 to 2 meters, are damp. The humidity also damages such buildings as cathedrals, the churches of St. Gayane and St. Shogakat, church fences of St. Hripsime and the cells of Yeremyan, Kazarapat, and Trdatatur. There were no such problems in the past. The situation arose with the closure of the old water supply system, which had vertical cisterns in the ground and a connecting network of underground canals. It was used until 1930. After the installation of metal pipes for the city water-supply system, the old system was buried and forgotten. Due to this closure, drainage of underground waters was also blocked, and these began to intrude into the foundations of buildings. Humidity is a serious threat for the Zvartnoc complex also. Even more exposed are architectural fragments located on the ground. A program for the partial reconstruction, strengthening and territorial improvement has been prepared: it envisages the protection and exhibition of 1500 fragments.

In recent years, the number of multi-stage accidents has increased, in which one natural disaster leads to another, resulting in fatal consequences in the social, economic, urban and environmental fields as well as in the sphere of cultural heritage. Many regions of the country are characterized by a simultaneous exposure to environmental risk factors that often mutually strengthen each other. In some districts (such as Ijevan, Noyemberyan) of Shirak Marz, the earthquake of 1988 has increased land slide processes.

Soil creep is very typical for Dilijan, or rather its separate areas; it damages national architectural monuments as well as capital buildings. Soil creep has caused damage also to the Abbey of Jukhtak-Vank, located not far from this city in the Bldan-Chay Valley, resulting in cracks in the main church. For this reason, the whole volume of the church was encased in a metal structure, and with the efforts of geologists the land slide process was halted. Soil creep occurred also under the northern part of Makaravank Abbey. To stop the soil creep process here, the soil was fixed with concrete poles and plants at the bottom of the land slide area. Soil movements have been aggravated by extensive irrigation and related works.

In the 1980s and 1990s, Armenia was characterized by climate fluctuations beyond the limits of normal variation: there were in turn sudden temperature increases in winter, temperature decreases and snowfalls in spring, long-duration strong winds and other climatic anomalies, causing major damage to cultural and historical monuments.

Strong winds; eroded wind-blown soils; and the transfer of bacteria, microfauna, fungi and other organisms that accumulate on the walls and rooves of buildings, especially in holes in stone walls and in seam connections, and can then expand and spread: all these create damage, separating stones from mortar and bringing monuments closer to their destruction. This is a problem also for mosses, grasses and bushes, in particular in cracks and corners, where it is easy for dust to accumulate and act as humus. The numerous headstones, *khachkars*, of notable

medieval sculptural and architectural value, are also affected. Fungi and mosses accumulate on khachkars and spread on their surface, sometimes close to valuable writings, bas-reliefs and ornaments.

An extremely dangerous problem arises when the roots of nearby trees intrude into the foundations of monuments or their walls, sometimes spawning trunks and roots inside. These problems are seen especially in monuments located in the dense forests of Armenia, in the Lori, Tavush and Syunik Marzes. It is necessary to separate carefully tree trunks and roots from the walls, then restore the damage and block possible further intrusion of tree roots and other plants.

It is obvious that the mechanical removal and chemical treatment of plants covering monuments will be effective only if this work is undertaken parallel to regular surveys to understand the process of humus accumulation. Also dangerous are organic materials such as excrement droppings, which are bad from aesthetic, chemical (the acid mixture damages the stone) and hygiene points of view.

Significant damage to monuments also arises from broad-scale formation of wetlands and soil salinity processes.

Changes and damages to many monuments have arisen from mineral build-up (white accumulations, which most likely are the result of water leakage), and soil accumulation, with crystallization taking place on the stone surface, and on the closed soil crystals.

In addition to a number of negative anthropogenic impacts on cultural monuments, there are the geological disturbances affecting the Tolors village in Syunik Marz, near reservoirs, and the 5th century church near Pogos-Petros, located on the Aparan Reservoir.

A large number of Armenian monuments are located in city environments. Their conditions to a great extent are affected by anthropogenic impacts, first of all pollution. Air pollution leads to the formation of chemically aggressive conditions that damage natural building materials. (Examples include cement plants in the cities of Ararat and Razdan and copper smelters in Kapan and Alaverdi).

Yerevan's problem have become catastrophic due to the fact that construction projects and plans are undertaken without the determination of protected zones and the dislocation of architectural monuments: stage-by-stage projects for city reconstruction were elaborated without consideration of historical and cultural factors in planning; these not only were not oriented towards the preservation of historical districts of the city, but in fact did not foresee them at all. The current, uncontrolled situation is connected with rising risk factors in the historic zone of Yerevan. Among most problematic situations are visual impacts on the landscape created by unregulated construction within the protected zones of monuments (the Opera House, memorials for Avetik Isahakyan, Mikayel Nalbandyan, Vardan Mamikonyan, etc). It is necessary to separate and isolate monuments from built-up areas, with the help of urban planning decisions and methods, and reduce intrusions and interference in the protected zones of monuments, as these disturb the integrity of monument complexes and the surrounding landscape.

Urban foundations for the preservation and reconstruction of historical environments should be the corner stone for the system for the preservation of the country's architectural heritage, since architectural monuments are an inalienable part of their ensemble or complex. The most important elements that national heritage adds to modern life include the uniqueness and beauty of cities, their historical centers and architectural ensembles, planning structure and green areas.

Recommendations for necessary measures:

1. Analyze the possibility of implementing measures to improve the environment and preserve and restore Armenian historical and cultural monuments.
2. Offices responsible for urban areas, for environmental protection and for historical and cultural monuments protection should elaborate basic environmental and urban plans, identifying environmentally unfavorable territories and creating programs of environmental activities.
3. In the elaboration of general plans, detailed plans and projects, it is necessary to consider their possible negative impacts and separate these from the protected zones of cultural and historic monuments (historic, administrative, and natural boundaries), regulating built-up zones and protecting natural landscape zones.
4. Near zones for protected historic and cultural monuments, projects reviews should be the basis for detailed planning and construction of territorial districts and other settlements. Construction and other works, as well as economic activities within such zones, should be implemented only with the permission of the authorized state body.
5. It is necessary to investigate existing geological and related conditions surrounding monuments, in particular those, such as environment pollution, causing damages.

Since the Spitak earthquake in 1988, 15 years have passed and new earthquakes have occurred, but their impact on monuments has not yet been studied. The resolution of this problem will provide an opportunity to obtain information about the present condition of monuments. It is necessary to undertake new research to understand the conditions of monuments, as in the current process of land privatization in Armenia, as instances have occurred in which architectural monuments have been destroyed.

Part IV

Hot Spots

Chapter 1 Yerevan

After the collapse of the USSR, economic indicators in Armenia fell, gross domestic product declined, social problems increased, and living standards of the population went down. This process had twofold impact on environment. On the one hand, due to general economic decline, the total negative impact of economic activity was reduced (from industry, power generation, agriculture and transport). On the other hand, in some regions of the Republic, a number of environmental protection problems arose related to air and water pollution, land resources degradation and soil erosion, desertification, deforestation and the existence of pollution "hot spots".

In Yerevan and especially in its center, in recent years the urban building process has raised serious anxiety. Today, anxiety turns into indignation among experts as well as wide sections of the public.

The issue is about neglect and violation of the legislation that regulates urban planning. It is a question of violations of the General Plan of Yerevan occurring without public discussion, illegal allocation of land, neglect of existing projects for completion and area reclamation, infringement of copyright, illegal construction of unapproved and even rejected projects, etc.

Incorrect use of topographic relief, inappropriate construction in green areas, violation of the long-term plan for tree planting in the capital, approved in 1974, and infringement of the landscape planning project for Yerevan territory have turned the capital into dusty, dark, choking city. What occurs in the areas around the Opera and Ballet Theatre, Swan Lake, Circular Boulevard, ravine of the Hrazdan River, and Victory Park has no relation either to professionalism or to ordered processes. Today more than 50% of green areas is built-up.

As designed by urban planners, the Circular Boulevard was intended to ameliorate the climate of the capital and protect it from dry winds by means of verdure and water surfaces. Once covered in green, this boulevard has now been turned into an area of chaotic construction. Formerly there were marvelous and rare trees – coma, liana, plane – that blocked dust and dirt in the air. With the assent of city authorities, businesspersons put in around their new concrete facilities incorrect types of plants, instead of those necessary in this district. The same problems are seen around the Opera and Ballet Theatre. Where there were trees, now cafés have been built, and instead of places to walk there are parking lots. Of great cultural value, the Opera and Ballet Theatre is now lost amid numerous cafés and bars; the visual field of view of the monument is lost.

As a result, the environmental situation has drastically declined. The concentration of hazardous substances in the air in the center of the city exceeds pollution standards; by evening a cloud of smoke wraps around the city.

Unfortunately, today Yerevan's appearance has started to change. Numerous cafés and restaurants have been built instead of trees and bushes, often clashing with the surrounding planned environment. The most important concept of the city's plan – viewpoints of the natural environment – has been lost. These points, identified in the Tamanyan General Plan of modern Yerevan, have disappeared.

Aesthetics consistent with the environment are also an important indicator of the quality of human settlement and of a developed cultural landscape.

Oppressive city construction with faceless buildings, kiosks, and stalls psychologically traumatizes individuals, making them indifferent to their surroundings. Aesthetic "pollution" of cities might seem not as destructive as chemical pollution, which has a material basis. However, downcast residential areas, lacking in humanistic substance, insufficient greenery and poor planning of city territories create a distressing effect, with negative impacts on the mood, health, and work of citizens.

Today in Yerevan, not only the look of the city is changing; unregulated construction and related activities are violating visual landscapes and protected areas for monuments, architecture, and archeology.

For example, the unique archeological monument on the hill of Karmir Blour, where in 1936 the ruins of Tayshebainy Stronghold were discovered, allows visitors to imagine the rich culture of ancient State of Van, of the 7th and 8th centuries BC. The border of Charbagh Cemetery immediately adjacent to Karmir Blour violates this protected area. In 1999, in the territory of the monument's museum, more than 30 people were buried; in 2000, 45; in 2001, 24; and in 2002, 26. The monument is under the threat as city cemetery practically occupies its territory.

Financed by the Lince Fund Program, road construction will start in the near future to connect Charbagh with the South-East District of the city. The Agency of Historical and Cultural Monument Protection of the RA has permitted construction of the road under the condition that illegal burial stops and existing graves are removed from the monument's territory.

Conclusions and Recommendations.

A high percentage of the territory of Yerevan has unfavorable pollution levels. For this reason, in *residential zones* it is necessary to:

- prohibit the construction of projects for new residential construction without information indicating a decrease in environmental pollution levels;
- ensure development and application of special building and green planting techniques that enhance the environment (fountains and water bodies, aeration corridors, special types, mixtures and planning methods for yards and mall green areas).

For *construction on public territory*:

- prohibit the construction of large new commercial facilities (supermarkets, shopping centers, show-rooms and fair-rooms, big institutions of cultural-domestic service etc.);
- reduce the pressure of existing large commercial facilities on open spaces (markets, goods fairs, sport complexes);
- equip existing large facilities with ventilation systems to clean the air;
- Apply technological and planning methods that reduce the negative impacts of environmental pollution on the population (noise-gas-dust protective walls, "green" pedestrian corridors, planning with ventilation etc.).

For *green zones*:

- For reconstruction and new development of green areas, use materials with enhanced pollution reduction functions (for noise, gas and dust) and ensure the consideration of health aspects in planning, with a view towards improving environment quality.

Chapter 2 Lake Sevan

General overview of the problem

Lake Sevan is in the central part of the Republic of Armenia, at an altitude of 1900m above sea level. The total surface area of its catchment basin is about 5000 km^2, the lake surface itself is 1200 km^2, and the volume is 35.8 billion cubic meters. The lake is fed by 28 rivers in its catchment area, and only one, the Hrazdan River, flows out of the lake.

Lake Sevan is the only large water body of Armenia and has an important role in the water balance of the whole South Caucasus as well as the northern regions of Iran and Turkey. It is the main strategic supply source of drinking water for Armenia and neighboring countries.

The use of lake waters for irrigation started in 19th century, and from the beginning of 20th century its waters were also used for energy production, to address the country's energy deficit. Drawdown of the water level in the lake began in the 1930s.

The original scheme at this time planned to direct lake waters through the Hrazdan River to the Ararat Valley, to irrigate 100 000 ha of land. Over 50-60 years, the water level in the lake was expected to fall up to 50 meters, corresponding to 93% of its volume (54.55 cubic meters), and completely draining the Big Sevan. If this plan had been followed, the water level would have fallen by 6 times.

Based on this scheme, facilities to use Lake Sevan's water were built, including an irrigation system for 80 000 ha; the Sevan-Hrazdan hydroelectric power station, with total power of 556 000 kilowatt, was finished in 1962 with the completion of last step of a series of hydroelectric power stations for Yerevan.

The Lake's water level started falling in 1933, when the drainage of its waters for economic use exceeded the natural yearly inflow. More intensive use began in 1949. In 1953, 1.75 billion cubic meters were taken.

Before the water level of Sevan started falling, the lake was an oligotrophic reservoir with a slow release of its waters, with a complete renewal every 44.3 years, high water clarity (average of 13-14 meters) and high oxygen levels during the year.

As a result of this brutal use of water, the level of the lake has fallen by 19.6 meters, its volume of water from 58.5 billion cubic meters to 33.0 billion cubic meters, and its area from 1416.2 km^2 to 1238.1 km^2. During the years of most intensive water use (1949-1962), the water level fell 13 meters (1m per year).

From an environmental point of view, this quick reduction in water level played a key role in the destabilization of the lake's ecological indicators, which led to the following negative consequences: reduction in water temperature stratification, reducing the hypolimnion volume up to 50% in the Small Sevan (from 13 km^2 up to 6 km^2) and its complete disappearing in the Big Sevan.

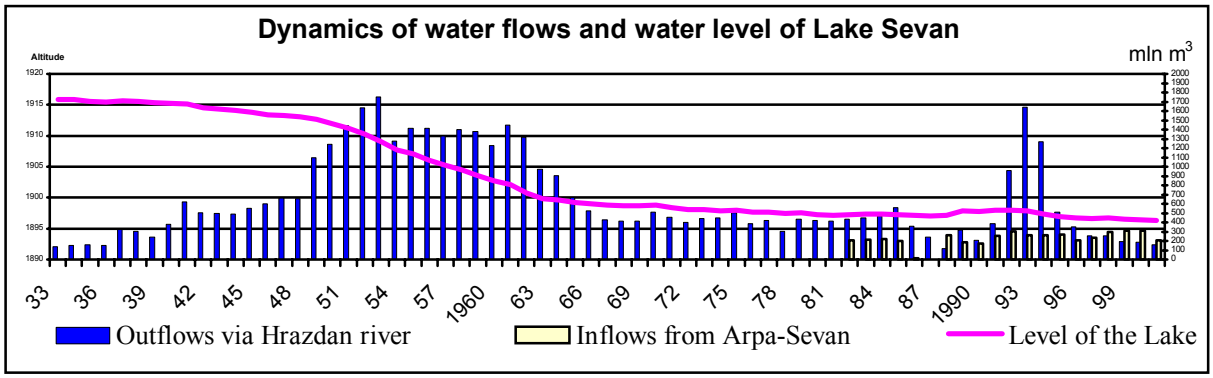


Figure 4.2.1
Source of Information: Ministry of Nature Protection;

The reduction in the hypolimnion raised the average temperature of the lake by up to two degrees, increasing the longevity and intensity of horizontal and vertical flows. As a consequence, concentrations of suspended and dissolved organic substances increased several times in the upper and middle water layers of the lake; during their oxidation, the concentration of dissolved oxygen in the lake falls from 8.0 to 3.0 mg O^2/l. Concentrations of minerals and general nitrogen in the lake increased up to 30 times (from 0.01 till 0.32 g/m^3), and the concentration of phosphorus decreased 20 times (from 0.32 to 0.017 g/m^3). This led to the intense assimilation of oxygen and phosphorus by macroalgae, which promoted to the height increase. Water clarity, which plays crucial role in physical-chemical and biological processes, decreased by four times (from 13 to 3 m).

Major changes in biodiversity occurred in the biota of the lake's ecotones, where many species of aquatic and terrestrial flora and fauna lived, supporting the trophic level of the littoral zone of the lake.

Because the lake has a rocky bed, spawning Sevan trout disappeared in the aquatic part of the ecotone: this is one of the main reasons for the irreversibility of the loss of generative lake species.

In the period from 1993 till 1995, a mass death of whitefish was observed, due mainly to the reduction of their food base within the framework of the general ecological situation in the Sevan ecosystems.

In the shore part of the ecotone of the lake, as consequence of the drying of more than 1000 ha of wetland areas, out of the 167 species of endemic and migrating birds once present 18 are now found. The number of mammal species has fallen sharply.

At present, there is an intensive process of desertification.

The reintroduction of lost elements is a very important precondition for the ecological restoration of the lake. Even if the water level achieves some stability, the increasing inflow of organic elements sooner or later will result in the super saturation of organic substances of the lake. At the present stage, the lake is in a mesotronic condition, close to eutrophication. The main consequence of this process, which began in the 1970s, is the reduction in dissolved oxygen at the near-bottom layer of the lake: and in 1975, oxygen starvation was observed, accompanied by the appearance of methane and hydrogen sulphide.

As a result, very deep, in some cases even irreversible changes took place: for example, a sharp reduction in the biomass of large water plants (macrophytes). Because of aforementioned changes in the lake, deep abnormalities of ecosystem took place, and in the middle of 1970s the lake began to blossom with macroalgae. This started the eutrophication of the Sevan.

Studying the mechanism of eutrophication has shown that to slow this process, it is necessary to use ecosystem regulation for both the lake and its catchment basin, by which the inflow of biogenic substances into the lake will be reduced.

It has been shown that for the de-eutrophication of the lake, it is necessary to:

- increase the level of the lake by 6 meters, to the level that will bring the reappearance of the hypolimnion;
- review and from the ecological point of view regulate all socio-economic activity on the territory of the lake's catchment basin, because pollution in drainage waters is also a serious problem;

Activities to manage Lake Sevan issues

To increase the water level of the lake, it is necessary to increase water inflows, using flows from neighboring water basins, and to reduce outflows of water. For this purpose, in 1962 major construction was started for infrastructure to transfer part of the Arpa River flow to the lake. It was planned to transfer about 250 million of cubic meters of water per year to the lake. The Arpa-Sevan Tunnel was inaugurated in 1981.

To change the output of the Sevan-Hrazdan system, a new hydroelectric power station was built. For irrigation, part of the water coming from the lake was exchanged with waters from the Ararat Valley. These measures allowed, beginning in 1965, a significant reduction of lake water outflows, bringing outflows of water down to 500 million cubic meters per year, of which 380 million cubic meters were used for irrigation and 120 million cubic meters for energy production. Energy use stopped in 1978. After these measures, the lake level increased to 0.9 meters from 1981-1990.

From 1991 to 2000, as the result of use of water during the energy crisis, the level of the lake again decreased by 1.5 meters.

To increase water inflows to the lake, after the completion of the Arpa-Sevan Tunnel, construction of the Vorotan-Arpa Tunnel began. This should supplement the lake with 165 million cubic meters of water per year. Construction of the Vorotan-Arpa Tunnel is planned to finish in 2003.

According to the yearly water balance of the lake, because of the above-mentioned transfers, and without other changes in the balance water, the lake's level should increase up to 12 cm per year.

To improve Lake Sevan's conditions, from 1996 to 1998, with the financial help of World Bank, the ***Program of Reconstruction of the Ecological Balance of Lake Sevan*** was prepared. This included improvements in legislation and management to increase the lake's water level, reduce pollution in the drainage basin, improve industrial and other waste management, reduce of non-point source pollution, protect the reproduction of fish supplies and provide biodiversity protection.

Considering the importance of Sevan for the Republic, in 2001 the National Parliament of the Republic of Armenia adopted the Law on Lake Sevan. Based on this law, Lake Sevan is now considered an environmental, economic, social, scientific, historical-cultural, esthetic, health, climatic, recreational and cultural entity that has strategic significance as a source of drinking water. Each year, complex programs of measures with regard to the ecosystem, reconstruction, protection, reproduction and use of Lake Sevan are to be elaborated and adopted.

In 2002, outflows from the Sevan were only 98.3 million cubic meters of water. Since the 1930s, massive outflows from Lake Sevan began, there hasn't been such a low removal of water. Comparison with 2001, Lake Sevan's water level increased 44-45cm.

Anticipated results.

A 6-meter increase in the level of the Lake would mean an additional 9 billion cubic meters of water in the Lake, deemed a strategic natural resource for energy and other branches of the economy.

Gradually, the exogenous pollution of the Lake will diminish, and favorable conditions will be created for the Lake to purify itself and for biological features to be restored.

An integrated and controllable system of water use management will be developed as a result of improving the water supply and sewage networks in the settlements in the catchment basin of the Lake and implementing outflow and inflow measures.

Efficient mechanisms will be established for basin biological diversity preservation and sustainable use, to ensure the normal development of the ecosystem and its components.

A realistic opportunity will emerge to introduce a consolidated system for the recreation sector in the Lake and in its catchment basin: an income generating, labor intensive and environmentally friendly sector for the region.

Part V

Environmental policy Measures and State Regulation of Natural Resource Use and Environmental Protection

Chapter 1 Management System Legislative Basis

Legislation and Institutional Framework

Following the World Summit on Environment and Development that took place in Rio de Janeiro in 1992, at which a number of multilateral environmental agreements were adopted and signed, the Republic of Armenia has signed and ratified 13 environmental conventions and six associated protocols.

The authorized state agency for the aforementioned conventions is the Ministry of Nature Protection of the Republic of Armenia.

Since independence was proclaimed, the Republic of Armenia has adopted a number of laws in the sphere of nature protection, as these were dictated by the new political and economic realities. Many of them are directed at the implementation of obligations under conventions signed. The basis of environmental legislation was formulated after the Summit in Rio.

Article 10 of the Constitution of the Republic of Armenia guarantees protection of the environment by the state, as well as the rational use and renewal of natural resources.

Currently, four codes and 17 laws on the environment and related sectors are in force in the Republic of Armenia. They are:

Table 5.1.1 **Environmental Legislation in Armenia**

#	**Name of Law**	**Date Adopted**
1	Principles of Legislation on Nature Protection of RoA	1991
2	RoA Law on Specially Protected Areas	1991
3	RoA Land Code (a prior code was adopted in 1991)	2001
4	RoA Water Code (a prior code was adopted in 1992)	2002
5	RoA Code on Underground Resources (a prior code was adopted in 1992)	2002
6	RoA Forest Code	1994
7	RoA Law on Atmospheric Air Protection	1994
8	RoA Law on Environmental Impact Assessment	1995
9	RoA Law on Environmental and Nature Use Charges	1998
10	RoA Law on Rates of Environmental Charges	2000
11	RoA Law on the Purposeful Use of Environmental Charges Paid by Companies	2001
12	RoA Law on Flora	1999
13	RoA Law on Fauna	2000
14	RoA Law on Hydro-meteorological Activity	2001
15	RoA Law on Lake Sevan	2001
16	RoA Law on Complex Program for the Lake Sevan Ecosystem Restoration, Conservation, Reproduction and Use	2001
17	RoA Law on the Annual Program for the Lake Sevan Ecosystem Restoration, Conservation, Reproduction and Use	2001
18	RoA Law on Environmental Education	2001
19	RoA Law on Seismic Protection	2002
20	RoA Law on Concession of Subsoil for Surveying and Mining for the Purpose of Exploiting Useful Ores	2002
21	RoA Law on Amending the Code on Administrative Violations	2002

The environmental sector is also regulated by the Civil, Administrative and Criminal Codes of Armenia and the Law on Inspections in Organizations in the Republic of Armenia and the Law on Licensing as well as other laws.

It is noteworthy that prior to the end of 2002, the administrative sanctions and procedures relating to environmental violations were those set in the Administrative Code of Armenia, adopted in the Soviet period, with some amendments made during 1991-1996; in fact, the negligible sanctions provided under this Code left much room for environmental violations and encroachments.

The Republic of Armenia Law on Amending the Code on Administrative Violations, adopted in 2002, set liability provisions in line with environmental laws adopted in the country over the last 12 years. These sanctions were established as 50 to 200 times the minimum salary and this amount is now the equivalent of US $100-300. The basis for determining the sanctions are environmental impact assessment criteria for each violation, taking into account social factors as well.

In the framework of the laws listed in Table 5.1.1, more than 500 subordinate legislative acts have been adopted, providing the implementation of these laws and more than 150 other acts yet to be adopted.

According to the Republic of Armenia Law on Public Administrative Establishments adopted in 2002, public administration bodies (bodies of executive authority), including ministries, public agencies, and territorial administration bodies (regional governor's offices and the city Hall of Yerevan), were reorganized into public administrative establishments, the founder of which is the Republic of Armenia acting through and represented by the Government of the Republic of Armenia.

In the framework of governance system reform, agencies and inspectorates were created as detached units of the Ministry of Nature Protection with administrative and servicing functions. The aim of this measure is to ensure that the commitments of the Republic of Armenia under environmental international treaties are fulfilled.

The functions laid down in the by-laws of the Ministry of Nature Protection are carried out by means of structural and detached units of the Ministry and public non-commercial organizations and companies under the jurisdiction of the Ministry.

In the framework of restructuring in the sector, significant changes were made to the status of specially protected areas, including the public entities responsible for their management. The Government of RoA adopted decrees in this respect, approving the by-laws of executive bodies carrying out management.

In the framework of government structural reform, the RoA Law on Civil Service was adopted, defining the status of employees of public administration bodies, including those of structural and detached units implementing environmental management, as civil servants. This status guarantees security and will be conducive to a reduction in the drain of human resources and will provide an improvement in competence.

Today, the institutional capacity built as a result of structural reforms in the environmental sector needs to be reinforced, and the support of relevant international organizations is expected for this purpose.

Although various legal acts regulating the environmental sector have been adopted over the last 12 years, many of them, as a consequence of rapid changes in the legal and economic realities in the country, have become outdated, and contradictions and deficiencies have emerged therein.

Today, there is an urgent need to improve the legislative foundation for the environmental sector, with a specific focus on standards and rules necessary for efficient use of natural resources, including realistic justifications for establishing restrictions.

In order to address relevant environmental concerns, and within the framework of pertinent international conventions, the implementation of commitments made by the Republic of Armenia should be undertaken only by adopting scientifically justified, appropriate laws and

standards, creating relevant infrastructure and necessary governance tools for the sector and a sound system, with the objective of harmonizing the RoA legislation with that of the European Union.

Chapter 2 Enforcement Measures

The State Environmental Inspectorate is within the structure of Ministry of Nature Protection of Armenia. Figure 5.2.1 shows the number of violations discovered by the State Inspectorate.

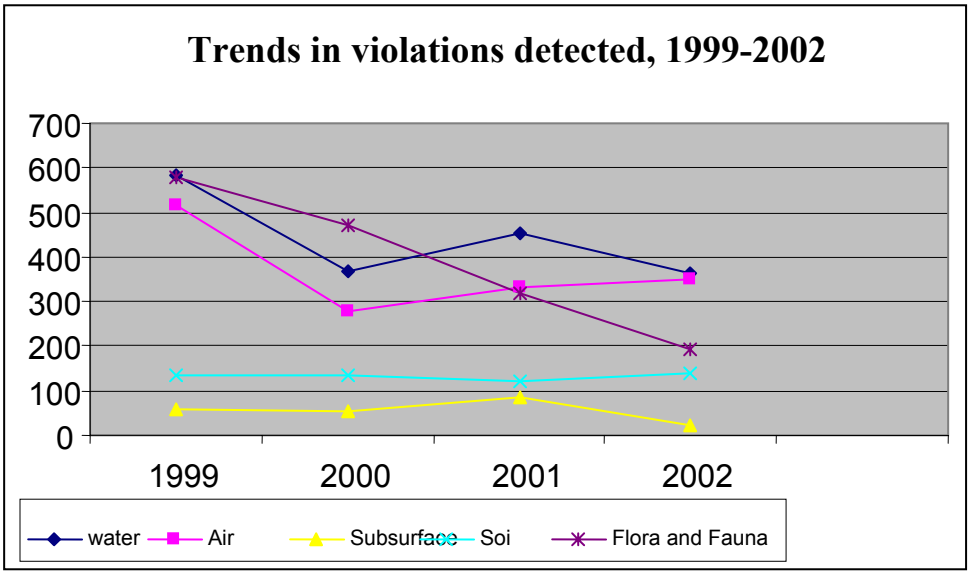


Figure 5.2.1
Source: State Environmental Inspectorate of the Nature Protection Ministry of RA (Yerevan Department)

In 2002, 38% of detected violations were halted. The reduction in the number of facilities inspected is due to restrictions in the Law on Inspection Operations in Armenia. The most common violations are in the sphere of water resources protection (34%) and air protection (33%). For violation of nature protection legislation, 948 enterprise officials were brought to account, i.e. violations are detected in every other facility examined. Fines of 3.37 million drams were imposed for violations detected.

In recent years, high emphasis has been placed on the control of enterprises documentation on environmental protection. Instructions on their compulsory safekeeping are given.

Out of 30 biological treatment facilities for sewage built in Armenia, the majority (23) does not function or functions at a level below projected capacity, performing mostly mechanical treatment. Inspectorate enforcement activities and measures taken do not lead to the results desired because large financial investments are needed for restoration of normal operations.

The Analytical Laboratory of the State Inspectorate in 2002 conducted 5542 controlling analyses, most on sewage (5388).

As a result of the examinations of State Inspectorate, the operations of 28 enterprises and offices were suspended.

The State Inspectorate cooperates with environmental citizens' organizations. In 2002 the Inspectorate responded to 81 public requests, conducting additional control examinations.

Chapter 3 Ecological Expertise

In the 1980s, within the structure of the Ministry of Nature Protection, the Division for the Management of Ecological Expertise was set up; in 1988, this was reorganized into the "State Ecological Expertise" (SEE) and now is a State Non-Profit Organization (SNPO). At first, the ecological expertise was conducted in accordance with the procedures in force in the USSR, under which the construction of facilities was not funded without a positive ecological expertise conclusion. Since November 1995, expertise assessments have been conducted according to the Law of Environment Impact Expertise, approved by the National Assembly of Republic of Armenia. From the introduction of this law through the end of 2002, a total 727 documents for proposed activities and facilities have been subject to expertise procedures.

Table 5.3.1 **Trends in Ecological Expertise Conducted**

	Total, 1996-2002	Years						
		1996	1997	1998	1999	2000	2001	2002
Number of Expertise conducted	727	28	27	90	169	119	151	143

Source: National Statistics Agency of RA;

Most of these documents related to mining operations, filling stations, and recreational facilities and services. It is interesting that only seven facilities received negative conclusions. The reason for this small quantity is explained by the fact that a significant share of facilities (350) were returned for revision without a negative conclusion, and after revision they received positive conclusion.

Favorable elements of the Law of Environmental Impact Expertise include: 1) some provisions of the law are harmonized with the International Convention on Environmental Impact Assessment in a Transboundary Context; 2) subject to expertise are facilities undergoing construction, reconstruction, and re-equipment, etc., as well as strategic documents (conceptions, general plans, schemes, etc.); 3) for planned activities public hearings are foreseen in three stages (activity notification, project materials discussion, project conclusions discussion). For strategic documents, only the first stage of public hearings is foreseen.

However, the law has a number of shortcomings – insufficient support by regulatory acts, incompleteness and imperfection of its articles, neglect of local features, non-coordination with other laws and so on – which in combination with transition period processes of the Republic leads to its inefficiency.

Chapter 4 Economic and Financial Instruments

The types of charges for environmental protection and natural resources use (the revenues from both are included in the State Budget), as well as size of these charges, are regulated by the Law of the Republic of Armenia on Environmental and Natural Resource Use Charges, as well as other laws and regulations for the implementation of this law. This law and related laws and regulations have established economic mechanisms for environmental protection, creating equal conditions for users, raising necessary financial means for environmental measures, and controling activities that have negative impacts on the environment.

The following types of pollution control charges are used:

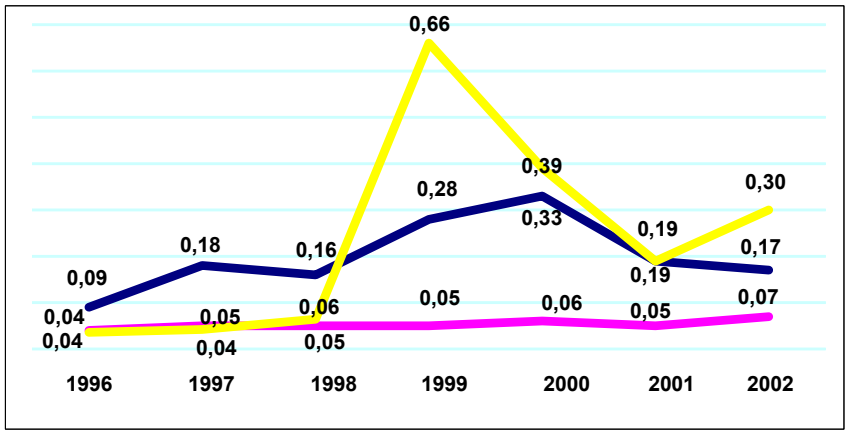
- on hazardous substances emissions in the environment (air and water basins);
- for industrial and other wastes, according to prescribed norms; and
- for environmental damages.

The following types of natural resource charges are compulsory:

- for water usage;
- for underground natural resource extraction; and
- for biological resource use.

Tax legislation in the sphere of natural resource use and environmental protection was reformed in the period 1997-2000, when new tax laws were adopted, based on international criteria. Connected with these developments, there is an ongoing trend to increase the charges for natural resource use and environmental protection, whose revenues are included in the State Budget of the Republic.

Figure 5.5.1 **Environmental Protection and Natural Resource Use Charges, as a share of GDP (in %)**



Total environmental protection expenditures of State Budget, in % of GDP

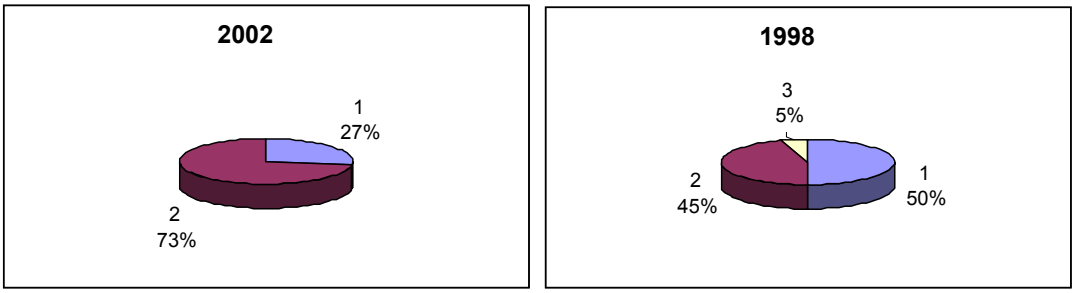
Operational environmental protection expenditures (without capital construction, capital repair and maintainace of hydro technical buildings), in % of GDP

Environmental protection and natural resource use charges, in % of GDP

Source: Ministry of Nature Protection of RoA, From Aarhus to Kiev, Kiev, 2003.

In recent years, the charges for natural resource use and environmental protection have undergone structural changes (see Fig. 5.5.2).

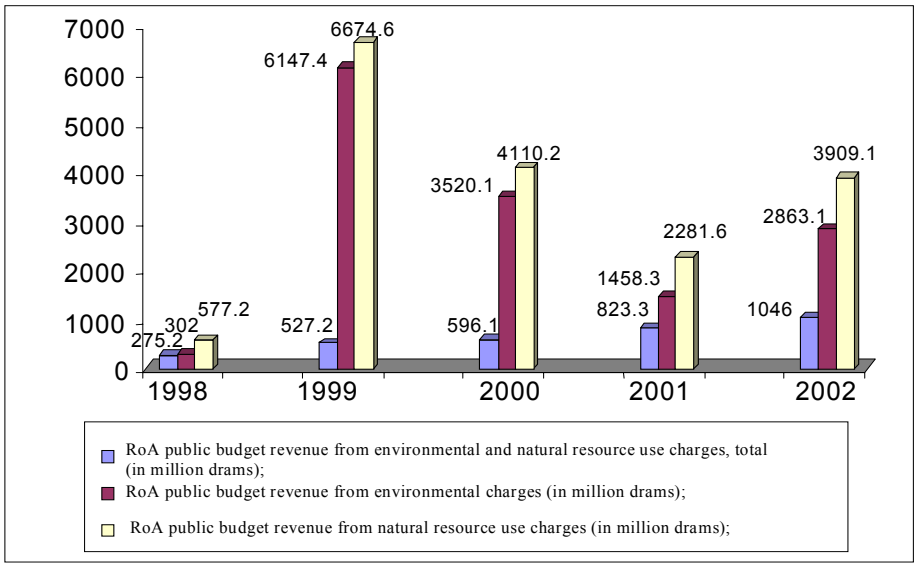
Figure 5.5.2. **Structure of Environmental Protection and Natural Resource Use Charges (in %)**



1. natural resource use charges
2. environmental protection charges
3. other charges

Source: Ministry of Nature Protection of RoA, From Aarhus to Kiev, Kiev, 2003.

Figure 5.5.3 Dynamics of RoA Public Budget Revenues from Environmental and Natural Resource Use Charges, 1998 – 2002 (million AMD)



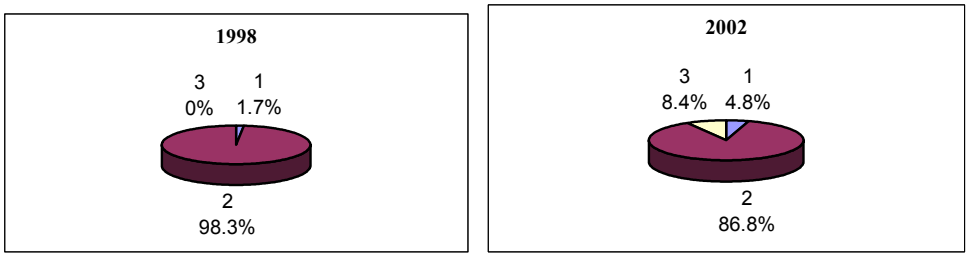
Source: Ministry of Nature Protection of RoA, From Aarhus to Kiev, Kiev, 2003.

In 2002, natural resource use charges were 1.15% of general budget income (Brief Guidance on State Budget in 2002, Ministry of Finance of RoA); environmental protection charges were 9.5 times were higher in comparison to 1998 levels, and natural resource use charges, 3.8 times (see Fig. 5.5.3 and 5.5.4).

REPUBLIC of ARMENIA

Area - 29,743 thousand quadric meters^2
Population - 3,213 million people
Density of population - 108 head per quadric kilometer ^{2}
Urbanization - 66,8%
Consists of administrative-territorial divisions (marzes)

Figure 5.5.4 Structure of Natural Resource Use Charges



1. water use charges
2. underground resources use charges
3. biological resources use charges

Source : Ministerial Report "from Aurhus to Kiev", Kiev, 2003.

***Table 5.5.1* Recent Trends in Natural Resource Use Charge Revenues (in million AMD)**

#	Type of Natural Resource Use Charge	1998	1999	2000	2001	2002
1	Water use	5.2	129.4	93.6	413.2	50.2
2	Underground Resource use	300.0	360.0	390.0	320.0	910.0
3	Bio. resource use	-	42.0	112.3	87.9	87.9
4	Total	305.2	531.4	596.2	821.1	1048.1

Source: Ministerial Report "from Aurhus to Kiev", Kiev, 2003.

There was a significant increase in the volume of underground resource charges in 2002 (Table 5.5.1). This is related to trends in the mining and metal industries, as well as an increase in underground resource use charges. In the sphere of tax legislation, as a result of fines and penalties imposed by the Environmental Inspectorate, increasing control measures and efforts to bring economic actors into the tax field, these actions contributed to an increase of charge revenues for natural resource use in the State Budget.

***Table 5.5.2* Recent Trends in Environmental Protection Charge Revenues (in million AMD)**

#	Type of charge	1998	1999	2000	2001	2002
1	Air Emissions of hazardous substances	1.3	173.8	29.8	44.3	37.0
2	Air emissions of hazardous substances from stationary sources	2.4	10.4	39.9	10.7	82.0
3	Air emissions of hazardous substances from mobile sources	272.1	723.8	777.9	843.2	2175.7
4	Production and consumption waste	0.4	3.3	5.3	4.5	22.3
	Total	276.2	911.3	852.9	902.7	2317.0

Source of Information: Ministerial Report "from Aurhus to Kiev", Kiev, 2003.

Notable is the trend of revenue charge increases for hazardous substances emissions in the air basin from mobile sources, as well as for production and import of goods harmful to the environment (Table 5.5.2). This is related to an increase in charges rates for hazardous substance

emissions in air basins, as well as an increase in the volume of revenues from transport, including international cargo transport through the territory of Republic of Armenia. Overall, as was mentioned, environmental protection and natural resource use charges revenues to the State Budget have been increasing. Unfortunately, there is still a weak regulatory role for economic mechanisms in the sphere of environmental pollution. Fines and penalties used in tax policy do not , do not create incentives for the responsibility of users and do not anticipate increases in hazardous substance quantities into the environment. There are no statistical analyses in the Republic on the basis of which the effectiveness of fines in terms of creating economic incentivies for investing in clean technologies could be estimated, as well as their effect on relations between natural resource users.

Correlations between Budget spending on environmental protection activities and the charges show that there are serious obstacles in the way of environmental problem solving. Charges are not completely earmarked for the financing of environmental protection activities. Parallel to economic growth in the Republic, environmental funds should be created (Republican and local) specifically for this financing. Armenia has adopted a Law on The Purposeful Use of Environmental Charges Paid by Enterprises, and a Law on the Concession of Subsoil for Surveying and Mining for the Purpose of Exploiting Useful Ores. Such laws will promote the effective use of nature resources and increase of natural resource users' responsibility.

Development of financial and economic mechanisms in the environmental protection system of Armenia will be especially effective in influencing the conditions of development of the whole economic system of the Republic. For this purpose, it is necessary to:

- ensure the sustainable use of natural resources, stimulating the introduction in the economy of low and no waste and energy saving technologies and encouraging activities that promote the renewal of natural resources and the strengthening of environmental protection, including the treatment and re-utilization of solid wastes and the use of economic methods of incentivies (subsidies, tax credits, tax and other levies);
- in the sphere of natural resource use and environmental protection, create insurance funds for risk coverage, for damages to the environment;
- increase the effectiveness of legal acts, develop the authorization and activities of environmental protection bodies;
- strengthen the use of fines and other measures for violations of environmental legislation, including the non-use or inappropriate use of new, more effective resources, equipment, technologies and science;
- identify additional taxes for the use of hazardous technologies;
- improve economic methods of natural resource estimation and appropriate rates for natural resource use and environmental protection charges, based on international market criteria;
- identify new privileges for natural resource users; and
- increase the role of local self-regulatory bodies and communities in programs for environmental and natural resource protection.

Ongoing activities are being implemented to develop alternative financing sources, which are the most important factors for economic mechanisms of environmental protection and natural resources management.

Chapter 5 International Cooperation and Environmental Programs

Armenia's international cooperation in the environmental sphere has been shaped by the impulse of the World Summit on Environment and Sustainable Development in Rio, the first and the largest forum on environmental issues at which Armenia participated as a sovereign state. The principles of that forum established a basis for future actions in the sphere of environmental protection and sustainable development. At Rio, Armenia signed its first two international environmental conventions: the Convention on Biological Diversity and the Framework Convention on Climate Change. Later, Armenia joined a number of other environmental conventions. At present, Armenia has signed and ratified 14 conventions and 9 protocols (Table 5.5.1).

In addition to participation in these conventions, Armenia's international environmental cooperation includes: membership and participation in the programs of different international organizations (global and regional), such as the UN structures and the Council of Europe, which provide an opportunity for Armenia to participate effectively in international processes and present its interests; cooperation with international financing entities – GEF and World Bank in particular – to attract external financing; and bilateral cooperation with other countries.

In general, Armenia's international environmental cooperation is determined by national priorities, geographical location, the necessity to solve jointly with other countries common environmental problems (at both regional and global scales), as well as by the domestic economic situation.

Participation in international environmental conventions

Ratified conventions are the part of the legislative framework of the Republic (Article 6 of the Constitution of the Republic of Armenia) and serve as a basis for the development and amendment of national legislation in order to comply with the provisions of international legislation.

Domestic mechanisms have been developed – such as the establishment of interministerial commissions, development and adoption of working plans by the Government of the Republic of Armenia, development of laws and other approaches – to ensure the fulfillment of commitments under international conventions.

It should be mentioned that Armenia receives financial and advisory support from international financial organizations for the process of implementing global environmental conventions, at least at the stage of action plan and program development. In this regard, Armenia cooperates with GEF, UNEP, UNDP, World Bank and other organizations. The situation is less favorable for the implementation of the UNECE's regional environmental conventions: international financial organizations provide less support for national implementation of these regional conventions as compared with global conventions.

Representatives of the Republic of Armenia have participated in large international forums and a number of working groups and commissions as a Party to regional and global conventions.

Table 5.5.1 **Participation of Armenia in International Environmental Conventions**

	Title of convention, place and date of adoption	Signed	Ratified/Acceded
1	Convention on Wetlands (Ramsar, 1971)	USSR	Armenia joined after making the request to the Ramsar Convention Secretariat
2	Convention on Biological Diversity (Rio de Janeiro, 1992)	1992	14.05.1993
3	Framework Convention on Climate Change (New-York, 1992)	1992	14.05.1993
	• Kyoto Protocol (Kyoto, 1997)		23.12.2001
4	Convention on Long-Range Transboundary Air Pollution (Geneva, 1979)		21.02.1997
	• Protocol on Persistent Organic Pollutants • Protocol on Heavy Metals • Protocol on the Reduction of Acidification, Eutrophication and Ground Ozone	1998 1998 1998	
5	Convention on Environmental Impact Assessment in Transboundary Context (Espoo, 1991)		21.02.1997
	• Protocol on Strategic Environmental Assessment (Kiev, 2003)	2003	
6	Convention on Transboundary Impact of Industrial Accidents (Helsinki, 1992)		21.02.1997
	• Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters (Kiev, 2003)	2003	
7	Convention to Combat Desertification (Paris, 1994)	1994	02.07.1997
8	Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal (Basel, 1989)		26.03.1999
9	Convention on the Protection of the Ozone Layer (Vienna, 1985)		28.04.1999
	• Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal, 1987) • London Amendment • Copenhagen Amendment		28.04.1999 22.10.2003 22.10.2003
10	Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus, 1998)	1998	14.05.2001
	• Protocol on Pollutant Release and Transfer Registers (Kiev, 2003)	2003	
11	Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (Geneva, 1997)		15.05.2002
12	Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemical and Pesticides in International Trade (Rotterdam, 1998)	1998	22.10.2003
13	Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992)		
	• Protocol on Water and Health (London)	1999	
14	Stockholm Convention on Persistent Organic Pollutants (Stockholm, 2001)	2001	22.10.2003
15	Convention on Protection of World Cultural and Natural Heritage (Paris, 1972)		1993

Source: Department of International Relations of the Ministry of Nature Protection of the Republic of Armenia

Brief information on activities implemented in the framework of several global and regional conventions is presented below.

Global conventions

Activities implemented under the UN Framework Convention on Climate Change and the Kyoto Protocol, as well as the Vienna Convention on the Protection of the Ozone Layer and Montreal Protocol on Substances that Deplete the Ozone Layer are described in Part I, Chapter 2: Climate Change and Ozone Layer.

UN Convention on Biological Diversity

The following reports have been prepared: Biodiversity Strategy and Action Plan, Submission of the First National Report on Biodiversity to the Convention Secretariat (financed by GEF), Biodiversity Priorities Assessment and Establishment of CHM structures.

Implementation of the Program for the Development of a National Framework on Biosafety in Armenia has been started with GEF support.

Armenia also participates in the development of documents in the framework of the Pan-European Biological and Landscape Diversity Strategy.

UN Convention to Combat Desertification

Starting in 1999, the National Action Program to Combat Desertification in Armenia was developed with the support of UNEP, the UNCCD Secretariat and the Yerevan office of UNDP.

The National Action Program envisages the implementation of an integrated policy in the sphere of environmental protection and natural resource use to improve the national management system aimed at the coordination of activities of agencies dealing with environmental problems.

However, the process of desertification in Armenia is continuing. A number of technical programs of local significance have been developed to prevent desertification. They are linked to the reconstruction and use of irrigation systems, prevention of erosion and mudflows, engineering-geographical studies of landslides, and other processes.

Ramsar Convention on Wetlands

An inventory of Ramsar sites in Armenia has been carried out with the financial support of the Ramsar Convention's Small Grants.

Basel Convention

Following the requirements of the Convention, the registration and control of wastes produced, imported and exported as well as of enterprises at risk of potential industrial accidents are carried out in the Republic.

The draft Law on Wastes has been developed to establish a legal basis for waste handling.

UNECE Conventions

Aarhus Convention

Armenia was the sixteenth country that ratified the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters.

The Convention on Long-Range Transboundary Air Pollution

In the framework of this Convention, Armenia participated in the development of three protocols: the Protocol on Heavy Metals (1998, Aarhus), the Protocol on Persistent Organic Pollutants (1998, Aarhus) and the Protocol on the Reduction of Acidification, Eutrophication and Ground Ozone (1999, Göteborg). These protocols were all signed by Armenia.

Under these protocols, Armenia should prohibit the use, production and import of certain persistent organic pollutants and heavy metals. Armenia has notified the Convention Secretariat that until 2010, it will not exceed its 1990 levels of air emissions of the following compounds: sulfur and nitrogen oxides, ammonia, and volatile organic compounds. At present, the national normative-methodological basis is under development, in order to ratify the Protocols.

Convention on Environmental Impact Assessment in Transboundary Context

The implementation of the Convention refers to specific activities envisaged in the Annex of the Convention. Up to now, there have not been cases requiring the application of the Convention. However, there is a need to develop a proper legislative framework for its implementation.

Regional Cooperation: the UNECE "Environment for Europe" Process

Armenia has actively participated in cooperation within the framework of the "Environment for Europe" Process. Armenia participated in the second, third, fourth and fifth "Environment for Europe" Ministerial Conferences. The national report, Environment for Europe: Dobris Assessment (Dobris+3), was prepared for the fourth Ministerial Conference. Armenia actively participated in the preparation of the fifth Ministerial Conference, at both European and national levels. Armenian experts contributed to the development of three protocols: the Protocol on Pollutant Release and Transfer Registers (to the Aarhus Convention), the Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters, and the Protocol on Strategic Environmental Assessment, which were signed by Armenia and other countries during the Kiev Conference in May 2003. An Interministerial Commission, with the participation of government and non-government representatives, was established in Armenia to coordinate the Conference preparatory process. Armenia's Ministerial Report for the Kiev Conference is among the results of the Commission's activities. Representatives from different ministries, non-governmental organizations and the scientific community participated in the preparation of the report.

Within the framework of the UNECE program on the development of national environmental performance reports (EPR), a Review on Armenia was prepared by the UNECE experts. It was approved by the UNECE in 2000.

Preparatory work for the Fourth European Conference of the Ministers of Environment and Public Health (held in Budapest in 2003) was also carried out. This process is a joint initiative of the WHO European Regional Bureau and UNECE.

In the framework of the European Union's Initiative on Water Resources, discussed at the World Summit on Sustainable Development in Johannesburg, August 2002, Armenia has participated in the component for the NIS, developed under the oversight of Denmark. This component is aimed at partner activities between the NIS and EU to implement parts of the Strategy.

It should be mentioned that Armenia receives international support envisaged by Rio decisions. Numerous projects and programs have been developed in the country in cooperation with GEF and other international financial organizations and donor agencies. However, international organizations and developed countries mostly provide technical support rather than technology or financial resources for the implementation of projects developed. Such an approach does not match the specific needs of the country. As a result, more and more new project and program proposals are developed, that, however, are not implemented.

Nevertheless, several programs (see Table 5.5.2) have been and continue to be implemented in Armenia with support of international financial organizations, as well as in the framework of developed countries' aid programs.

Sub-Regional Cooperation (Caucasus region, CIS, Black Sea Economic Cooperation)

Sub-regional cooperation includes both participation in common programs and bilateral and multilateral agreements on specific environmental issues or the overall environmental field.

Since the establishment of the Regional Environmental Center for the Caucasus in 2000, Armenia has been actively participating in its activities. A National Coordination Point of the REC Caucasus has been established in Armenia.

Since 1992, Armenia has been a member of the Black Sea Economic Cooperation (BEC). This regional cooperation initiative focuses on the problems of the Black Sea environment; therefore, Armenia's participation is not that effective.

In 1992, Armenia signed the Agreement on Interaction in the Sphere of Environment and Environmental Protection (among CIS countries) and in the following years actively participated in the activities of the CIS Interstate Environmental Council (IEC). Within the framework of this cooperation, numerous agreements have been signed and ratified by Armenia, such as an Agreement on Information Cooperation, cooperation in the sphere of forestry and the forest products industry, cooperation in the sphere of environmental monitoring, and the Agreement on Cooperation in the Sphere of Prevention and Resolution of Emergency Situations of an Environmental and Technology-driven Nature.

There is close cooperation with Georgia, Russian Federation, Brazil, Egypt, Iran, Syria, and Tajikistan, as well as with the Netherlands, Japan, Denmark, Sweden, Great Britain, and Greece, based on bilateral agreements for environmental protection.

Since 1999, environmental problems have been discussed in the framework of Armenian-German intergovernmental cooperation. The Caucasus Initiative of the German Federal Ministry on Economic Cooperation and Development (BMZ) has been important. A regional project on the protection of environment and biodiversity in the Caucasus region – the Establishment of Protected Areas on the Javakhk Plateau – was developed in the framework of the Initiative.

In 2003, implementation of the Project for the Development of Transboundary Cooperation for the Prevention of Emergency Situations in the Basin of the River Kura, was started.

Since 1998, environmental cooperation with Japan has been significantly expanded. In 1999, the Japan International Development Agency (JICA) – within the framework of the ODA (Official Development Aid) program – provided technical support to Armenia, particularly for the re-publication of the Red Data Book and the establishment of a proper database. Participating Armenian institutions were provided equipment as part of this aid. In 2001, it was agreed to develop a general plan on underground resource management in Armenia.

Active cooperation with the Netherlands started in 1997, with the development of the National Action Plan on Environmental Protection for Armenia. In the framework of cooperation with the Netherlands, work on the issue of alternative sources of energy is under development.

Armenia actively cooperates with USAID, particularly in the sphere of water resources management. USAID acknowledged the priority of water resource problems for Armenia and allocated additional resources to contribute to the solution of these problems.

It should be mentioned that issues of water resource protection and management are included in USAID's five-year strategic plan.

The Program for Support to the Government of Armenia in the Process of Assistance and Stimulation to Supply and Use of Clean Fuels in the Republic has been implemented with the support of the Government of Denmark, in the framework of the Pan-European Strategy to Phase out Leaded Petrol. The program resulted in a Governmental Resolution of the Republic of Armenia to prohibit the use of ethylated (leaded) petrol in the Republic. Equipment to control the quality of imported petrol was provided to Armenia by Denmark.

Table 5.6.2 **Sub-Regional Environmental Programs being Implemented and Planned to be Implemented in Armenia (as of mid 2003)**

N	Title of program	Budget (grant resources)	Terms, duration	Donors/co-implementers
Under implementation				
1	Joint Program on River Management, Monitoring and Water Quality Assessment of Transboundary Rivers - the Basin of the River Kura	4 million Euros (total budget)	14.01.2002-14.01.2004	TACIS
2	Intergovernmental program Environmental Information, Education and Public Awareness in the NIS	2.75 million Euros (for six countries)	from 17.06.2002 for 30 months	TACIS
3	Water Resource Management in the South Caucasus Region	4 million USD	October 2000 - September 2003	USAID/DAI
4	Water Resource Sustainable Management Program	2 million USD	11.2001 - 11.2003	USAID/ARD
5	Development of the Vision of Environment Protection Ecoregional Plan and Development of Proposals on the Program of Nature and Biodiversity in the Caucasus Region (under the Caucasus Initiative)	Investigation expenses - 500 000 Euros	Duration of preparation: 12 months (August 2002 - August 2003)	German Ministry of Economic Cooperation and Development (BMZ)
6	South Caucasus River Monitoring	Armenia (Center on Noosphere Studies, NAS of RA)	3 years	Implemented under the NATO for Peace Program, supported by OSCE
7	Capacity development for the improvement of national inventory of greenhouse gases (Europe and CIS)	2.8 million USD (total budget for 12 states)	3 years	GEF/UNDP
Planned for implementation				
8	Prevention of Transboundary Pollution of the Kura Arax River Basin	696 000 USD (total budget for four countries is 1-1.2 million USD)	20 months	GEF/UNDP Co-financed by the Governments of countries
9	Establishment of Protected Areas in the Javakhk Plateau (in the framework of the Caucasus Initiative for Armenia)	7 million Euros (for 3 countries) of which 2.5 for Armenia	starting November 2003	German Min. of Econ. Cooperation and Development (BMZ), KfW, AHT
10	Program of Environmental Cooperation in the South Caucasus Countries	Approximately 750 000 USD for three countries		UNECE

11	Under the Regional Program on Cultural and Natural Heritage of the South Caucasus: Management of Historical Cities and Establishment of Institutional Capacities	for 3 countries (Armenia, Georgia, Azerbaijan)	2003-2005 two years	Council of Europe, Directorate of Culture and Cultural and Natural Heritage

Source: Department of International Cooperation of the Ministry of Nature Protection of the Republic of Armenia

Since 1998, Armenia has been cooperating with Sweden on the sustainable management of natural resources. In 1998, implementation of the Program on Forest Resource Assessment was started with the financial support of the Swedish International Development Agency (SIDA). In 2000, a new phase of negotiations initiated preparation of the Natural Resource Management and Poverty Reduction Project, as a result of which SIDA expressed its willingness to contribute to the implementation of the Forest Management Component of the project and provided financial resources and technical assistance.

The Ministry of Nature Protection of Armenia acknowledges the experience of the central and eastern European countries in addressing environmental problems during economic transition and emphasizes cooperation with them. Armenia cooperates with Czech Republic in improving areas of environmental legislation, including standards, institutional systems and policy, mitigation of health risks, development of natural resource sustainable management, improvement of monitoring system, enhancement of power efficiency and introduction of clean technologies.

It can be concluded that in recent years there have been significant changes in Armenia's international environmental cooperation: new conventions, protocols and agreements have been signed and ratified, environmental programs developed and implemented, and Armenia is more and more involved in international processes. It is obvious, however, that Armenia still cannot fully fulfill the obligations of international agreements, due to an imperfect legislative framework, lack of institutional potential at national level, lack of financial resources and other obstacles.

Though coordination mechanisms are established in the framework of projects implemented by the Ministry of Nature Protection, it is still necessary to establish institutional mechanisms at national level to improve the coordination and management of internationally financed programs, in order to avoid duplication, overlap and inefficient distribution of resources.

Chapter 6 Scientific Research

In Armenia, the once-high level of scientific research has declined significantly due to economic hardship and the unstable situation in the country. However, existing scientific and technical resources as well as the intellectual potential of the country still support research in environmental sciences.

According to the annual reports of scientific research institutions, submitted to the Department of Scientific-Educational Strategy and Ecopolicy of the Ministry of Nature Protection of the Republic of Armenia, from 1992 to 1999 scientific research in the sphere of environment and nature protection were carried out in scientific research institutions of the National Academy of Sciences of the Republic of Armenia (NAS RA) and in the framework of eight ministries, as well as in the Department of Emergency Situations of the Republic of Armenia.

Analysis of these reports shows that in 1998-1999, about 110 to 120 scientific themes on environmental issues, environment protection and naturarl resource use were researched. They covered in particular issues of air, water, soil and biological resources protection, the use of underground resources, environmental problems of the energy sector, as well as issues of public safety in natural disasters and accidents.

In the framework of the NAS RA, environmental science research has been carried out in 12 scientific research institutions and in two scientific centers. Among important research, it is worth mentioning the publication of the ninth (1995) and tenth (2001) volumes of Flora of Armenia, a basic resource on biodiversity, the development of industrial technologies for fodder and of biologically active substances for clean production, research on fast-growing tree species for the establishment of a sustainable timber resource base, as well as research on growing tree seedlings in hydroponic conditions. There is a trend toward a decrease in the number of new themes, though the majority of themes do not match the environmental priorities of the Republic (numerous previous themes are continued; few have applied significance).

In the framework of the Ministry of Nature Protection, environmental research carried out in the applied science Center of Hydrometeorology and Ecology of Armhydromet is of special significance.

In the framework of the Ministry of Education and Science, environmental topics have been researched at Yerevan State University (YSU) and Armenian State Polytechnic University (ASPU). The faculties of Geography, Biology and Chemistry of YSU have a special focus on environmental research. Research work of the Geography Faculty on problems of desertification and sustainable development in Armenia is of special significance. Research on the dynamics of skin cancer linked with changes in the ozone layer, carried out in ASPU, is important as well.

In the framework of the Ministry of Agriculture, measures against flooding and waterlogging, which are extremely urgent for Armenia, have been developed and implemented: these prevented 4000 ha of arable lands from flooding and reestablished normal groundwater levels over an area of 8.3 ha.

In the framework of the Ministry of Public Health, environmental research has been focused on occupational health conditions at a number of industrial enterprises, as well as links between exceedance of maximum permissible concentrations of heavy metals and the health of employees.

In the framework of the Ministry of Energy, environmental research at the Armenian Nuclear Power Station has focused on the implementation of a system of measures for the reduction of liquid radioactive wastes and the extraction of cesium and boron isotopes.

Research carried out in the Department of Emergency Situations has mainly focused on the articulated program for and mapping of risk control (seismic risks and flooding risks) and on measures required for reservoirs in emergency situation.

Evaluation

There is a positive trend towards the diversity and applied focus of scientific research themes implemented, especially in the framework of the NAS RA, as well as the Ministries of Energy and Nature Protection. Unfortunately, due to the lack of financial resources, the implementation of a number of research programs with expected outcomes of practical significance has been stopped.

Some important themes – such as human ecology, waste treatment and the secondary use of resources, application of clean technologies, environmental impact assessment, development of normative documents for the legislative framework of natural resource use, as well as environmental education and training – are not in the list of environmental research themes.

For further development of environmental research, the following recommendations are proposed:

1. Make preliminary assessments of environmental research themes in terms of their correspondence with the environmental priorities of Armenia (in particular by the Ministry of Nature Protection);
2. Revise environmental research priorities in this regard, and consider research on issues of environmental economics, use of waste and secondary use of resources, environmental impact assessment methodology, sustainable development and other themes;
3. Establish a special Department of Ecology and Environmental Protection in the framework of the state structure for environmental research;
4. Stimulate the implementation of research activities and important measures on environmental priorities in the country, through the support of environmental funds and of international projects carried out in the framework of the Ministry of Nature Protection; and
5. As a priority, encourage new scientific research focused on forest recovery and Lake Sevan restoration – themes of strategic national significance for Armenia.

Chapter 7 Environmental NGOs and Public Participation

The public environmental movement emerged in Armenia at the end of 1970s and served as one of the bases for the development of the entire democratic movement of 1970 and 1980s, which then led to independence.

At present, 10% of the more than 2000 NGOs registered in Armenia are environmental NGOs. However, not more than 20% of environmental NGOs are function actively and work consistently on the objectives stated in their charters.

A lack of financial stability and financial independence hampers the growth of NGO activities.

NGOs are supported financially almost solely by grants from international organizations and funds. Membership fees and other own resources as a rule are not sufficient for active operations. In addition, the legislation of the country does not provide incentives for fundraising.

The public environmental movement of 1980s managed to halt the operations of the most hazardous industries of the Republic as well as the Armenian Nuclear Power Station. This led to significant negative social and economic consequences and resulted in the decline in public support for environmental organizations.

Recently, there has a trend towards the “rehabilitation” of the environmental movement and the restoration of trust in environmental NGOs. At present, numerous NGOs to some extent fulfill their objectives.

In recent years, youth environmental organizations as well as youth sections of existing NGOs have been established. These groups focus mainly on awareness raising among youth through the organization of seminars, conferences, training, and ecotours, as well as the cleaning of natural areas, planting of trees and other activities. Youth representatives also participate in international and regional events.

Active NGOs are involved in a number of international coalitions: the Pan-European Ecoforum; ANPED, the Northern Alliance for Sustainability; WEDO, Woman for Environment and Development; RIOD, the network to combat desertification; and others. NGOs also participate in information networks: Global-Info (coordinated by the Ecosoglasiye Center in Moscow), the electronic Network of the Caucasus NGOs (CENN, Tbilisi), the Regional Network on Sustainable Development and others.

A number of alliances have been established at national level to solve the specific problems. These include: the NGO Board under the Environmental Protection Public Advocacy Center and coalitions such as RIOD, For Forest Protection, Yerevan Green Belts Protection, For Water Resource Sustainable Development and others. The Electronic Forum of Environmental NGOs operates with the support of the UNDP.

NGOs work together in the framework of the non-governmental National Board on Sustainable Development, representing all key stakeholders: public and professional organizations, entrepreneurs, the scientific community, the mass media and others.

The establishment of the Regional Environmental Center for the Caucasus in 1999 should be considered as a positive step for the development of NGOs in Armenia. The Center supports environmental NGOs and facilitates public participation in the process of decision-making. It also supports free information exchange.

Public participation in environmental decision-making in Armenia has started to increase gradually. There are institutions of independent experts and public hearings of draft laws in the National Assembly of the Republic of Armenia. NGOs are invited by government bodies to participate in the development of national reports, as well as in activities linked with international conventions.

It should be mentioned, however, that this participation is mostly of an advisory nature and in some cases decisions are made in favor of urgent economic interests rather than environmental priorities. Thus, the long-lasting fight of environmental NGOs against construction in Yerevan's green belts is still not effective.

Armenia's ratification of the Aarhus Convention significantly stimulated the process of public participation in environmental decision-making and sustainable development. The EU project on Environmental Information, Education and Public Awareness in the NIS, underway in Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine, works with government officials, NGOs, the mass media and the broad public to support implementation of the Convention's provisions.

The Public Environmental Information Center, established by a Communiqué between the Ministry of Nature Protection of the Republic of Armenia and the OSCE, has the same aim. To support environmental NGOs, the Ministry of Nature Protection provided the venue, which was equipped through the financial support of OSCE. A library was established, containing extensive information materials. Round-tables for NGOs are organized.

Practically all environmental NGOs envisage activities in the areas of information dissemination and enhancement of environmental education, public awareness and publications.

Chapter 8 Environmental Education and Training

The introduction of environment into the education system and general environmental education and training are important for Armenia. In this regard, environmental education is gradually expanding and becoming a constituent part of the education system in the Republic. To some extent, it exists at all levels of education. Under the Law on Environmental Education and Training of the Population, continuous environmental education includes the following levels:

- pre-school;
- secondary school;
- specialized secondary education;
- specialized higher education;
- post-graduate education;
- public environmental education and training, including in military forces.

Environmental education and training in pre-school institutions is not systematized. It is carried out in the form of continued, traditional events such as "Bird day", "Flower holiday" and others. Kindergartens in general lack green areas where children might learn about nature. Methodological manuals and didactic materials on environmental education for educators are missing. The best example of pre-school environmental education can be found in the environmental kindergarten functioning in the city of Abovyan since 1993.

Environmental education in secondary schools. By Resolution of the Government of RA (No. 226, 08.05.2002) new subjects such as environmental education, the use of natural resources, basics of nature protection and others were included in the "State Standard for Secondary Education".Environmental education is emphasized in a few schools in Yerevan and in some regions. It is carried out through environmental study groups and nature protection events (discussions, quizzes, competitions and others); however, these are not organized regularly. In Yerevan and in some regions there are didactic materials that remain from the past in biology classrooms.

Secondary school environmental education, however, is not systematized by the state. Environmental schools and classes are missing. Environmental education is based on biology and geography subjects. Teachers lack curricula and methodology manuals for environmental education.

In 1998-2002 women accounted for the majority (80% and more) of school teachers. The gender problem in the sphere of schoolteachers is obvious.

Environmental education in specialized secondary educational institutions. In Armenia, specialized secondary education is carried out in colleges.

Environmental education in specialized secondary institutions is not unified and systematized by the state. There is the need for state standards, curricula and textbooks. The list of secondary

education specialties needs to be revised and amended (adding specialties such as Environmental protection and natural resource rational use, Forestry, and Garden-park management).

The need for specialties has been identified by the Ministry of Nature Protection and the Ministry of Education and Science of the Republic of Armenia. It has an important strategic significance. From the perspective of the environmental education strategy, it is important as well that the list of secondary education specialties is not supplemented by environmental specialties of applied significance (air, underground resources, water, soil, biodiversity protection, forest management and others).

Environmental education in institutes of higher education. In 2002, higher education was provided by 16 state institutes of higher education with 10 branches and 72 non-state institutes of higher education. The majority of institutes provided general environmental education. Environmental education is provided as well in universities focused on the humanities, such as the V. Bryusov Linguistic University and Yerevan Hrachia Ajarian University. It is necessary to introduce environmental education in the Yerevan State Conservatory and Yerevan State Academy of Fine Arts.

Post-graduate environmental education. A unified system of post-graduate environmental education is missing.

Public environmental education and training is not carried out regularly. In this sphere, some activities are implemented by the NGO Center, though environmental and nature protection events carried out by environmental NGOs are not systematized and regular.

Human resource retraining is carried out by the Academy of Management adjacent to the Government of the Republic of Armenia, through lectures on environmental issues. The Center on Educational Reforms in the Ministry of Education and Science of the Republic of Armenia organizes retraining courses, including environmental courses. Few specialists have an opportunity to receive environmental education or retraining courses in western institutions.

Outdoor education and education in museums are of special significance in the system of continuous environmental education. This method, though, is rarely applied in Armenia. For example, the Nature Museum in Yerevan (established in 1952) and its branch in Gyumri (established in 1995, including a Winter Garden where schoolchildren take care of animals), and nature museums in the Sevan and Dilijan National Parks, as well as the Zoological Museum of the Institute of Zoology NAS RA (Yerevan) and others all provide a suitable base for environmental education at different levels. They need, however, financial investments for rehabilitation.

International conventions ratified by Armenia (including the Framework Convention on Climate Change, the Convention on Biodiversity, the Convention to Combat Desertification, the Aarhus Convention and others) support public environmental education in the Republic. National reports, action plans and other publications provide favorable conditions for the distribution of environmental knowledge, exchange of experience, and information flow. Unfortunately, materials are not published in many copies, are not available for the wide public and are distributed only among specialists. The ratification of the Aarhus Convention (14 May 2001) has had a positive influence on public environmental education and awareness raising. The Public Environmental Information Center was established adjacent to the Ministry of Nature Protection, with the support of the Yerevan branch of the Organization of Security and Cooperation in Europe (OSCE).

International organizations and their representations in Armenia (Eurasia Foundation, World Bank, UNDP, UNICEF, IREX and others) contribute to environmental education. They implement innovative educational programs, support the organization of lectures, training, workshops and other events, as well as publications.

There are common priorities for all levels of environmental education in Armenia. They were developed by an Interministerial Commission of the Ministries of Nature Protection and Education and Science (established in 1998). The priorities can be grouped in the following areas:

- development and approval of standards, curricula, programs, methodological manuals;
- training and retraining of trainers - educators, teachers, lecturers;
- publication of special literature - textbooks, guidelines, atlases and others; and
- dissemination of information and knowledge - publication of available materials, organization of conferences, seminars, round-tables, TV and radio programs, and creation of films and other works.

The legislative basis for environmental education in Armenia is set by the Laws of the Republic of Armenia on Education (14 April 1999) and on Environmental Education and Training of Population (20 November 2001). The framework of supporting regulations needs to be amended.

Since 1997, the Ministry of Education and Science has been implementing the Program on Reforms of Education Management and Financing.

The Education Development State Program (2001-2005) was approved by the President of the Republic on 31 June 2001. It envisages the implementation of a three-step program for the improvement of the educational system. Special sections of the program are focused on environmental education.

Chapter 9 Environmental Awareness and Feedback

In 1998, the Information Analysis Center was established in the framework of the Ministry of Nature Protection of the Republic of Armenia. The provision of environmental information is among the goals of the Center. The Center has supported the installation of a local computer network in the Ministry: the network allows the distribution of quarterly information on activities implemented in all the Ministry's sub-divisions. Daily weather forecasts are posted on the network. Monitoring center data on air and water basins are available on the network. In 2002, the Information Analysis Center developed a Ministry web site (www.mnpiac.am) that provides information about the Ministry, its activities and environmental measures implemented, as well as other environmental information. In this web site there is a link to another site (Erevan-eko) containing information on Yerevan's urban environmental situation. This site is widely used by students and NGOs for additional information.

In 2002, the Public Environmental Information Center was established adjacent to the Ministry of Nature Protection, in collaboration with the OSCE and with the financial support of the US, British and German Embassies and the Yerevan office of UNDP. The Information Analysis Center supports the Public Environmental Information Center in its activities. In the Public Environmental Information Center, environmental information is available to the broad public via Internet, printed materials and diskettes. Additional information is provided by request. Internet, copying and computer services as well as a collection of video films are available in the center.

Publication of the periodical *Bnutyun* is another form of information distribution.

Conclusion

General Description of Situation

The ecological state of the Republic of Armenia was unfavorable still in Soviet times. The development of resource- and power consuming industries, weakly equipped cleaning plants, application of extensive agricultural methods, lack of systems for neutralization and waste development etc. had a negative impact on the environment. Such cities as Yerevan, Vanadzor, Hrazdan, Alaverdy, Ararat, Kajaran, Agarak, became sources of biosphere pollution. The ecological condition of Lake Sevan basin has worsened and its water has been intensively used for irrigation and energy purposes.

The Republic experienced some changes in 80-90s: a number of cleaning plants, as well as Arpa-Sevan tunnel were built and significant work was done on afforestation of the terriotory. However, the condition still remained alarming particularly in terms of the high level of air basin pollution in the cities and disposal of the radioactive waste of nuclear power station of Armenia.

The socio-economic crisis of the transition period, aggravated blockade and energy crisis of the 1991-1995s deteriorated the ecological condition of the country. The water of Lake Sevan again began to be released for meeting the energy needs of the country, forests were massively cut, land degradation process was liven up and desertification risk increased.

Later, a number of industries were closed in the country, which brought to decrease in air basin pollution level in cities. However, the situation is still alarming partly because of the increase in car number and decrease in public electrical-transportation means, as well as sharp reduction of green zone areas, especially in Yerevan. In the result of closing the industries, there was consequently decrease in volume of industrial waste water. However, the pollution of water resources is still immensely threatened by the disorder and malfunctioning of cleaning plants- at present waste water is only mechanically cleaned, and even this is done only partially.

Environmental policy and reasons for modern trends

Currently some stabilization and economic growth of the socio-economic situation are to be observed in the country. More importantly stirring up of economy should base on the principles of the sustainable development, without harming environment and, on the contrary, promoting it's improvement, contributing the natural processes restoration.
After independence Armenia has joined a number of international environmental conventions and in this regard a general activity is launched - national reports prepared, action plans developed.

NEAP is developed and approved, a special program on restoration of ecological balance of Lake Sevan is accepted, an environmental legislation, adapted to the new economy is being formulated, and "polluter/user pays" principle is inculcated. The same time, in spite of a number of positive changes, situation is complicated in whole and the following factors favor it:

- Extremely high social costs of transition period, resulted in impoverishment of the significant part of population, surviving due to overexploitation of natural resources;

- Legal nihilism, manifested in the failure to execute environmental legislation, mainly from the newly formulating business sector;
- Implementation crisis of the majority of the tuned projects, plans and programms due to lack of financial assets;
- Weakening of ecological monitoring systems;
- Town planning policy, carried out in new economic conditions, conflicting with the principles of sustainable development and contradicting environmental priorities
- Weak concernment of international investors in ecologically sound industy;
- Insufficient public awareness on environment, including the decicion makers level;
- Insufficient stakeholder involvement into the process of environmentally sound decision making.

Recommendations on activization of ecological actions for sustainable development.

This report contains special chapters, which present detailed recommendations on the improvement of the situation in all sectors. Below summarized versions of recommendations are set on reorientation activities to sustainable methods of demands and industries, reducing anthropogenic impact on environment, contribution to restoration of natural resources:

- Improvement of financial-economic mechanisms promoting sustainable nature use: introduction of waste-free, little waste creating and energy-efficient technologies, waste treatment and utilization, activities promoting the restoration of natural resources and protection of environment;
- Formation of ecological funds of national and local importance aimed at implementation of ecological projects and programmes;
- Improvement of legislative-normative basis in the sphere of environmental protection with a focus on norms and instructions on rational nature use;
- Strengthening and development of complex ecological monitoring, introduction of complex ecological assessment systems (indexes for atmosphere pollution, water resources, lands etc);
- Provision of correlation between town-planning practice (especially in Yerevan) and developed and announced projects in the country in regard to Habitat principles;
- Optimization of institutional relationships between national and local authorities on controlling urban development;
- Provision of reconstruction of irrigation nets, hydro-technical structures, pumping stations and deep wells, strengthening and reconstruction of water reservoirs, exploitation of collector-drainage nets;
- Completion of construction activities and exploitation of hydro-technical structures of River Vorotan, which will provide an opportunity for annually throwing additional 165 mln m^2 water to Lake Sevan;
- Implementation of activities in light of the project on restoration of Lake Sevan ecological balance;
- Restoration and expansion of cleaning plants, introduction of modern technologies for sewage water cleaning and circulation of water-supply;
- Strict follow-up and maintenance of sanitary norms for water use and water discharge;

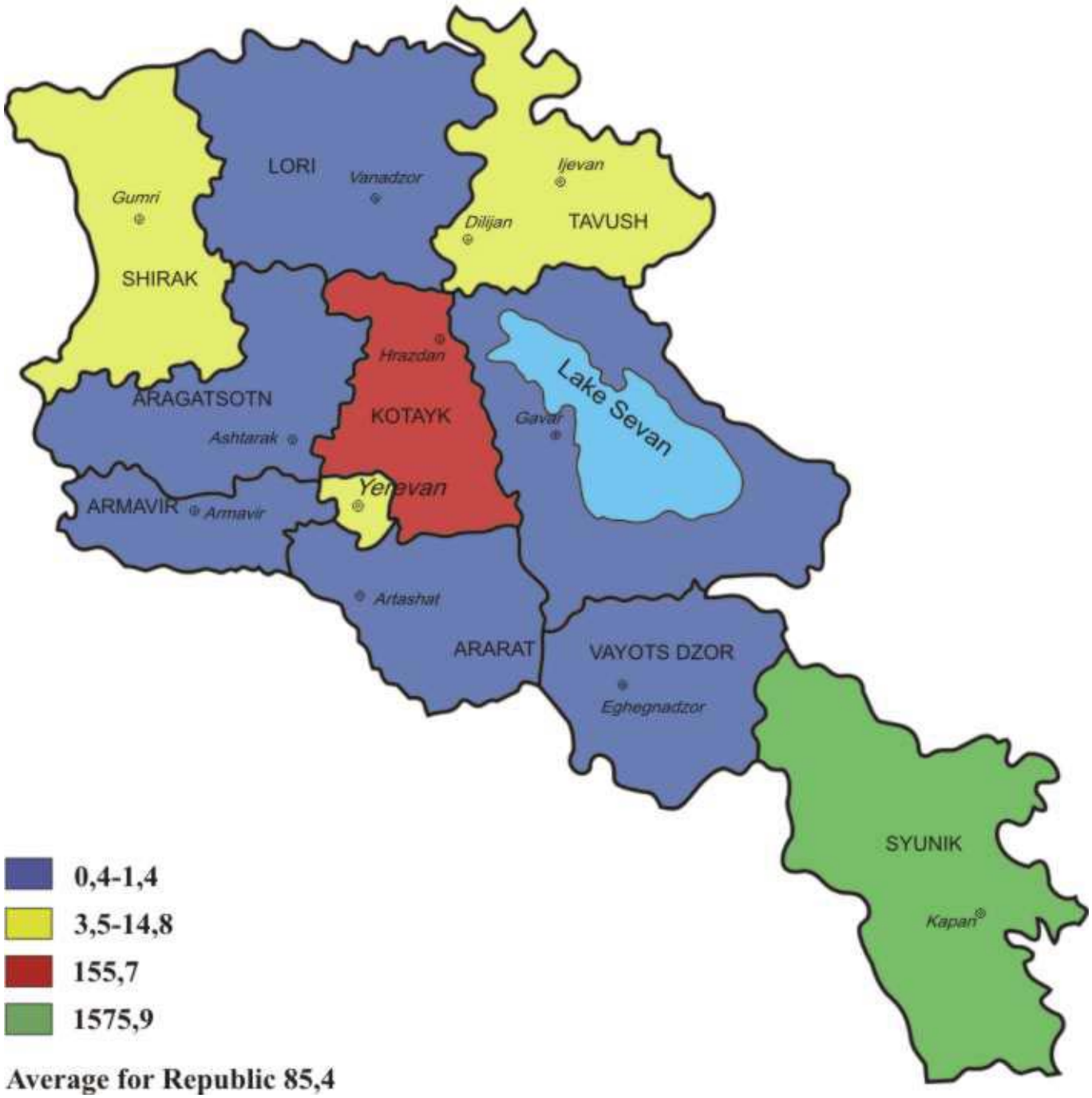
- Introduction of dust and gas-purification modern systems and clear technologies;
- Review the policy on transportation for cities (especially in Yerevan), introduction of operating mechanisms stimulating reduction of emissions to the atmosphere, realization of complex measures in this sphere;
- Implementation of complex measures on reduction of ozone layer destroying emission;
- Prevention of future degradation of lands, restoration of green zones in cities, restoration and expansion of zones of multilevel functional greening;
- Development and implementation of programs on adaptation to prognosed climate change;
- Development and implementation of a national strategy on limitation of greenhouse gas emissions, as well as development of sinks and accumulators, application of modern technologies in this sphere;
- Provision of control on disposal of wastes in the environment, development of a modern system for collecting, utilization and interment of hard, household and industrial wastes;
- Implementation of special complex of measures on prevention and decrease of environmental pollution from toxic and radioactive wastes;
- Optimization of agro-meliorative activities for increasing effectiveness of agricultural industries, prevention of development of erosion and other negative processes, especially on slopes, re-cultivation of degraded and eroded lands;
- Reorientation to sustainable methods for agricultural industries (minimization of use of pesticides, herbicides, inorganic fertilizers, introduction of organic and ecologically acceptable methods for protection of plants and increase of soil fertility);

- Application of most effective, ecologically safe complex methods of outputs and development of useful minerals, excluding super-normative losses, combination of mineral raw material and selective resource treatment;
- Exclusion of non-justified damages to exploitable and neighboring deposits, as well as protection of cavities in depths, formed during resource conservation;
- Optimization of economic mechanisms oriented on sustainable use and conservation of biological (in-situ and ex-situ) and landscape diversity of the country;
- Passportization of bio-resources (particularly of forests), permanent monitoring of species and ecosystems;
- Restoration and expansion of forest covered areas, forest belts and plantations;
- Strengthening and improvement of protected areas management;
- Formation of a net of SPAs as an “ecological net” or as a “framework of territory’s sustainability”;
- Strengthening and development of formal and informal ecological education systems for awareness increase aimed at ensuring sustainable development;
- Provision of wide access to ecological information, integrating interested people to decision making process of ecological importance;

The recommendations set in the present document will be possible to implement only with joint efforts by the state structure and civic society, which will be targeted on integration of principles of ecological sustainability into sector policy, and socio-economic development policy as a whole.

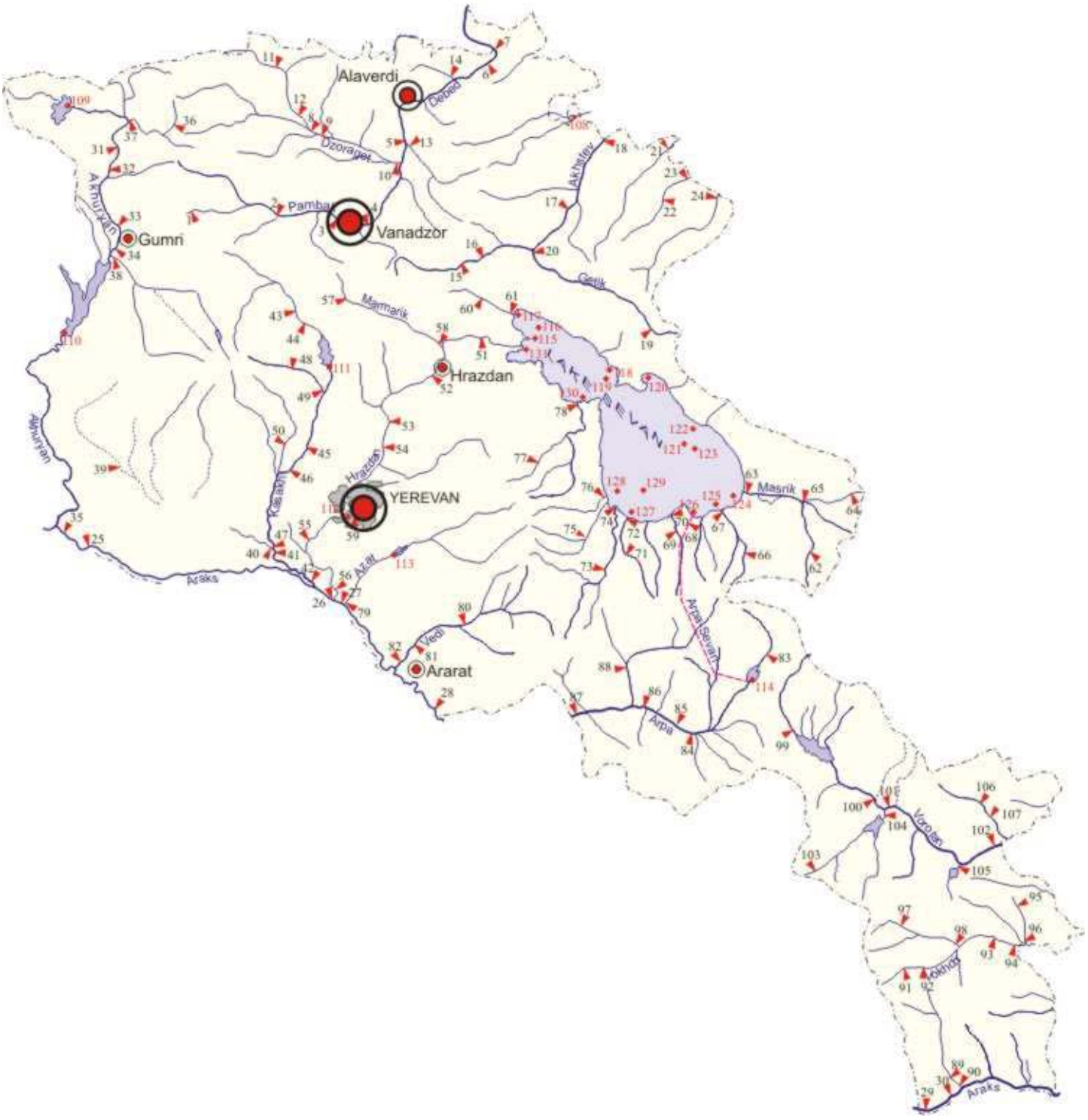
2001

Waste quantity per unit of population, kg



Average for Republic 85,4

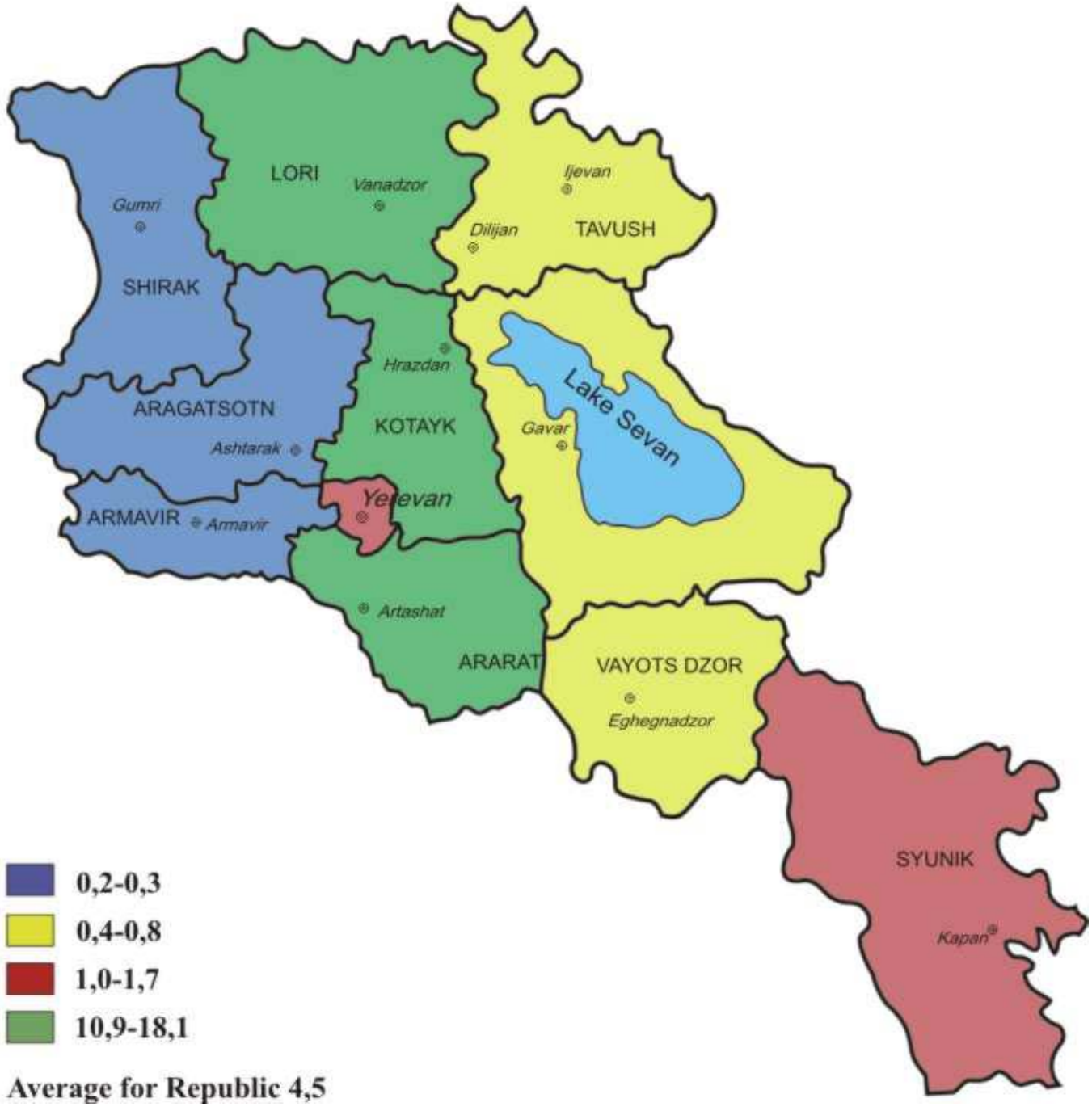
Observation points for RA water and air bassin quality



Prospective planning structure of RA settling

2001

Quantity of air venting from sources per unit of population, kg



Average for Republic 4,5