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DRAFT ENVIRONMENTAL PERFORMANCE REVIEW OF ARMENIA[1]

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***NOTE:** All data, city names and geographical references will be reverified before final publication.*

TABLE OF CONTENTS

PART I: THE FRAMEWORK FOR ENVIRONMENTAL POLICY AND MANAGEMENT

Chapter 1 Legal instruments and institutional arrangements for environmental protection ... 3 - 13
1.1 Environmental legislation and enforcement ... 3
1.2 Priorities of environmental policy ... 6
1.3 Institutional arrangements for environmental protection ... 7
1.4 Environmental monitoring, information and education ... 7
1.5 Public awareness and participation in environmental decision-making ... 9
1.6 Conclusions and recommendations ... 10

Chapter 2 Economic instruments, regulatory instruments and their enforcement ... 15 - 25
2.1 Economic instruments ... 15
2.2 Regulatory instruments and enforcement ... 19
2.3 Environmental expenditures and revenues ... 21
2.4 Conclusions and recommendations ... 23

Chapter 3 Spatial planning ... 27 - 36
3.1 The framework for territorial development ... 27
3.2 Spatial planning priorities, instruments and institutions ... 31
3.3 Conclusions and recommendations ... 35

Chapter 4 International cooperation ... 37 - 49
4.1 General objectives for international cooperation ... 37
4.2 Cooperation in the framework of UNECE and other regional cooperation ... 38
4.3 Global cooperation ... 39
4.4 Technical cooperation and international funding ... 42
4.5 Conclusions and recommendations ... 48

PART II: MANAGEMENT OF POLLUTION AND OF NATURAL RESOURCES

Chapter 5 Forest, biodiversity and nature management ... 53 - 68
5.1 Present state of nature ... 53
5.2 Pressures on nature ... 60
5.3 Nature conservation policy and management ... 63
5.4 Conclusions and recommendations ... 66

Chapter 6 Land management and soil protection ... 69 - 84
6.1 Land resources and use ... 69
6.2 Degradation, state and quality of land resources ... 71
6.3 Policy and management of land resources and soil protection ... 76
6.4 Conclusions and recommendations ... 80

Chapter 7 Hazardous chemicals and waste management ... 85 - 97
7.1 Structure and recent development of industry ... 85
7.2 Waste risks and generation by type ... 86
7.3 Collection, sorting, recycling, treatment and disposal ... 89
7.4 Waste policy and management ... 92
7.5 Conclusions and recommendations ... 95

Chapter 8 **Management of water resources and quality** ..... **99 - 117**
8.1 The state of waters 99
8.2 Water use and pollution pressure 103
8.3 Policy and institutions for managing water 108
8.4 Conclusions and recommendations 114

Chapter 9 **Air management** ..... **119 - 134**
9.1 State and determinants of air pollution 119
9.2 Policy objectives and management practices 125
9.3 Policy objectives and management practices in the transport sector 130
9.4 Conclusions and recommendations 132

Chapter 10 **Management of mineral resources** ..... **135 - 146**
10.1 Mineral resources: potential and use 135
10.2 Environmental concerns in mining and mineral processing 139
10.3 Instruments for the management of mineral resources 141
10.4 Conclusions and recommendations 144

PART III: **ECONOMIC AND SECTORAL INTEGRATION**

Chapter 11 **Environmental concerns in agriculture** ..... **149 - 167**
11.1 The situation of agriculture 149
11.2 Major environmental issues in agriculture 153
11.3 Policy priorities and management 158
11.4 Conclusions and recommendations 163

Chapter 12 **Environmental concerns in energy** ..... **169 - 183**
12.1 Energy resources and technical infrastructure 169
12.2 The national energy economy and environmental issues 171
12.3 The situation in the energy sector 175
12.4 Management of the energy sector 178
12.5 Conclusions and recommendations 181

Chapter 13 **Human health and the environment** ..... **185 - 204**
13.1 Overall health status and environmental conditions 185
13.2 Environmental conditions associated with health risks 188
13.3 Environmental health policy and management 194
13.4 Conclusions and recommendations 200

ANNEXES

Annex I Recommendations Chapters 1 to 13 207
Annex II Selected economic data 217
Annex III Selected environmental 219
Annex IV Selected bilateral and multilateral agreements 221

LIST OF FIGURES

Chapter 1: **Legal instruments and institutional arrangements for environmental protection**
Figure 1.1 Map of Armenia (administrative units and main cities)

Chapter 3 **Spatial planning**
Figure 3.1 Built-up areas

Chapter 5 **Forest, biodiversity and nature management**
Figure 5.1 Annual regular cuttings
Figure 5.2 Forest fires

Chapter 7: **Hazardous chemicals and waste management**
Figure 7.1 Municipal waste generation in selected countries, mid-1990s

Chapter 8 **Management of water resources and quality**
Figure 8.1 Hydrographic Network of Armenia
Figure 8.2 Waste-water discharge, 1998

Chapter 9 **Air management**
Figure 9.1 Air emission, 1996
Figure 9.2 Emissions by sector, 1987
Figure 9.3 Emissions by sector, 1998

Chapter 10: **Management of mineral resources**
Figure 10.1 Location of principal mineral deposits
Figure 10.2 Extracted reserves of raw materials for construction
Figure 10.3 Mineral prospecting activities by category and type of resource

Chapter 11: **Environmental concerns in agriculture**
Figure 11.1 Rough mapping of the agricultural regions and environmental threats

Chapter 12: **Environmental concerns in energy**
Figure 12.1 Hydro power production and change in water level of Lake Sevan
Figure 12.2 Supply of district heat, 1989-1997
Figure 12.3 Natural gas supply 1989-1998 and days of maximum available supply
Figure 12.4 Consumption of petroleum products, 1991-1998

Chapter 13: **Human health and the environment**
Figure 13.1 Mortality rates in a few newly independent States, 1985-1997

LIST OF TABLES

Chapter 2: **Economic instruments, regulatory instruments and their enforcement**
Table 2.1 Water use charges
Table 2.2 Inflation and exchange rates 1994-1999
Table 2.3 Quantities of pollutants and corresponding charges, estimated for 1997 and 1998
Table 2.4 Environmental revenues, 1995-1999
Table 2.5 Environmental and nature use charges, 1998 and 1999
Table 2.6 Environmental fines and compensation, 1994-1998
Table 2.7 State environmental expenditure, 1995-1999
Table 2.8 Expenditures for waste removal, treatment and disposal, 1997-1998
Table 2.9 Environmental expenditures by enterprises, 1997-1998

Chapter 3: **Spatial planning**
Table 3.1 Dwelling stock, 1990-1998
Table 3.2 Dwellings in urban areas by type of equipment 1990-1998
Table 3.3 Dwellings in urban areas by number of rooms, 1996
Table 3.4 Responsibility and administration by cadastral category, 1998

Chapter 4: **International cooperation**
Table 4.1 Ministerial programmes financed by external donors

Chapter 5: **Forest, biodiversity and nature management**
Table 5.1 Plant diversity in Armenia
Table 5.2 Fauna of Armenia
Table 5.3 Number of rare and endangered plant species by region
Table 5.4 Number of threatened animal species found in Armenia
Table 5.5 Protected areas in Armenia
Table 5.6 State reservation and State reserves in Armenia
Table 5.7 State forest resources
Table 5.8 Forest plantations
Table 5.9 Hunted species and number of hunting licences

Chapter 6: **Land management and soil protection**
Table 6.1 Structure of land resources, 1999
Table 6.2 Types of soils, their characteristics and planned use
Table 6.3 Irrigation, 1995
Table 6.4 Extent of soil erosion within the natural soil zones, 1998
Table 6.5 Extent of soil erosion by type of soil
Table 6.6 Fertilizer use, 1985-1994
Table 6.7 Change in crop areas and yield before and after independence
Table 6.8 Cadastral value of land classes in Ashtarak area

Chapter 7: **Hazardous chemicals and waste management**
Table 7.1 Classification of wastes
Table 7.2 Generation of industrial wastes, treatment, use and disposal, 1997 and 1998
Table 7.3 Solid waste components in Hrazdan and Yerevan
Table 7.4 Pesticide use, 1988-1994
Table 7.5 Dumping sites served by the State Enterprise of the Ministry of Urban Development
Table 7.6 Waste average composition, 1999

Chapter 8: **Management of water resources and quality**
Table 8.1 Underground water resources in Armenia
Table 8.2 Main rivers in Armenia
Table 8.3 Water abstraction and use in Armenia, 1985-1998
Table 8.4 Trends in estimated water supplies, 1980-1997

Table 8.5 Sewerage network characteristics
Table 8.6 NEAP identification of main issues and problems regarding water management in Armenia
Table 8.7 Prices for drinking water, 1998

Chapter 9: Air management
Table 9.1 Trends in anthropogenic emissions of selected pollutants, 1987-1998
Table 9.2 Annual total emissions by sector, 1987 and 1998
Table 9.3 Spatial distribution of emissions, 1996
Table 9.4 Ambient air quality in selected towns, 1987-1996
Table 9.5 Comparison of selected Armenian air quality standards with recommended WHO guiding values and EU present and future standards
Table 9.6 Transport infrastructure, 1998
Table 9.7 Fuel consumption in the transport sector, 1985-1998

Chapter 10: Management of mineral resources
Table 10.1 Heavy metal concentration in areas adjacent to the Kapan copper deposit and its tailings
Table 10.2 Volumes of extracted minerals and related charges, 1997-1998

Chapter 11: Environmental concerns in agriculture
Table 11.1 Farm structures and livestock
Table 11.2 Actual situation of environmental threats and measures in agriculture (by regions)
Table 11.3 Potential situation of environmental threats and measures in agriculture (by regions)

Chapter 12: Environmental concerns in energy
Table 12.1 Summary of energy balances, 1991-1998
Table 12.2 Final energy consumption, 1991-1998
Table 12.3 Planned supply development
Table 12.4 Forecast of energy supply, 2000-2010
Table 12.5 Forecast of energy demand, 2000-2010
Table 2.6 Forecast of fuel demand, 2000-2010
Table 12.7 Forecast of electricity generation, 2000-2010
Table 12.8 Emissions of CO_2, CH_4 and N_2O from the use of natural gas and coal, 1990-2010
Table 12.9 CO_2 emissions from energy use, 1991-1998
Table 12.10 Power plants

Chapter 13: Human health and the environment
Table 13.1 Standardized mortality rates of the most important causes of death, 1997
Table 13.2 Intestinal and diarrhoeal diseases, 1997-1998
Table 13.3 Comparison between Armenian and WHO Water Quality Guidelines for selected pollutants

LIST OF BOXES

Chapter 1: **Legal instruments and institutional arrangements for environmental protection**
Box 1.1 Basic environmental laws in Armenia

Chapter 7: **Hazardous chemicals and waste management**
Box 7.1 Processing of tailings at Ararat Gold Recovery Company

Chapter 8: **Management of water resources and quality**
Box 8.1 Lake Sevan
Box 8.2 Vanadzor water supply facility
Box 8.3 Management policy for Lake Sevan
Box 8.4 The Vorotan tunnel and Yehvards reservoir projects and Lake Sevan

Chapter 10: **Management of mineral resources**
Box 10.1 Construction material exploitation
Box 10.2 The Alaverdi metallurgical plant
Box 10.3 Projects relevant for the management of mineral resources

Chapter 11: **Environmental concerns in agriculture**
Box 11.1 Small and large farms in the irrigated plain
Box 11.2 New farming structures on a former kolkhoz in the northern hills
Box 11.3 The grazing problem in Armenia
Box 11.4 Integrated agro-business: a model for the future?

ABBREVIATIONS

APO	Hazardous Waste Management Agency
AWSE	Armenian Water Supply Enterprise
BAT	Best Available Technology
BOD	Biological Oxygen Demand
BS	Black smoke
CFC	Chlorofluorocarbon
COD	Chemical Oxygen Demand
CIS	Commonwealth of Independent States
CHP	Thermal Power Plant
DALY	Disability adjusted life years
DOTS	Directly Observed Treatment, Short-course
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EIE	Environment Impact Expertise
ELV	Emission Limit Value
EMCS	Emergency Medical Care Service
EQRP	Earthquake Reconstruction Project
EQO	Environmental Quality Objectives
EU	European Union
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
GATT	General Agreements on Tariffs and Trade
GDP	Growth domestic product
GEF	Global Environmental Fund
GPS	Global Positioning System
HP	Hydropower plant
IAE	International Atomic Energy Agency
IPCC	Integrated Prevention Pollution Control
IUCN	World Conservation Union
ISO	International Organization for Standardization
LPG	Liquefied petroleum gas
LV	Limit concentration value
MoA	Ministry of Agriculture
MAE	Maximum Allowable Emission
MEAs	Multilateral Environmental Agreements
MoH	Ministry of Hygiene
MNP	Ministry of Nature Protection
MPC	Maximum Permissible Concentration
MoUD	Ministry of Urban Development
NEAP	National Environmental Action Plan
NGO	Non-governmental organization
NIS	Newly Independent States
NMVOC	Non-methane volatile organic compound
ODS	Ozone depleting substances
OECD	Organisation for Economic Cooperation and Development
PAHs	Polyaromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PEC	Predicted environmental concentration
PHARE	Assistance for Economic Restructuring in Central an Eastern European Countries
PNEC	Predicted no-effect concentration
PPC	Project Preparation Committee
PRTR	Pollutant release and transfer register
QA	Quality assurance

QC	Quality control
REC	Regional Environmental Centre
RON	Regular Octane Number
RV	Recommended concentration value
SDR	Standardized death rate
SHESS	State Hygiene and Epidemiological Surveillance
SMEs	Small and medium size industries
TLV	Threshold limit value
TP	Thermal power plant
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Organization for Industrial Development
USAID	United States Aid Agency
VOC	Volatile Organic Compound
WB	World Bank
WMO	World Meteorological Organization
YWSE	Yerevan Water Supply Enterprise

SIGNS AND MEASURES

..	not available
-	nil or negligible
.	decimal point
ha	hectare
t	metric tonne
kt	kilotonne
g	gram
kg	kilogram
mg	milligram
mm	millimetre
MWt	Megawatt thermal
Mwe	Megawatt electrical
cm^2	square centimetre
m^3	cubic metre
km	kilometre
km^2	square kilometre
toe	ton oil equivalent
l	litre
ml	millilitre
min	minute
s	second
PJ	petajoule
m	metre
°C	degree Celsius
GJ	gigajoule
kW_{el}	kilowatt (electric)
kW_{th}	kilowatt (thermal)
MW_{el}	megawatt (electric)
MW_{th}	megawatt (thermal)
MWh	megawatt-hour
TWh	terawatt-hour
Bq	Becquerel
Ci	Curie
MSv/a	Millisievert per year
y	Year
Cap	Capita
Eq	Equivalent
H	hour
KV	kilovolt
MW	megawatt
Gcal	gigacalorie
Hz	hertz
GWh	gigawatt-hour

Currency

Monetary unit: Dram

Exchange rates: The Armenian National Currency, the dram, was introduced on 22 November 1993.

Year	1 US$
1993	9.11
1994	288.65
1995	405.91
1996	414.04
1997	490.85
1998	504.92
1999*	538.56

Source: International Financial Statistics, IMF, 1999

Note: Values are period averages
* average for the nine first months of 1999

PART I: THE FRAMEWORK FOR ENVIRONMENTAL POLICY AND MANAGEMENT

Chapter 1

LEGAL INSTRUMENTS AND INSTITUTIONAL ARRANGEMENTS FOR ENVIRONMENTAL PROTECTION

1.1 Environmental legislation and enforcement

Legal framework

The Constitution of the Republic of Armenia provides in its Chapter 10 for State responsibility regarding environmental protection and the rational use of natural resources. Although its Constitution was adopted in 1995, Armenia started to create new environmental legislation at the end of 1990, soon after the Declaration of Independence (September 1990). In 1991, the Supreme Council (Parliament) passed the "Green Constitution" – "Principles of Legislation on Nature Protection". It lays down the main areas of environmental protection, such as: nature objects under protection, the use of natural resources, economic mechanisms for ensuring nature protection, governmental obligations regarding safe and healthy natural conditions, as well as the effective use of nature, preventing its deterioration, the competencies of environmental authorities, State ecological expertise, citizens' rights and obligations (e.g. the right to environmental information, the right to compensation for environmental damage, the right of association in public organizations for nature protection, responsibility to meet the requirements of environmental legislation), the general provisions concerning environmental quality, the ecological requirements in production activities, the basic principles for controls in protecting the environment. Since its adoption, the so-called "Green Constitution" has played the role of a general umbrella law.

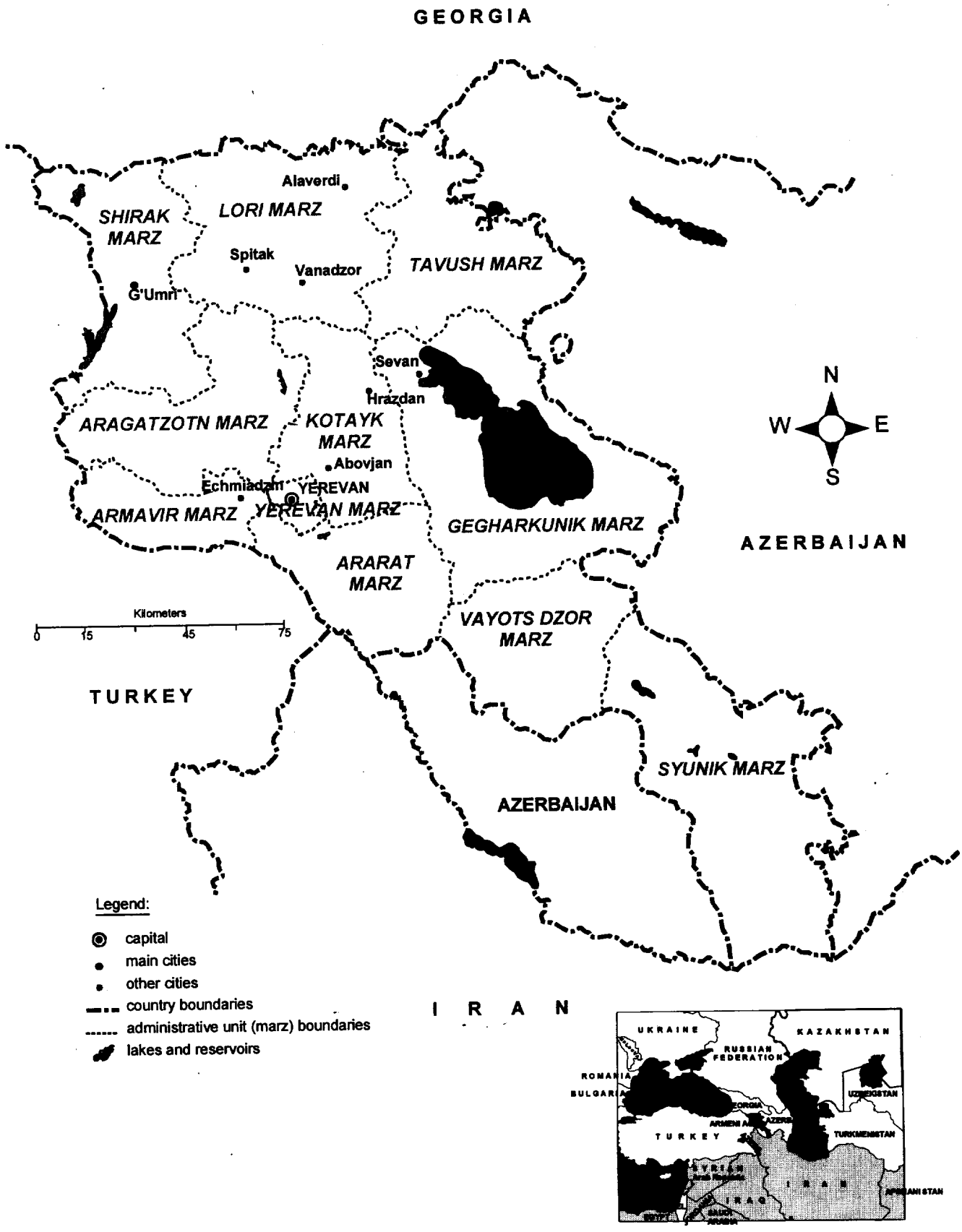
The general requirements of the Principles of Legislation on Nature Protection are reflected in the specialized laws. For example, the Water Code regulates State management and control over water use and water consumer rights and duties in water protection and water impact prevention; the Land Code classifies territories, regulates competence and functions of land protection, as well as the status and structure of the State Land Register; the Forest Code regulates the conservation, protection and management of forests; the Law on Specially Protected Natural Territories outlines the procedures for establishing protected areas and their management; the Code on Subsoil Minerals contains the main directives for the use and protection of the mineral resources, etc.

The existing legal framework governing the use of natural resources and environmental protection includes a large variety of legally binding documents, classified in the following groups:

1. Environmental conventions
2. Environmental legislative acts (laws, codes, government resolutions equivalent to laws, National Council resolutions)
3. Environmental regulations (government resolutions, Prime Minister's resolutions)
4. Environment-related legislative acts (laws, codes, presidential decrees, National Council resolutions)
5. Environment-related regulations (government resolutions, Prime Minister's resolutions).

Between 1993 and 1999 Armenia ratified nine environmental conventions. It is unclear how these were introduced into national legislation after their ratification. The most important legislative acts are listed in Box 1.1.

Figure 1.1: Map of Armenia (administrative units and main cities)



Box 1.1: Basic environmental laws in Armenia

Principles of Legislation on Nature Protection	**29.07.1991**
Law on Specially Protected Territories	**29.01.1991**
Law on Environmental Impact Expertise	**20.11.1995**
Law on Atmospheric Air Protection	**01.11.1994**
Underground Resources Code	**23.03.1992**
Water Code	**29.01.1991**
Forest Code	**01.11.1994**
Land Code	**29.01.1991**
Law on Environmental Protection and Natural Resource Use Taxes	**28.12.1998**
Law on Flora	**22.12.1999**

Laws on hazardous chemicals and waste management are under preparation. The draft law on Lake Sevan is in Parliament. The document "Principles of Legislation on Nature Protection" is more a policy than a legal document. Some of its principles and objectives cannot be implemented. Very few of these principles have therefore been incorporated into sector-specific laws and regulations. The absence of an umbrella law (environmental protection law) is felt to be a weakness, and a draft is under preparation. It has already been broadly discussed with NGOs and international organizations.

Other important legislative acts contain provisions related to the environmental legislation:

- Criminal Code (1999)
- Code on Administrative Infringements (1999)
- Law on Sanitary-Epidemiological Safety (1992)
- Law on Energy (1997)
- Law on State Statistics (1997)
- Law on Urban Development (1998)
- Law on Drugs (1998)
- Law on Population Safety in Emergency Situations (1998)
- Law on Standardization and Certification (1998)
- Civil Code (1998)
- Government Resolution on Sevan Fishery (1996)

Government resolutions are the main legal implementing instruments for environmental laws. Between the time of the Declaration of Independence in September 1990 and September 1999, nearly 150 government resolutions on the environment were passed (some of them are no longer in force). In addition, State management of the environment is also regulated by presidential orders and Prime Minister's resolutions. There are currently over 130 of these. Nevertheless, not all regulations foreseen by the environmental legislation have been developed. For example, the Law on State Environmental Impact Expertise of 1995 requires public participation, especially during the environmental assessment of the planned activity or activities. This part of the Law is very detailed, but it is not implemented properly because the required special regulation is not in place.

Aspects closely connected with environmental protection are the subject of nearly 50 more laws and other legislative acts and 90 regulations, all of which contain provisions closely tied to environmental State activity. For example, Article 13 of the Law on Automobile Roads (1998) regulates the separation zones and protection areas of roads. Article 12 of the Law on Local Self-Administration (1996) regulates all relations existing around land-use schemes. Articles 17 and 18 of the Budget Law define the status of budget income and expenditure related to nature protection. The overall system of legal instruments that are relevant to environmental management is therefore very rich in Armenia.

Liability for environmental damage

Privatization legislation was adopted in Armenia in 1991 and 1992, but privatization did not really begin until 1995, owing primarily to the war with Azerbaijan over Nagorno-Karabakh. In the existing privatization law there is no provision governing the liability of the State for past environmental damage, nor any other provision for liability. Since 1995, privatization has been fairly rapid. In 1997, more than 60 per cent of GDP was produced in the private sector. Chapter 3 contains a description of the privatization process.

Law enforcement and compliance mechanisms

Environmental laws are implemented through permits and licences, emission limit values and limits on the use of natural resources. The controlling authorities are the State Inspectorate for Nature Protection and the regional inspectorates (one in Yerevan and 10 in the country) (See Figure 1.1). The permits are medium-oriented, relating for instance to air emissions, water use or waste-water discharge. See also Chapter 2.

1.2 Priorities of environmental policy

The drafting of Armenia's first National Environmental Action Plan (NEAP) and the development of a process for national environmental management were initiated in 1996. The Government received a grant from the World Bank's Institutional Development Fund (IDF). The Governments of Denmark, Finland, the Netherlands, Norway, Sweden and Switzerland made additional funding available for foreign experts. The NEAP was approved through Government Resolution 801 of 14 March 1998.

Problems identified in the Action Plan were evaluated and prioritized in order to focus on the most important tasks. Priorities were set according to the following criteria:

- Impact on economic productivity and efficiency
- Impact on human health and well-being
- Impact on ecosystems
- Scale of the problem
- Urgency of the problem

Three priorities were identified:

1. air, land and water pollution
2. the overexploitation of natural resources and threatened ecosystems (including the overuse of water, land and forestry and depletion of biodiversity)
3. environmental health problems and hazards.

It is expected that the Action Plan will be implemented gradually through a range of actions which collectively and cumulatively will promote environmental awareness and sustainability. The proposed implementation programme supports parallel actions to address management, policy and legal issues and the development of integrated plans, while at the same time undertaking investment activities and institutional strengthening through technical assistance and training.

The technical assistance and capital investment activities are divided into projects that are considered to be a prerequisite for a successful implementation of the Action Plan (*Phase I)*, projects that could initially be incorporated into ongoing programmes at limited cost *(Phase II)*, low- to medium-cost projects that are prerequisites for more substantive development programmes (*Phase III)* and major investment projects on which information is currently insufficient to assess their technical or economic feasibility (*Phase IV)*.

Attempts have been made to develop environmental policies at sectoral level. A limited water policy is being developed and a forest policy was adopted in 1996 to meet the objectives related to environmental protection, economic use, rural development and land use.

1.3 Institutional arrangements for environmental protection

Overall environmental administration and coordination

The Ministry of Nature Protection, through its functional divisions, is responsible for enforcing existing environmental legislation. There are also other ministries and central offices with responsibilities for environmental management. The Ministry of Agriculture and the Ministry of Health with their networks of regional agencies assume specific responsibilities regarding natural resource use and pollution control. The Ministry of Finance, the Ministry of the Interior and the Ministry of Justice have responsibilities for environmental protection too.

The national environmental authority collaborates with other ministries and agencies on the basis of intersectoral commissions. They are convened when specific environmental protection problems have to be solved and common measures have to be taken. However, there is no integrated environmental policy; few formal mechanisms exist for cross-sectoral coordination.

The monitoring systems of the Ministry of Nature Protection and the Ministry of Health work separately. Regional cooperation is very weak.

The environmental administration is characterized by a strong vertical management structure with limited authority for the regional agencies. In line with the general organizational structures of the regions (Marzpetarans), there is a special unit for environmental protection under the supervision of the Deputy Governor in each region. The regional inspectorates of the Ministry of Nature Protection collaborate with these units, whose staff usually consists of 5 persons who mainly enforce environmental legislation in their respective marzes. The current economic difficulties do not allow for the application of basic schemes of cooperation.

The Yerevan municipality has the status of a region. Until 1996, its environmental protection unit included 12 specialists. The specialized unit no longer exists, and two specialists on environmental protection are working within a mixed structure that also covers agriculture. There is no single specialist on environmental protection in any of the 12 districts within the city of Yerevan.

Local self-governments are partly involved in nature protection and nature conservation, as well as in environmental monitoring. The competencies of the local self-governing bodies are generally defined in the Principles of Legislation on Nature Protection. Municipal structures related to environmental protection differ from one municipality to the next. Usually there is no independent structure, but environmental protection is combined with other functions, for example urban development, agriculture or health care. These structures are weak and not well prepared to fulfil environmental tasks. This is partly due to the absence of relevant legislation on the responsibilities and competencies of the municipalities in environmental management.

Ministry of Nature Protection

1.4 Environmental monitoring, information and education

Environmental monitoring

The Ministry of Nature Protection is responsible for ambient environmental monitoring. The Environmental Monitoring Centre monitors air quality, surface water quality and soil quality. It has been subordinate to the Ministry since 1992. It has 81 employees, including the staff at the central laboratory in Yerevan and the six regional laboratories. The Centre's observation network is neither sufficient nor efficient. The data issued from State monitoring have official status and are used in planning and carrying out environmental protection activities.

The Monitoring Centre drew up a programme to improve its network, at a total cost of 150 million drams. The programme was approved by the Government in 1998, but was not implemented due to a lack of finances. It focuses on increasing the number of observation sites and modernizing the laboratory equipment. The

programme does not tackle data collection, standards and analytical problems related to the Soviet methodology that is still in place.

The Ministry monitors atmospheric pollution caused by transport on the basis of information gathered by the State motor licensing and inspection department. Enterprises and organizations periodically (every three months) present reports to the environmental inspectorates about their emissions to air and water. These reports are not forwarded to the Environmental Monitoring Centre. So far there are no links with the regional control authorities except the Sanitary-Epidemiological and Hygiene Inspectorates. The Environmental Monitoring Centre does not aggregate nor analyse the data on the state of the environment.

Environmental information system

There are several sources of environmental information. The Ministry is responsible for its compilation. The Environmental Monitoring Centre has issued, since 1980, a monthly bulletin of pollution, containing data on ambient air and surface water quality in settlements, including recent trends. The information is obtained from the Centre's laboratories. Past issues of the bulletin also contained information on transboundary pollution.

The Analytical Information Centre of the Ministry prepared a first state-of-the-environment report in 1998. It focuses on current environmental management problems and activities. An update of the report is being prepared for 1998/1999, reflecting changes in environmental legislation, as well as the present situation of nature protection and international environmental cooperation.

The Ministry of State Register and Statistics issues an annual specialized statistical bulletin with data on air emissions, waste-water discharges, waste processing, payments for the use of nature resources and for pollution. The information is obtained from enterprises and validated by the respective regional inspectorate.

Research and education

Armenia has a rich tradition in environmental sciences and research. A number of institutions engage in applied research, notably the relevant branches of the Academy of Science (Institute of Botany and Botanical Garden, Institute of Zoology, Institute of Hydroecology and Ichthyology, Institute of Microbiology, Centre for Ecological-Noosphere Studies), the Yerevan State University (faculties of Geography, Biology, Chemistry), the State Engineering University of Armenia, as well as specialized scientific centres: the Scientific Centre for Agriculture and Plant Protection (of the Ministry of Agriculture), the Institute of Biotechnology (of the Ministry of Industry and Trade), the Institute of General Hygiene and Occupational Diseases (of the Ministry of Health), the Scientific Centre of Hydrometeorology and Ecology (at the State Department of Hydrometeorology), or the Institute of Environmental Hygiene and Preventive Toxicology (of the Ministry of Health).

During the past 15 years, and especially since 1991, most research activities have been dramatically curtailed as a result of the economic crisis. Education is seriously hampered by the absence of teaching material and its development. Research institutes lack resources for the implementation of programmes, updating of information bases and publication. Environmental surveys seem at present to depend on international cooperation, which is forthcoming mainly regarding research on Lake Sevan, the use of mineral resources, deforestation, the conservation of biodiversity, and climate change. At present, it can only be hoped that the budgetary problems in science and education can soon be alleviated, so that the national assets in these areas will not be lost.

The Scientific Educational Strategy and Ecological Policy Department of the Ministry suffers from the low priority that is generally attached to science. Despite funding uncertainties, it issues a bulletin called "Science and Nature Protection", which surveys the activities and priorities of the different branches of ecological science in Armenia.

The study of natural sciences is part of the national educational programmes for secondary schools. While ecology or nature conservation are not specifically maintained in the curriculum, most primary and secondary schools organize field trips and visits to protected areas or botanical gardens. However, there is a lack of specialized teachers and suitable teaching materials for environmental education at primary level.

The conservation and sustainable use of natural resources are part of the curriculum at the faculties of biology, geography and chemistry of Yerevan State University, the National Pedagogical Institute, the Agricultural Academy and a number of private higher education institutes. The lack of technical and financial resources means that education is theoretical, to the detriment of field studies and visits.

A new Law on Education was adopted in 1999, and the standard for environmental education was approved. At present, a national strategy for environmental education has been suggested, and proposals have been drawn up at marz educational administrations, the national administrations or ministries concerned, NGOs and other stakeholders, including for institutional changes.

1.5 Public awareness and participation in environmental decision-making

Environmental awareness and NGOs

The National Environmental Action Plan acknowledges that environmental issues are generally not considered a top priority in Armenia. There is little social and local awareness of the need for environmental protection, and efforts made to preserve the natural resource base are limited.

During the Soviet period a number of NGOs were active in nature conservation and environmental awareness, most of them were created and managed by scientists and experts from Armenian universities. Since 1997 the Ministry of Justice has registered a total of over 2000 NGOs. Few of them, around 70, are environmental NGOs, and approximately half of them are active. Key members of the principal NGOs have been involved informally in government policies and decisions on environment and conservation issues but their involvement was as individual experts in specific fields, called upon when needed for technical advice by the relevant ministry.

The current activities of all environmental NGOs are severely limited by the lack of funds. The Government recognizes that these organizations should play a more active role, especially in awareness raising, education, research and monitoring, but admits that there is a lack of know-how as well as of financial resources.

Access to information

The Principles of Legislation on Nature Protection (1991) grant every citizen the right to demand and obtain complete and reliable information on environmental conditions. There is no special regulation on the conditions and procedures for accessing environmental information. Only "budget organizations" provide official information on the state of the environment. Environmental NGOs do not collect environmental information, but use the official data on the environment in their activities.

One of the priorities of the NEAP is to develop a detailed stakeholder participation plan. It is largely expected to become a communication activity, involving the collection, processing and analysis of environmental data and their effective dissemination to all stakeholders, including the public, resource managers, resource users, researchers and NGOs. The stakeholder participation plan will be developed jointly by the Government and NGOs.

Public participation in environmental decision-making

There are significant opportunities for public participation in the solution of environmental problems in Armenia. Environmental impact assessment (EIA) has been performed since 1986, and was in compliance with the normative and methodological documentation and standards in force in the former Soviet Union.

These practices have been replaced by the provisions of the new Law on Environmental Impact Expertise (EIE), which entered into force on 12 December 1995. The Law forbids any economic unit to operate or any concept, programme, plan or master plan to be implemented without a positive conclusion of an EIE. The Law provides for public involvement and participation at all stages of the EIE. For details, see Chapter 3.

The main requirement for successful implementation of the National Environmental Action Plan is Government and broad public support. The success of the Action Plan will depend on a number of actions involving national and local governments, industrial leaders, businessmen, NGOs and local people. Many of the actions do not need large capital investments, but may require drastic changes in social behaviour and attitudes. To raise awareness and understanding of the urgency, as well as the impact of various activities, stakeholder commitment will be sought through information, communication and participation during implementation.

Key stakeholders have taken part in various stages of preparation of the NEAP. In the first place, local experts helped to prepare the NEAP in sectoral working groups. Second, a number of meetings were convened throughout the country with representatives from ministries, other central institutions and local governments. Consultations were also held with representatives of Armenia's academic institutions, research institutes and NGOs. However, it seems that NEAP was mainly discussed with environmental protection specialists, but not with affected or interested parties, especially not with those who are or will be involved in further developing projects under NEAP. It is planned that they will be partners in ensuring the sustained implementation of the Action Plan.

1.6 Conclusions and recommendations

Since independence, Armenia has succeeded in creating a distinctive body of law on nature conservation and environmental protection, making use of the full range of legal instruments. Nevertheless, some gaps and weaknesses in the environmental legal system remain, such as the lack of a regulation on access to justice (right to appeal). The existing legal framework, especially regarding environmental regulations, also appears unnecessarily fragmented. This may lead to contradictions or overlaps.

The lack of an umbrella law on environmental management may also be the cause of certain difficulties in the enforcement of the large number of laws that, partly or wholly, deal with environmental management. Such an umbrella law would be the place to define the applicable management instruments, including, for instance, a national environmental protection fund, environmental auditing for the existing enterprises and facilities as a background to the determination of emission limit values, mitigation measures, compliance programmes and self-monitoring plans. The umbrella law should also specify the competencies of regions and municipalities in environmental management, and should provide the general legal framework for public access to environmental information and to justice, as well as public participation in environmental decision-making.

An umbrella law for the protection of the environment would have the advantage of harmonizing procedures for permits, licences, etc., which would also be beneficial to enterprises. The law may stipulate rules for environmental management in enterprises, certification of products, and environmental standards. Existing codes for the protection of air, water or land may be integrated progressively, i.e. the umbrella law may be developed and enter into force chapter by chapter, rather than in one piece, in accordance with priorities. The umbrella law should also cover the management of wastes and chemicals.

Recommendation 1.1:
A revised, comprehensive environmental protection law should be developed and enacted possibly step by step. It should specify the subjects of environmental protection, the mandates for environmental management at different levels of public administration and the management instruments, possibly including an environmental fund.

Some aspects of the procedures followed in developing legal instruments do not seem to be helpful for the establishment of an optimal legal framework. The preparation of special legislative acts and regulations to transpose fully international legislation should lead to rapid changes in the relevant national laws. It is in theory clear that, once ratified, the international obligations become national law because this is stated by the Principles of Legislation on Nature Protection. However, it is still unclear how this is achieved in practice.

The drafting of environmental legislation and its adoption should be more transparent and open to the public. The Ministry of Nature Protection should stimulate a broad discussion of draft environmental laws and regulations. There is no database on either national or international environmental legislation.

Recommendation 1.2:
Environmental legislation in general should be prepared under greater public scrutiny. A procedural routine should be established to ensure the swift enacting of ratified international obligations into national law. The use of references to foreign legal frameworks and to related national laws already in force should be facilitated in national legislative processes.

The gap in the legislation on privatization governing liability for past environmental damage may cause difficulties when large industrial enterprises with a history of environmental pollution are sold off. The development of legal prescriptions on liability for environmental damage is necessary. It could play a significant role in the further privatization process, particularly if the participation of foreign investors is to be increased.

Recommendation 1.3:
The development of all necessary legal instruments regulating liability for past environmental damage should be considered a priority.

Law enforcement is currently primarily based on control and inspection instruments. The State Inspectorate on Nature Protection and the regional inspectorates appear isolated in their control activities. No effective links exist with other departments in the Central Administration of the Ministry of Nature Protection. There is therefore a need for broader involvement of the inspectors at both national and regional levels in the activities of the Ministry for the development of environmental management. Such involvement would make national and sectoral environmental development goals more consistent. The inspection needs for water and air pollution and waste generation will have to be specified in the emerging legal framework in such a way that the existing administrative structure and capacity are recognized.

At the same time, law enforcement would also benefit from complementing control and inspection with new practices. In the first place this would require increased intersectoral collaboration on environmental issues. The principles of such 'integrated management' should be incorporated into the sector-specific laws and regulations.

Recommendation 1.4:
Inspectors from the State Inspectorate for Nature Protection as well as from the regional inspectorates should be involved in all institutional strengthening projects relevant to them and their tasks. Control and inspection practices should be complemented by coordination instruments that help law enforcement.

The preparation of a coherent environmental policy has not been a priority during the transition period. The National Environmental Action Plan (NEAP) could play this role. Although the preparation of NEAP was announced, and interested and affected parties discussed the final results, it is still not well known even among the specialists within the Ministry of Nature Protection. There is a need to discuss this important document again and to ensure broad public participation in this discussion, leading to the revision and updating of the NEAP. Special attention should be given to projects for the city of Yerevan - nearly one third of the population of Armenia is concentrated in the city, and the issues related to the state of the living environment there are complex.

Once revised, the use of NEAP as a framework for regional environmental development programmes would also help to improve cooperation on the national, regional and local levels between authorities with responsibilities in environmental management. Project management should include the management of foreign funding where it occurs in order to avoid duplication and ensure the rational use of the financial resources granted through the projects.

Recommendation 1.5:
The National Environmental Action Plan (NEAP) should be revised on the basis of a broad discussion, with public participation. The coordination of all NEAP projects, including those funded internationally, should be ensured by the International Cooperation Department within the Ministry. The development of regional environmental management programmes should be encouraged, including, if possible, through international funding. *See Recommendations 6.4, 10.2 and 13.1.*

The strong, mainly vertical structuring of administration, combined with the lack of technical and managerial capacity and financial resources, has on the one hand led to a significant fragmentation of environmental management in Armenia. On the other, it has not prevented overlapping among various government entities, thereby further impeding horizontal cooperation between neighbouring administrations at the same level of management. As a result, such horizontal cooperation is weak.

The organizational structure of the Ministry, including the Central Administration, was the result of unification of former management systems and Central Administration offices. During the unification, different spheres having similar but also contradictory functions were grouped under one and the same system (Ministry of Nature Protection) and the consequences are partially overlapping and partially contradictory functions complicating the effective accomplishment of tasks. This is the case with the Underground Protection Department and the Geology Department as well as the Bioresources Protection Department and the Forestry Department. At present, it would seem advisable to strengthen the Normative-Methodological Department of the Ministry and create a structure for the coordination of national environmental programmes and projects and their implementation.

Similarly, the status of the Scientific Educational Strategy and Environment Protection Policy Department at the Ministry needs reconsideration. Armenia has broad experience in both fundamental and applied research into nature and environmental protection. The country has a large pool of well-educated people and a high-quality education system at all levels. The Scientific Educational Strategy and Environment Protection Policy Department, together with academic institutes in the country, could develop a strategy for environmental research and contribute to setting research priorities. It should also stimulate the development of educational programmes for environmental protection in primary schools, but needs to be strengthened.

The recent establishment of the Public Relations Department within the Central Administration of the Ministry was a very important step towards establishing new relations between government authorities and the public. There is a need for appropriate technical equipment in this Department, as its real tasks of shaping an adequate public relations policy still lie ahead.

Recommendation 1.6:
The organizational structure of environmental management in general and of the Ministry of Nature Protection in particular should be reconsidered. Provision should be made for upgrading the technical equipment of its key departments.

The preparation of a coherent environmental policy has also been hampered by the lack of adequately compiled and analysed environmental information. As long as accurate and timely information is not regularly available, decision-making as well as policy control and enforcement remain too difficult. Since 1990, no institution has been mandated or equipped to carry out a comprehensive environmental monitoring programme; and the national monitoring system is in a dismal situation. Before 1990, more money was available to develop the national environmental monitoring system, including to buy equipment. Now, not only has the staff been drastically reduced, but so has the budget for routine monitoring tasks. The monitoring system today relies very much on external measurements ordered by private companies or other organizations. It is isolated from other structures of the Ministry. The links with the inspectorates and their laboratories are severed. The Environmental Monitoring Centre is not involved in the implementation of environmental policy. Thus, it is impossible to fully evaluate the current environmental situation in the country. For example, air pollution in rural and suburban areas is not monitored, making it impossible to assess for instance the effects of air pollutants on sensitive ecological receptors like natural vegetation or agricultural crops. The situation regarding water monitoring is no better (See Chapter 8).

Recommendation 1.7:
A project for strengthening the national monitoring system should be developed as a top priority and in full coordination with all ministries and institutions involved in monitoring, such as the Ministry of Health, possibly as part of the National Environmental Action Plan. See Recommendations 10.4, 13.3 and 13.4.

The environmental NGOs in Armenia differ in their tasks and responsibilities, but they cover practically all aspects of the environment and nature protection. The involvement of NGOs in environmental decision-making

ought to be strengthened. However, there is also still no general legislation regarding public access to information and public participation in environmental decision-making. Their relations with the Ministry vary greatly; some of them enjoy quite constructive collaboration.

The biggest hindrance to NGOs work is the lack of finance. Most NGOs live on grants mainly obtained from abroad. As NGO connections might be able to help finance some environmental problems that are suitable for international cooperation, their legal and organizational capabilities to receive foreign donations may be improved, for instance by creating a centre for the protection of the environmental rights of consumers. It could offer services such as receiving donations for NGOs, analysing products for compliance with environmental norms, consultancy, legal assistance in cases of litigation over environmental risks, etc.

Recommendation 1.8:
Financial bases should be created for the further development of independent NGOs. The creation of a centre to protect the ecological rights of consumers or any other suitable institution serving this purpose should be considered.

Despite the scarcity of resources, important organizational steps could be taken by the Ministry of Nature Protection and the NGO community to improve the situation. For example, the clout of the NGO community would probably increase, if they improved their coordination. The Ministry should involve not only individuals but also NGOs as such in the preparation and discussion of the environmental laws and regulations. Similarly, NGOs should also be involved in discussions of environmental impact statements, and could be involved in the preparation of national and regional programmes for environmental management.

The Ministry of Nature Protection is currently trying to improve public information and consultation in the development of an integrated water resources management plan (see Chapter 8). The lessons that will be learned from this experience should be thoroughly analysed and used to improve general contacts between the Ministry and the NGO community.

Recommendation 1.9:
The NGO community should review its internal organization with a view to improving its coordination. The Ministry of Nature Protection should systematically associate NGOs with the discussion of all environmental issues of public interest.

Chapter 2

ECONOMIC INSTRUMENTS, REGULATORY INSTRUMENTS AND THEIR ENFORCEMENT

2.1 Economic instruments

System of charges

A new governmental decision on environmental charges was adopted in 1997, replacing an earlier scheme of 1993. Charges are at present levied for the purpose of *nature conservation and use* on:

- the use of surface and groundwater (Annex 1 to the decision)
- the extraction of mineral resources (Annex 2)
- air emissions of dangerous substances from stationary sources (Annex 3)
- fuel, road motor vehicles and emissions from mobile sources (Annex 4)
- discharges of dangerous substances to water (Annex 5)
- the disposal of waste (in landfills, Annex 6)

The six annexes notably specify applicable rates for one of the above items, together with the methodology for calculating the payments due. Till 1993, there was no general charge on the withdrawal of water. An abstraction fee was charged to industrial users (including energy production), but did not apply to water extracted from Lake Sevan. In 1997, extraction charges were extended to cover domestic and industrial uses of groundwater, surface water and water from Lake Sevan. The 1997 system was chiefly intended to raise revenue. However, out of a projected revenue of 890 million drams in 1998, only about 30 million were collected. This is less than the revenue collected in 1996 under the previous system. Apparently, families on average incomes could not afford the new charges (that amount to more than 5 per cent of the family revenue, which is the highest affordable limit according to the World Bank). Also, doubt was cast on the capacity of the Ministry of Nature Protection to collect the charges.

Payments are imposed for geological exploration and the exploitation of mineral resources. Users are not charged for geological exploration if the survey was funded from their own sources, or if the minerals in question belong to an approved special category. Charges for exploitation purposes are based on the volume extracted in a defined period, and on the actual price of the mineral resource (current price for extracted amounts sold, average price of previous period for unsold amounts). Noble, non-ferrous and rare metals as well as semi-precious stones are exceptions, since the charges are applied to the international average price of metal or stone and based on the price announced by the Precious Metals and Stones State Storage for the accountable period. For one gram of gold extracted, the rate is 6 per cent. For one tonne of copper and molybdenum, the rate is also 6 per cent. A cubic metre of basalt is charged at 3.5 per cent. Payments for the use of mineral resources in 1997-1998, including the corresponding volume of extracted useful minerals, are shown in Table 10.2.

Rates were updated on 1 January 1999, and a few other changes were introduced. The only significant change concerns the introduction of a charge on water withdrawal from Lake Sevan for irrigation purposes. Water use charges are the subject of Table 2.1. A systematic change was introduced for mineral extraction charges, which are now calculated on the basis of the volume extracted as reported by the manufacturer instead of the weight. The charges for precious and non-ferrous metals that are exported are based on world market prices. The tax authorities are involved in the collection of overdue payments and the payments are paid into the

State budget. Overall, the 1999 rates are differently structured from their predecessors, but total incidence is unchanged.

Table 2.1: Water use charges

Drams/m^3

Purpose of use	Before 1999	Since 1999
Groundwater		
- for drinking purposes	1.0	1.0
- other uses	1.0	1.0
Surface water		
- for domestic and industrial uses	0.5	0.5
- for irrigation	0.0	0.0
- for fisheries	1.0	1.0
Water from Lake Sevan		
- for energy production and industry	1.5	1.5
- for irrigation	0.0	0.2

Source: Cabinet Decree, Republic of Armenia, 1999.

In January 1999, new payments were introduced by decree for the use of biological resources. Resources subject to charges are specified, together with their rates. Some industrial effluents were added to the list of water pollutants, but other rates remained unchanged. The rates for industrial waste disposal were doubled. The decree also modified the rates on private vehicles, which were increased between 3 and 6 times depending on whether the owner of the car is a physical or legal person. All increases were meant to adjust for inflation. The development of the consumer price index during 1994 to 1999 is shown in Table 2.2, together with the trend of the annual average dram - US dollar exchange rate.

Table 2.2: Inflation and exchange rates, 1994-1999

	1994	1995	1996	1997	1998	1999
Inflation (%)	4 962.3	176.0	18.8	13.8	8.7	2.0
Exchange rate (dram/US$)	287.0	405.9	413.4	490.0	504.9	535.1

Source: Ministry of State Register and Statistics.

Annex 3 of the 1997 decision lists components and charges levied per tonne of pollutants emitted. Charges on emissions from road transport differentiate between enterprises (for which rates depend on the type of fuel used), private cars and foreign vehicles entering the territory of Armenia. Charges for the last two categories are based on the type of vehicle. Water pollution charges are levied on industrial users according to water-quality standards and emission standards. From 1999 onwards, water pollution charges apply to 34 industrial pollutants instead of 28. The rates remained unchanged except those for sulphates, phosphates, BOD and suspended solids, which were raised by a factor of five. Charges range from 1 million drams per tonne for very toxic elements (cadmium, nickel, copper, phenols) to only 30 drams per tonne for chlorides. According to the Decision, one tonne of phosphate is charged 10 023 000 drams, a rate which is currently being reconsidered because it is too high. What remains unclear is the way the discharged quantities are measured and whether the charges will be enforced. At present, the Government is deliberately lenient in the enforcement of emission limits and the collection of pollution charges and fees.

1997 and 1998 charges for discharges of effluents into water bodies are shown in Table 2.3. 78 per cent of the amount is levied on phosphate pollution, 8 to 9 per cent on nitrates and 1 to 2 per cent on suspended solids and copper. In 1998, the contribution of each of the other discharges to collected revenues was less than 1 per cent.

Apparently, there are no charges on BOD, COD and global toxicity. Dissolved matter includes organic material and represents noticeable quantities, but makes up less than 1 per cent of collected charges.

The charge on the disposal of industrial waste depends on its toxicity. Five categories are distinguished (see Chapter 7). Charges are 18 000 drams/tonne (first category of toxicity), 9 000 drams/tonne (second category), 1 800 drams/tonne (third category), 600 drams/tonne (fourth category) and 300 drams/tonne (fifth category).

Table 2.3: Quantities of pollutants and corresponding charges, estimated for 1997 and 1998

	Quantity		Charges			
	Tonnes/year		Thousand drams		as % of total charges	
	1997	1998	1997	1998	1997	1998
Total			262 340.80	294 252.70	100.0	100.0
Suspended solids	6 864.00	6 028.00	4 643.00	4 101.00	1.8	1.4
Dissolved matters	51 926.00	71 344.00	1 558.00	2 140.00	0.6	0.7
Chlorides	14 150.00	15 018.00	425.00	451.00	0.2	0.2
Sulphates	21 686.00	16 708.00	2 050.00	1 671.00	0.8	0.6
Nitrates	15.50	10.60	12.90	11.80	0.005	0.004
Nitrites	42.00	53.00	21 381.00	27 026.00	8.1	9.2
Phosphates	20.80	23.20	203 499.00	232 253.00	77.5	78.9
Iron	10.80	4.70	366.90	160.40	0.1	0.05
Copper	5.30	2.40	5 443.00	2 460.00	2.1	0.8
Zinc	0.10	0.03	461.00	26.00	0.2	0.01
Nickel	0.10	0.00	40.30	2.30	0.02	0.001
Chromium	0.02	0.01	0.30	0.10	0	0
Aluminium	0.02	0.01	0.40	0.10	0	0
Others (16)	-	-	22 460.00	23 950.00	8.56	8.14

Source: Ministry of the State Register and Statistics, 1999.

The 1999 decree also added a new tax on "goods containing harmful substances". It is levied on 20 categories of goods like oil products, car batteries, etc. The tax rates are a percentage of the market price before taxes. The revenues collected from the different charges in recent years are shown in Tables 2.4 and 2.5.

Table 2.4: Environmental revenues 1995-1999

	1995	1996	1997	1998	1999
	Million drams				
Total State revenues (excluding grants)	73 775	89 910.8	118 204.0	160 722.0	180,995.4
of which:					
Tax revenue	55 778.0	70 335.8	107 691.2	136 595.6	150,743.3
Charges on nature conservation and nature use					
Budgeted	-	-	980.0	1 076	3,000.0
Actual	390.0	235.0	336.0	608.0	6,606.5
	Percentages				
Nature conservation charges in total State revenue	0.53	0.26	0.28	0.38	3.65
Nature conservation charges in tax revenue	0.70	0.33	0.31	0.44	4.38

Source: Ministry of Finance.

Table 2.5: Environmental and nature use charges

Million drams

Type of duty	1998 Total	1998 %	1999 Total	1999 %
TOTAL	608.0	100.0	6 606.5	100.0
I. Nature use charges, total	302.0	49.7	527.2	8.0
1. On water use	5.2	0.9	129.4	2.0
2. On extraction of useful minerals	296.8	48.8	355.8	5.4
3. On use of biological resources	0.0	0.0	42.0	0.6
II. Environmental charges, total	275.2	45.3	6 079.3	92.0
1 On atmospheric emissions of harmful substances, total	273.5	45.0	734.2	11.1
1.1 From stationary sources	2.4	0.4	10.4	0.2
1.2 From mobile sources	271.1	44.6	723.8	11.0
2. On emissions of harmful substances into water	1.3	0.2	173.8	2.6
3. On specific forms of disposal of industrial and municipal wastes	0.4	0.1	3.3	0.1
4. On goods causing harm to the environment	0.0	0.0	5 168.0	78.2
III. Other charges	30.8	5.1	0.0	0.0

Source: State Committee of Nature Protection.

Armenia's legislation provides for:

- User charges for cleaning, removing and disposing of domestic waste
- Product charges to cover recycling.

The normative department of the Ministry of Nature Protection is drafting new laws on:

- tax differentiation for unleaded/leaded fuel
- municipal, regional and State environmental funds.

Each landowner must pay land tax. The tax is calculated on the basis of the cadastre and usually includes 15 per cent of the calculated cost of the agricultural product. For some farms producing organic products or especially important agricultural products, the tax can be reduced. Garden owners are exempt from taxes until the gardens start to give crops, and owners of arable land do not pay taxes for two years after privatization. The rate of collection of the land tax is low. The tax on land for non-agricultural use amounts to 0.5 - 1 per cent of the cadastral value.

Collection of payments due

The Environmental Inspectorate determines the levels of emissions of hazardous substances for which charges are due. On this basis, a report is forwarded to the tax authorities that collect fees and fines. Municipalities are responsible for collecting and handling waste, water supply and waste-water treatment according to required standards. They also control the landfills. The payment of water-use fees, introduced in 1993, meets with widespread public resistance (see Chapter 8).

The collection of payments remains inefficient. The Environmental Inspectorate faces substantial problems, like low salaries, obsolete monitoring equipment and running costs not covered by the budget. Table 2.6 shows that the actual payments are low compared to the initial charges. The administrative cost of effectively collecting payments is often higher than the fines and fees.

Table 2.6: Environmental fines and compensation, 1994-98

Million Drams

	1994		1995		1996		1997		1998	
	Charged	Paid	Charged	Paid	Charged	Paid	Charged	Paid	Charged	Paid
Total	21.10	1.10	36.40	3.50	327.50	4.40	57.20	12.50	890.02	30.2
Environmental fines	0.30	...	1.60	...	2.10	...	2.00	...	...	...
Environmental compensation	20.80	...	34.80	...	325.50	...	55.20	...	...	...
% collection		5.21		9.62		1.34		21.85		3.4

Source: State Committee of Nature Protection.

2.2 Regulatory instruments and enforcement

Regulatory instruments

Since 1998 (Government Decision No. 1702) industrial enterprises have needed an "ecological passport" to pursue their activity. The "ecological passport" contains: general information about the enterprise, characteristics of the emissions (into atmosphere and water, separately), raw materials required, energy sources, water use, cleaning facilities, recultivation works, and information about waste. This passport is only a record; it is not designed nor used as an instrument for enforcing compliance with legislation. The Ministry of Nature Protection, the State Emergency Committee and the State Technical Inspectorate are responsible for implementing this decision. Ten such ecological passports have so far been prepared and submitted to the Ministry on Nature Protection.

Pollution control continues to be based on the former Soviet Union standards. No new standards are applied, and there are no guidelines on how to organize the control under transition period conditions. The State Regulation on air pollutants from pollution sources (stationary and mobile) is based on the Law on Atmospheric Air Protection. The main idea of this Law is to limit the emissions of anthropogenic air pollutants to levels that would not endanger national air quality standards. The State uses three basic mechanisms for protecting the air: limitation, governmental control and State registration of air pollutants.

A large number of laws and decrees regulate water use. A complex system of water quality standards, norms and ecological passports and permits is in place. Water-use fees are charged to commercial enterprises, water utilities and irrigation water users. Industries are charged fees for water pollution. Specific measures apply to Lake Sevan National Park, which is managed through a zoning system which defines permitted activities (protection, recreational and economic) within each area (See Chapter 8).

The legal framework for waste management is incomplete. Only the import, export and transit of dangerous and other wastes are regulated. The rights and obligations of waste producers, dump managers, hauliers and agencies responsible for solid waste management are scattered throughout various laws and regulations.

Enforcement tools

Environmental inspectorates control emissions. If violations of emission limitations are discovered, the head of the State regional inspectorate is empowered by the Law on Administrative Responsibility to start legal proceedings against the responsible executives. The Law on Atmospheric Air Protection is the legal basis for the compensation of damage caused to the environment by excess air emissions (See Chapter 9). The Criminal Code enables the State regional inspectorate to present the proper documents to the regional public prosecutors' departments in order to start a criminal case. The State regional inspectorate can also limit or prohibit the activities of enterprises, organizations and citizens.

Inspectorates are responsible for controlling a very broad scope of environmental activities: atmospheric air, water, soil and subsoil, flora and fauna, all industrial activities, fishing and hunting. The significant decrease in industrial activity (around 20 per cent of industrial capacity is currently used for production) increases the relative importance of pollution from mobile sources. It also explains the leniency in permit enforcement. The inspectors also check the permits issued by the Ministry. The number of staff in the State Inspectorate and the regional inspectorates is 230; in each inspectorate the average is 12-15 staff.

Regional inspectorates can inspect an enterprise at any time. They follow a standard inspection procedure. When environmental laws are violated, different actions are possible. A mandatory list of remedial actions can be issued, economic sanctions can be imposed, the case can be submitted to the prosecutor's office, and the production activity can be suspended. The currently low level of industrial production means these options remain theoretical.

The key role of inspectorates in law enforcement is difficult to maintain. Inspectors' salaries are very low (US$ 20 per month in September 1999). Financial resources are also lacking for strengthening the inspectorates in other ways, including through the purchase and maintenance of reliable laboratory equipment. On the whole, it is difficult for the inspectorates to remain competitive in the labour market. Lack of resources also makes it difficult for individual inspectors in the field to communicate regularly with their central administration – thereby impeding their coordination.

The inspectorates do not have direct links with the departments within the Ministry of Nature Protection that issue the permits. There is no collaboration between the State Inspectorate and the Environmental Monitoring Centre of the Ministry. Actual control over both emissions and immissions is scattered. The laboratories involved work separately in an uncoordinated manner. Under these circumstances, the national environmental monitoring system and the controlling system cannot perform adequately.

The economic sanctions that can be applied include fines, compensation payments and penalties:

- Fines can be imposed for violations of the environmental legislation, together with confiscation of the tool or project with which the violation was carried out (based on the legislation on administrative infringements)
- Compensation can be required for harm caused to nature, for excess consumption of natural resources, as well as for emissions into the environment (based on the environmental legislation)
- Penalties can be charged after appropriate judicial procedures.

The Law on Administrative Violations and Fines specifies fine levels. The Law dates from the former Soviet Union. If taxes and fees remain unpaid, the tax authorities can start penal proceedings 15 days after the due date. An administrative fine can be imposed for non-payment of the taxes and fees. The sanction amounts to 0.25 per cent of the sum in question for every day past the due date.

The system of "compensations" introduces additional penalties if emission levels exceed the maximum permissible concentrations (MPCs) known in the former Soviet system. The collection of compensation is under the jurisdiction of the Ministry of Nature Protection. MPCs are calculated for approximately 420 air and water pollutants, the levels are set according to public health considerations. The Environmental Inspectorate of the Ministry of Nature Protection uses the MPCs to calculate the maximum allowable emission (MAE). The MAE varies depending on the type of industry, its location and the type of pollutant. A compensation charge is levied if emissions exceed the MAE. Charge levels are set in the Governmental Decree on the Rates of Nature User's Charges. Two scales are applied, one for violations up to 50 times the MAE and one for violations over 50 times the MAE.

Fines and compensation charged and collected in selected years are the subject of Table 2.6. The high levels charged in 1996 compared to other years are due to one single compensation case, in which the Areatsya waste-water treatment plant had to pay an amount that accounts for over 80 per cent of this total. The discrepancy between the charged and the paid values is due to the collection mechanism. The problem is the same

for the collection of charges. The administrative cost of collecting a non-paid fine or compensation is generally higher than the fine.

Environmental standards

Armenia uses standards based on the former Soviet system. However, to reach international levels, the Ministry of Nature Protection is preparing new laws to facilitate the introduction of these standards in the legislation. (see Chapter 4).

2.3 Environmental expenditures and revenues

Sources of finance

The following are the most important sources of funding for environmental expenditures:

- State and regional budgets
- Private sector
- Foreign assistance

The budget of the Ministry of Nature Protection is the largest of the public budgets. It covers its operational and administrative tasks and those of its dependent institutions. In 1997, more than 90 per cent was spent on salaries and social contributions. A separate budget allocation from the State budget for Hydromet is intended to cover its operational costs. There are no State allocations for environmental investments. This means that no resources are available for either monitoring equipment and computers, or running costs like fuel.

In addition to the State budget, the Ministry of Nature Protection obtains revenues from some of its ancillary services. A percentage of these revenues go to the State budget. For example, the Hayantar service is involved in forestry activities. Its main functions are logging and forestry conservation. It is self-financed through its logging activities.

Another source of income for the Ministry is fishing in Lake Sevan. A proposal has been made to earmark a percentage of fishing revenues for the Sevan National Park. There is no detailed breakdown available of the Park's expenditure, but it appears that government allocations and fishery revenues are used to cover basic park management costs. See also Chapter 6 and Recommendation 6.3.

State expenditures

It is not always clear which expenditures can be considered environmental. For example, the Ministry considers projects on land rehabilitation as environmental expenditures, because these projects preserve and improve land quality, primarily for agricultural purposes - that is why they fall under the administration of the Ministry of Agriculture. They deal with:

- the repair of agricultural drainage systems and land reclamation
- flood protection
- earthworks
- the restoration of damaged land
- R&D related to land reclamation

Table 2.7 breaks down the State's environmental expenditures in accordance with current practices, i.e. it does not include the Vorotan tunnel, the Debet-Sevan link or land rehabilitation expenditures. Information on expenditures for waste management is available in Table 2.8.

Table 2.7: State environmental expenditure, 1995-1999

	1995	1996	1997	1998	1999	
					Budget	(Actual)
	Million drams					
Total environmental expenditure	253.1	292.5	331.8	504.2	741.5	463.0
Inspectorate, Monitoring, Information Centre	41.5	80.0	67.9	67.2	145.7	72.6
Forest economy	104.0	86.1	99.9	100.0	120.0	64.5
Special Protected Areas, excl. "Sevan"	12.1	15.3	14.3	86.0	95.0	69.1
"Sevan" National Park	11.1	16.0	19.6	63.0	81.1	38.2
Armhydromet	84.3	95.1	130.1	189.0	299.7	218.6
	Percentages					
State environment expenditure as % of GDP	0.048	0.044	0.041	0.053	0.074	0.047
State environmental as % of State expenditure	0.017	0.181	0.195	0.237	0.300	0.190

Source: State Committee of Nature Protection, Ministry of Finance.

Table 2.8: Expenditures for waste removal, treatment and disposal, 1997-1998

Thousand drams

Process of treatment/disposal	Total		of which: for hazardous wastes	
	1997	1998	1997	1998
Expenditures total	113 183.20	123 618.10	100 869.80	104 422.10
Waste treatment and elimination	105 181.30	103 953.80	98 969.80	103 612.80
Waste recycling/reprocessing	1 686.80	308.00	1 600.20	282.00
Removal and disposal on waste sites/landfills	3 782.70	3 993.90	198.50	527.30
Charges from other enterprises for receiving waste	2 532.40	15 306.40	101.30	–

Source: Ministry of State Register and Statistics.

Regional expenditures

The *Marzes* are responsible for supervising environmental policy in the regions. They have their own environmental departments, which are responsible for monitoring and enforcement (see Chapter 1). *Marzes* are allocated a total budget, without any budget lines. Without defined budget lines and in the current economic situation, they use their financial allocations mainly for salaries. Although article 2 of the Law on Environmental Payments stipulates that the payments they collect should be used for environmental purposes, the tight financial situation means that they are in fact a direct source of revenue for the State budget. The budgets of the municipalities relate to regional budgets in the same way as regional budgets relate to the State budget. They contain neither a budget line for environmental investments nor one for environmental expenditures.

Enterprise expenditures

Armenia is ending its privatization process (see Chapter 3 for more information). Most small, medium-sized and large enterprises have been privatized. Since 1991, the definitive closure of large-scale enterprises has resulted in a significant drop in pollution levels. Nevertheless, as Table 2.9 illustrates, Armenia's industry incurs a certain amount of environmental expenditure, which is spent on operating and repairing pollution abatement equipment. However, there is a strong regional imbalance in the current expenditures, of which around 90 per cent are spent in Yerevan, while the Ararat Armavir, Lory and Kotayk marzes practically share the rest of the expenditures.

Table 2.9: Environmental expenditures by enterprises, 1997-1998

Million drams

Category of expenditure	1997	1998
Expenditure for repair of environmental capital goods - Total	126.7	181.5
For air pollution abatement	18.5	64.1
For equipment and structures for use and protect water resources and waste-water treatment	107.4	98.0
For treatment and disposal of wastes	0.8	19.4
Current environmental expenditures - Total	692.5	1 152.0
For water resources protection and use	510.9	943.7
From which paid to other enterprises for receiving and cleaning wastes and water	54.7	91.3
For air protection	79.2	146.0
For treatment of industrial wastes and other hazardous substances	102.4	62.3
From which paid to other enterprises for waste collection, storage, treatment and disposal	0.7	15.4

Source: Ministry of State Register and Statistics.

In the framework of future industrial development, Armenia envisages an improvement in the protection of its environment and the management of its natural resources, for instance through forest rehabilitation, reforestation, pollution abatement, sanitation of Lake Sevan and other projects. The preparation of a corresponding "Project on the protection of the environment and natural resources management" involves two main types of activities: replacing imports by domestic production adapted to the project's target, and obtaining loans or granting loans to small and medium-sized enterprises that would help reach the project's objectives.

Banks require a positive environmental impact assessment before financing major capital investment projects. The Ministry of Finance is working on a project to facilitate investments for environmentally friendly purposes. It intends to implement a system of soft loans, like loans at low interest rates for environmental protection investments.

Foreign assistance (grants and loans)

International financing institutions and other donors provide grants and loans. International financing takes the form of policy assistance (project preparation, feasibility studies, research, etc.), investments, etc. Foreign sources are the largest sources of finance for environmental investments. A detailed project overview of foreign funding of environmental protection is included in Chapter 4. Table 4.1 includes ministerial programmes that have obtained foreign funding.

2.4 Conclusions and recommendations

Armenia has started to develop a system of economic instruments to support its environmental policy and management. However, the severe economic depression is slowing down progress. In particular, there is at present only a very limited scope for introducing the full range of genuine economic instruments, i.e. those that induce economic decision makers to take more environmentally friendly decisions (which would enable them not to pay the charges or taxes introduced for this purpose).

While the current possibilities for an efficient kit of economic instruments are thus limited, Armenia will eventually have to design, introduce and enforce such measures. Such a need derives from both the features of a market economy (environmental management will have to adjust to steering economic actors via the market) and from international obligations (like those of conventions once they are in force, the United Nations Framework Convention on Climate Change being a case in point). In preparing for the full-fledged introduction of such a system, analytical research is necessary and helpful. It should aim at determining the types of economic

instruments that would be effective under Armenian conditions and at clarifying which application rates of the instruments would provoke the intended reactions of economic decision makers. Such a research programme appears to be feasible at present, in addition to the established system of economic instruments.

Recommendation 2.1:
The Ministry of Nature Protection should begin, at an early date, to develop a comprehensive and satisfactory system of economic instruments for environmental protection by undertaking research into the environmental and economic effects of the potential components of the future system.

At present, the primary role of economic instruments for environmental protection is to raise revenue for the State budget; it is not to influence the behaviour of economic decision makers. A secondary role also exists, that of enforcing environmental laws and regulations. However, the efficiency of economic instruments in these two regards is eroded by inflation on the one hand and by very unsatisfactory enforcement on the other. Consequently, even the current level of environmental protection in the country is being gradually undermined and even slow improvements are unlikely.

The remedy here seems to lie in stabilizing the level of income from economic instruments in real terms at a level that makes enforcement economically worthwhile. In other words, environmental payments that do not cover the administrative cost of their collection and enforcement need to be revised. The administrative cost of enforcement should include the cost of environmental inspection at a normal level (i.e. a budget for inspection that provides adequate salaries, adequate equipment for measurements and laboratories, and sustains a minimum level of operations, see also Chapter 1 and Recommendation 1.6). In addition, the charges for economic instruments should be set at such levels (still in real terms – i.e. after inflation) that they produce environmentally beneficial results without making economic activity impossible.

Recommendation 2.2:
Environmental charges should be increased to the minimum level producing the desired result in terms of enterprise behaviour. Their administrative cost could be reduced, if they were limited to those few substances which actually contribute substantially to revenues from charge collection. The rates should also be stabilized in real terms, i.e. they should be indexed to a suitable measure of inflation. The charges should be strictly enforced.

The development of effective environmental management, together with the introduction of a market economy, which is decentralized by nature, will bring about a need to devolve management authority. The corresponding process will require two mainstream activities. On the one hand, the capacity for environmental management will have to be strengthened at local and regional levels of administration (see Chapter 1 and, in particular, Recommendation 1.1). On the other, the decentralization of competences for environmental management needs to be paralleled with a decentralization of funds, possibly also budgetary authority. In this connection, the recent concentration of public revenues and allocations for expenditures in the State budget points in the wrong direction. It should be corrected at the earliest possible date.

Recommendation 2.3:
The funding situation and/or budgetary authority of administrative regions and municipalities should be improved together with their mandate for environmental management and their respective managerial capacities.

Transparent environmental management at all levels of administration requires sufficiently reliable and widely accepted information. Statistical information on environmental expenditures is one important part of this. The introduction of such statistics matching the above criteria is difficult. Nevertheless, since they are also needed for international purposes, their development is an urgent task. The Ministry of Nature Protection, the Ministry of State Register and Statistics, the Ministry of the Economy, the Ministry of Finance and other institutions involved should join in this task. The work might benefit from recent progress made in the European Union.

Recommendation 2.4:
The joint development of reliable statistics on environmental expenditures by all the ministries and other State institutions involved should start as soon as possible. The work should lead to internationally comparable statistics on environmental expenditures.

Armenia's strategy with regard to environmental regulations was to preserve the system inherited from the former Soviet Union, considering that its revision would not be a pressing priority for the State early in the transition process. It seems that the time has now come to proceed with such a revision, as the system is becoming less adapted to the socio-economic reality of the country, and its maintenance is very costly both for the public budget and for the budgets of economic actors. The revision of the regulatory instruments may require either new legislation or the revision of existing legal instruments, depending on circumstances.

Recommendation 2.5:
The regulatory instruments should be comprehensively revised to adapt them to the new socio-economic realities and make them less costly to apply.

Chapter 3

SPATIAL PLANNING

3.1 The framework for territorial development

Geographical context

Armenia is a landlocked mountainous country with an area of 29 743 square km. It lies south of Georgia, west of Azerbaijan, north of Iran and east of Turkey. The country is subdivided into the following eleven regions (see Figure 1.1): Aragatzotn, Ararat, Armavir, Geghark'unik', Kotayk', Lorri, Shirak, Syunik', Tavush, Vayots' Dzor, and the capital Yerevan, which in turn are divided into 37 districts.

Ninety per cent of the territory is 1 000 m or more above sea level, and forty per cent above 2 000 m, with an average altitude of 1 830 m. It is characterized mainly by the Alpine-Himalayan chain, extending from the north-west to the south-east of the country, its central portion containing important volcanic formations. The highest point is Mount Aragats, 4 090 m (13 419 feet) above sea level and the lowest point is the Araks River at the south-eastern border 450 m (1 475 feet) above sea level.

The protected area network of Armenia covers ten per cent of the national territory. Lake Sevan National Park makes up half the total protected area. Created in 1978, it is a unique alpine lake ecosystem, whose management has been revised and updated several times since then. The management of the Park has developed considerably in recent years.

In many cases only a small portion of State reserves have enjoyed a significant degree of protection, while large parts have been negatively affected by human activity. For more details, see Chapter 5. The other protected areas are in better condition, due to the relatively minor (though ever-present) pressure from human activity along their boundaries.

Selected population dynamics

The population of around 3.80 million represents a population density of approximately 128 inhabitants per square kilometre. Sixty-eight per cent of the population is urban, of whom one third lives in the capital Yerevan. Thirty-two per cent of the population lives in rural areas. Both internal and external migration are considerable. The search for employment is the main reason for internal migration to Yerevan and for emigration mainly to the Russian Federation. It is estimated that 800 000 persons left the country in 1991, and 600 000 more between 1992 and 1996.

In 1993, the population of working age was 2.1 million, of whom 1.53 million were employed. In January 1994, there were 102 600 registered unemployed persons, about 6 per cent of the labour force. The official rate of unemployment was 11-12 per cent on 1 December 1998, which is twice the level of 1992. It is also the highest level in all countries in the Commonwealth of Independent States (CIS). During two years, Armenia's gross domestic product fell by 67 per cent. Many of Armenia's chief industries such as chemicals, building materials and textile mills are very energy-intensive. The effects of the energy shortage on day-to-day life in cities have been equally devastating.

One particularity of the Armenian population is the Diaspora, estimated at nearly 3 million. Many Armenian emigrants have gone to the United States and Australia and to Europe, primarily to France. A census is planned for the year 2000 to assess the number of emigrants and their situation.

The unsolved conflict over Nagorno-Karabakh has also produced a refugee population inside Armenia. It totalled about 312 000 persons in 1998. The majority (approximately 80 per cent) of refugees are from urban settlements, but an estimated 70 per cent are settled in rural areas and have had to face the challenges of a rural lifestyle. Others are living in community centres, abandoned buildings, basements and apartments in Yerevan or other major towns. Some 40 000 people are still living in conditions that are considered hazardous to their health. In January 1999, the government authorized refugees to obtain Armenian nationality and to register in the place of their actual residence. The policy of privatizing houses in favour of refugees is strongly advocated. Special attention will be given to refugees living in community centres in Yerevan and other major cities.

Human settlements

Armenia's housing stock includes 771 285 dwellings (approximately 41 million square metres of floor space). About 55 per cent of them are in urban areas, more than half this number in Yerevan. Since 1990, some 4 646 residential premises have been left unoccupied (with an overall floor space of 2 415 million square metres). Of those, 4 002 (with an overall surface of 1 360 million square metres) are in the disaster zone and 644 premises (with an overall surface of 1 055 million square metres) are in other regions and towns. The scarcity of housing units and the insolvency of the people who need shelter are not favourable settings for the development of a private rental policy. Many young families live with their parents, a traditional habit that is reinforced by current economic difficulties. The premises, if not adequately taken care of, become dilapidated in a short time. Infrastructures (heating system, sewerage system, electricity supply system, etc.) have suffered particularly significant damage. The housing problem is expected to become one of the nation's most acute in the near future.

Table 3.1: Dwelling stock

Million m²

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Change in the dwelling stock									
Increase during the year, **total**	2.70	3.70	0.90	1.21	0.49	0.77	1.00	1.70	1.00
- in new construction	1.92	1.40	0.66	0.43	0.26	0.21	0.19	0.15	0.15
Decrease during the year, **total**	0.17	0.16	0.04	0.15	0.03	0.05	0.00	0.01	0.04
- resulting from demolition	0.13	0.14	0.03	0.12	0.02	0.03	0.00	0.01	0.03
- resulting from change in use	0.04	0.01	0.01	0.03	0.01	0.01	0.00	0.00	0.01
Dwelling stock at year-end	**50.15**	**53.85**	**54.75**	**56.02**	**56.40**	**56.97**	**57.93**	**59.66**	**61.41**
Dwelling stock per capita *(m^2)*	14.20	14.80	14.70	15.01	15.05	15.15	15.35	15.76	16.18

Source: Ministry of State Register and Statistics.

Table 3.2: Dwellings in urban areas by type of equipment, 1990-98

%

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Dwellings equipped with: *(as % of dwelling stock)*									
Piped water	45	44	43	66	63	65	65	64	63
Fixed bath or shower	42	41	38	57	55	56	57	57	55
Central heating	43	42	41	54	52	55	55	54	53
Connection to a sewerage system	44	43	42	63	61	65	64	63	63

Source: UNECE, Annual Bulletin of Housing and Building Statistics for Europe and North America.

The construction of new houses has resumed. In 1998, 1 200 construction permits were issued and 2 004 new dwellings were built. More than fifty per cent were detached houses (1 010 units), the remaining 994 being in apartment blocks. All of the detached houses are equipped with electricity and running water, but only 13 per cent actually pay for water use. Sewerage was installed in 24 per cent of the detached houses, central heating in

6 per cent and a hot water supply only in one per cent, but 79 per cent are equipped with electrical water boilers. During the same year, 1998, the sum spent on industrial construction reached almost 9 billion drams.

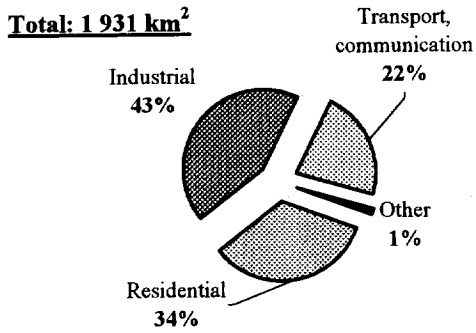
Table 3.3: Dwellings in urban areas by number of rooms, 1996

	Total	Dwellings with:		
		1 room	2 rooms	3 rooms or more
Number of dwellings *(1 000)*	516	90	157	269

Source: UNECE, Annual Bulletin of Housing and Building Statistics for Europe and North America, 1998.

The quality of construction is not always high. Inexpensive material is often used, and sometimes homes are built without plans being drawn up or architects being involved. The legal rules for construction are not always respected. The consequences on the environment include deforestation (wood cut illegally for heating, a problem that is exacerbated by the lack of building insulation) and water pollution because of the lack of water treatment facilities.

Figure 3.1: Built-up areas



Source: State of the Environment: Country Overview - Armenia, The European Union's TACIS Programme, Ministry of Nature Protection of Armenia, June 1998. Data as defined in the Land Code of Armenia adopted in 1991.

Historical and economic context

The Armenian nation is one of the world's most ancient. Its history has been very eventful. In modern times, Armenia regained its independence in 1918 and held it until 1920, when the Republic of Armenia was annexed to the USSR. The collapse of the USSR in 1989 preceded the declaration of independence of the present Republic of Armenia in 1990. The national currency (dram) was introduced in November 1993. During the Soviet period, Armenia was an economically developed region with several branch industries, intensive agriculture, and an elaborate social infrastructure. The division of labour of the former USSR with regard to agriculture attributed to Armenia mainly the production of fruit (apricots, peaches, quinces, wine grapes), vegetables, tobacco, geraniums, barley, cattle, walnuts, wheat, sheep and canned food.

Armenia is rich in mineral resources, especially in non-ferrous metals (molybdenum, copper, lead, zinc, gold, silver and rare metals) as well as non-metal minerals (such as diatomite, marble, basalt, granite and tuff). The reserves of molybdenum amounted to 35 per cent of stocks in the former USSR. Mining concentrated on molybdenum, copper, gold, lead and zinc. The mineral resources are widely used for industrial production. Some 45 per cent of Armenian industry was based on the mining and processing of molybdenum. In addition, Armenia manufactures chemicals, electronic products, machinery, processed food, synthetic rubber and textiles.

Industry grew continuously till 1988, when a major earthquake struck Armenia. It destroyed a significant part of its industrial potential. The disintegration of the former Soviet Union and the current economic difficulties of many of Armenia's traditional trading partners have caused severe economic problems for a country that used to export much of its production. See also Chapters 7, 10 and 11.

The economic plight hinders enterprises considerably in their restructuring efforts. New investment in many of the privatized enterprises is proceeding slowly. At the end of 1996, there were 250 joint ventures and 163 affiliates or subsidiaries of foreign companies registered in Armenia. Total FDI, however, was just US$ 35 million. Many foreigners have been discouraged by the state of Armenia's institutional infrastructure and of its legal system. Since 1998, FDI has grown strongly.

A new Law on Bankruptcy was enacted in January 1997. It included the initiation of liquidation procedures for enterprises that could not be successfully privatized. To date, 35 enterprises have been declared bankrupt, while others are going through bankruptcy procedures. The Ministry of Finance required all enterprises to introduce International Accounting Standards (IAS) in the course of 1997.

Privatization

The proclamation of independence was followed by the privatization of land, houses and apartments. Privatization stimulated the development of the housing market, and 70 per cent of dwellings are currently private property. Armenia was the first CIS country to initiate land reform. In 1991, the Supreme Council adopted the Law on Peasant Collective Farms and new land legislation.

Since 1995, enterprise privatization has been fairly successful, with some 62.5 per cent of large and 59 per cent of small units (1 358 and 6 166, respectively) privatized by autumn 1999. Over 61 per cent of 1997 GDP was produced in the private sector. Most sales of State-owned enterprises have been carried out via free subscription, with smaller properties (such as kiosks, small factories and hotels) sold by auction. After an enterprise's issue prospectus has been published, bids for shares can be made during a 40-day period and paid for in either cash or vouchers. Privatization goes ahead if bids for at least 25 per cent of shares are presented. There is no limit to the number of bids that a single bidder can submit, and where issues are oversubscribed, additional shares are created.

The enterprises to be privatized in a given period are decided by Parliament, while the government determines the order and methods of privatization, as well as enterprises' value and sales prices. Previously, a privatization commission - appointed partly by Parliament and partly by the President – was involved in the process or enterprise evaluation, but it was dissolved in 1996 on the grounds of inefficiency.

According to the 1992 Law on Privatization, every citizen is entitled to privatization vouchers. However, over 70 per cent of these vouchers have so far been sold, rather than exchanged for shares. So, few citizens have in fact become shareholders. The vast majority of shares are held in a few, concentrated holdings, including those of directors of the enterprises sold. Some 60 per cent of privatized companies have floated their shares on the Yerevan Stock Exchange.

By September 1997, some 1 700 medium to large Armenian enterprises had been privatized, mostly through public subscription but also at auction through employee buyouts. The sale of 14 enterprises to foreigners was announced by the government in June 1997. Among these were the Armenian-United States joint-venture telephone company Armental and the Yerevan cognac distillery, in addition to several hotels and mines. The sales were expected to be concluded in 1998. With the exception of nuclear power plants, the entire energy sector was expected to be privatized in 1998. The government had resolved to privatize 650 more enterprises by the close of 1997 and 120 more in 1998-99. That would bring the total number of firms in the private sector to 90 per cent.

A privatization programme for 1998-2000 was adopted, covering 280 enterprises, mostly in energy, transport, agriculture, electronics and mining. In some cases the government is clearing the company's debts or giving tax relief to large enterprises to assist their preparations for privatization. The government is likely to seek the participation of more foreign investors in the remaining privatization. The level of foreign participation has so

far been low, with foreign investors discouraged by energy shortages -- which have only recently been overcome -- and difficulties in importing component goods. As a result, the Law on Privatization was amended in 1996, allowing the government to sell some attractive enterprises via international cash tenders.

Separate procedures and legislation were adopted for the privatization of agricultural land and State-owned apartments. The privatization of agricultural land began in 1991, even before the break-up of the Soviet Union. Land that had belonged to the 'kolkhozes' (collective farms) was distributed free to families, with shares allocated in proportion to family size. A five-year ban on the sale of land was imposed. Little trading in agricultural land has occurred since the expiry of this period. Recently, land has more often been used for mortgage purposes in the emerging business of agricultural loans (see Chapter 11). Foreign investors are not allowed to buy land. It is generally agreed that land privatization has significantly intensified agricultural production. During the most acute economic blockade of 1992-95, little decrease in agricultural production was observed, while industrial production declined more than twofold. About 87 per cent of agricultural land has been privatized. Out of the previous 800 agricultural enterprises, about 320 000 private farms have been established. The effects of privatization on the structure of the agricultural sector are reviewed in Chapter 11.

Land cannot be sold to foreigners. Ownership of land is obtained in the following way:

1. An application is made to the local authority and to the regional administration where the land is located.
2. The local organs of various ministries coordinate their points of view on the application and produce their conclusions.
3. The application has to be approved by the ministries concerned (Ministry of Municipal Construction, Ministry of Agriculture, Ministry of Nature Protection).
4. All documents, accompanied by maps, are presented to the government, which takes a decision and allots the land.

Each landowner must obtain from the Cadastre Committee a 'land passport', which is a registration document, containing the description and a map of the plot, as well as indications of how the plot can be used. A landowner is obliged to protect the land from degradation and pollution. If the owner is an entrepreneur, an ecological passport is also required (see Chapter 2 for details). The Ministry of Nature Protection issues 50-100 passports of this kind per year.

State-owned flats account for some 55 per cent of total housing. They were given to their occupants in 1994-95. A real estate market has now been formed in which foreign investors are allowed to participate. However, the exclusion of foreigners from the land market has restricted their participation in real estate trading – 1.5 per cent of housing sold in Yerevan last year was bought by foreigners. Progress in privatization has been especially strong in housing, where 80 per cent of all units are now privately held.

3.2 Spatial planning priorities, instruments and institutions

Legislation

The most important piece of relevant legislation is the Law on Urban Development of 1998. Spatial planning is also covered by the Land Code (1991) and the Water Code (1991). The legislation deals with the relations between landowners and the authorities. It defines (a) the rights and duties of owners of land and of the authorities, (b) the rights related to the different activities pursued on the land (agriculture, human settlements, industrial activities, transport, communication, military land use, environmental protection, health care, recreational activities, sports, historical and cultural land use, forest, water, and reserve fund), and especially the allotment of land to new owners and uses, (c) the payment of compensation to landowners and land users for losing agricultural and forestry production during withdrawal from use or temporary use caused by activities pursued elsewhere, (d) the agricultural production on the land, (e) the State control of land (strategic zones), (f) the State cadastre, (g) land planning, (h) the possibilities for solving disputes over land, competence of local authorities and related procedural rules, (i) the responsibilities for violations of the Land Code, and (j) the follow-up to international agreements.

The Water Code regulates all aspects of water supply. It defines the responsibilities of all administrative entities and all kinds of water use. There is an intersection with the Land Code regarding the rules of construction of water installations. The Water Code specifies neither the control mechanisms for compliance with the law nor the measures to be taken in the case of non-respect of the law.

Some other legal instruments specify economic activities, like the Underground Resources Code (23 March 1992), the Forest Code (11 October 1994), the Code of Subsoil Minerals (19 March 1995), and the Law on Environmental Impact Expertise (12 December 1995). Many bylaws regulate the inspection procedures, sanctions in case of violation, and licences. The Law on Specially Protected Natural Areas establishes the protected area categories of State Reserves, State Reservations, National Parks and Nature Monuments.

The main law on the privatization of waste management services is the Law on the 1996-97 Programme of Distribution of State Enterprises and Uncompleted Construction (25 April 1996). The Ministry of Urban Development is drafting a new law to integrate the different functions of the city, as it is felt that town planning during Soviet times did not take account of realities. The intention is to add education to the functions of cities; it was not mentioned previously. For environmental protection, other texts are in preparation. They will define pollution taxes for special flora and fauna protection zones. The objective is to specify some fundamental aspects of nature protection issues in the principal codes or laws.

Major planning instruments

The Law on Urban Development determines the hierarchy of planning instruments. The so-called territorial 'Outline' provides a flexible, general framework, from which a more specific territorial plan is derived for the country as a whole. For each planning zone, territorial plans are established that are consistent with the territorial plan of the country as a whole. Master plans are foreseen for settlements within each zone, but exist at present only for a few of them.

During the Soviet period, there was an industrially oriented regional plan that related to the territory as a whole, including the settlements. It privileged the development of the capital, to which a high share of the available fiscal resources was allocated. Urbanization led to a number of new towns evolving around factories or huge specialized enterprises. The factories provided most of the housing, as well as social and technical infrastructure. Later, some of the planned communities diversified their economic profile and became larger industrial centres.

A new land code is currently in governmental clearing and may be submitted to Parliament for adoption this year. It would implement a new land-use classification. Four categories are distinguished in the draft: agricultural land, forest land, water resource protection land and urban development land. The urban development land is reserved for identified functions like education, transport infrastructure, culture and commerce.

Armenia is earthquake-prone. A study by specialized institutions concluded that the seismic hazard was underestimated in the code enforced prior to 1988 (i.e. the Soviet Seismic Code). The new Seismic Code of the Republic of Armenia was enacted in 1995, and it increased the level of seismic hazard to 9 of the Mercalli scale). Reconstruction remains a challenge to spatial planning, which the Earthquake Reconstruction Project (EQRP) is taking up. The Project was financed by a World Bank credit, and Japan supported its preparation with a grant.

Its primary objectives are (a) to provide improved housing and living conditions for residents of the earthquake zone, (b) to reconstruct basic infrastructure supporting the creation of employment in the affected zone, and (c) to develop a sustainable programme for rehabilitation. The EQRP included research and development of new technologies for retrofitting and constructing buildings, using laminated rubber bearings for seismic isolation. The technologies were developed in the Earthquake Engineering Centre (EEC) of the National Survey for Seismic Protection (NSSP) of the Government of Armenia.

Securing a supply of sufficient energy is another major problem for Armenia. Related spatial planning tasks are therefore also considered priorities. The main problem is the geo-political situation of the country. Landlocked

Armenia has been energy-starved for years. Trains via Georgia are considered insecure, and subject to a hefty cargo tax. An agreement was signed with Iran in May 1995, providing Armenia with natural gas for the next 20 years and also with electricity. In June of 1995, Armenia reopened its nuclear power plant, which had been closed since the 1988 earthquake. For details, see also Chapter 12.

Institutions

The Ministry of Urban Development is responsible for territorial planning, with 17 departments in charge of mapping, institutional projects, geodetic and other scientific studies, norms, and licences. In 1997, the Cadastre Department (since then renamed the Cadastre Committee) was created under the government to unify relevant databases and information about land registration. The Department was initially funded by the United States to develop the database. At the end of 1999, plots of 200 villages were introduced into the database, representing 20 to 25 per cent of the rural territory. The main part of the centre of Yerevan is also registered. The plan is to introduce all construction by 2004. The Global Positioning System (GPS) and computers are used to control the reliability of information.

The regional authorities deal with the cadastre and the construction permit according to the master plan. If the master plans are modified, the region will request an exemption from the Ministry of Urban Development, which has to respond within 15 days. The regional authorities also include authorities of different ministries. Libraries, clubs and kindergartens are also regional responsibilities, even though some are still national property, and the region or the city does not receive special funds for their restoration. The regional authorities now delegate the management of some schools to the municipalities.

The main ministries regulating land use and land resource protection are the Ministry of Agriculture and the Ministry of Nature Protection. Their respective functions are shown in Table 3.4.

Table 3.4: Responsibility for land administration by cadastral category, 1998

Cadastral category	Responsibility for use	Responsibility for protection
1. Land of agricultural significance	MoA (crop land mainly privatized)	MoA /MNP
2. Land under settlements (cities, towns and villages)	MoUD	MNP / MoA
3. Land under industry, transport/communication infrastructure or defence	MoUD / MoD	MNP / MoA
4. Land under nature or historical reserve, or sports/recreational facilities	MNP	MNP
5. Forest land	MNP	MNP
6. Surface water (rivers, reservoirs, canals, not including Lake Sevan)	MNP	MNP
7. Reserve land	-	MoA / MNP

Source: National Environmental Action Plan, 1998.

The local self-governing bodies conclude agreements on nature use with individual users, after the details have been agreed with the environmental protection agencies. Their consent is also required in matters of land use, as with construction permits, which are given by the regional authority, conservation of landscapes, ecosystems and other parts of nature. They are responsible for the appropriate control with the help of regional inspectors. Regional authorities are in charge of water supply, public transport, waste management and energy supply. When their economic resources are insufficient for carrying out their functions, the Ministry of Urban Development can be involved.

Environmental impact assessmt

Environmental impact expertise has been performed since 1986. It was subject to compliance with the normative and methodological documentation and standards in force in the former Soviet Union, i.e. the former OVOS process assessing environmental impacts. These practices were replaced by the provisions of the new Law on Environmental Impact Expertise (EIE), which entered into force on 12 December 1995. The Law requires the State to undertake EIE so as to identify, prevent or minimize hazardous impacts on the environment, human health, economic, social and natural development. Regulations are required in three respects. The government has passed a regulation specifying the minimum size of activities requiring EIE. It is also considering regulations on the list of required documents in EIE and on procedures, but has not yet passed them. In addition, amendments to the 1995 Law were submitted in summer 1999.

The procedures foreseen in the Law include public participation. At present, the draft text requires public participation at three levels: at the time of the preliminary information about the project, when the actual evaluation has been undertaken, and when the final statement is available. The procedure is derived from practices in the United States. Doubts about its applicability to Armenian circumstances at this time account for the long time taken by governmental clearing (four years) of the regulation on procedures.

The following planned activities may be subject to EIE:

(a) In the energy sector: nuclear plants and other installations with nuclear reactors; thermoelectric power plants; plants for the generation of steam and hot water; hydroelectric power plants; alternative energy plants; geothermal plants; facilities for the conversion, enrichment and production of nuclear fuel; spent nuclear fuel interim storage facilities; processing and final disposal of highly radioactive waste; processing and final disposal of radioactive waste from operating or shut-down nuclear power plants and from installations using radionuclides.
(b) In mining: extraction and processing of minerals; extraction and processing of coal, oil, natural gas; extraction and processing of uranium ore, decontamination of slag heaps and sludge ponds, rehabilitation of mines.
(c) In the chemical industry: production and processing of rubber, rubber items and other organic materials; oil-processing industry; production of inorganic acids, alkali and other products; production of detergents and other products of household chemistry exceeding a threshold value; production of toxic and pharmaceutical products; production of toxic substances and pesticides.
(d) In the construction sector: production of cement, lime and limestone; production of plates, bricks, reinforced concrete constructions and other construction material.
(e) In metallurgy: production and processing of crude iron, steel and non-ferrous metals; surface processing of metals exceeding a threshold value.
(f) In the electric and radio-electronic industry: activities exceeding a threshold value.
(g) In the wood-processing industry and production of cellulose and paper: activities exceeding a threshold value.
(h) In light industry: production of textile, footwear and other goods in an amount exceeding a threshold value.
(i) In food processing and fisheries: activities exceeding a threshold value.
(j) In the urban construction sector: houses, buildings, complexes and other planned activities exceeding a threshold value
(k) In municipal services: facilities for treating sewage waters.
(l) In waste processing: facilities for processing, decontaminating and incinerating waste; decontamination and disposal of industrial waste.
(m) In nature protection: rehabilitation and restoration of natural ecosystems affected by human activity; introduction of new animal and plant species.
(n) In agriculture: amelioration activities (such as desalinization of soils, construction of drainage and irrigation systems, drainage of swamps, protection of soil from erosion, salination and degradation) in areas exceeding a threshold value.
(o) In forestry: restoration of forests; qualitative improvement of forest.

(p) In water supply: construction of reservoirs and, dams, big canals, pumps and other water-supply facilities; withdrawal of groundwater.

(q) In infrastructure: construction of highways and roads, tunnels, bridges, underground tunnels, railways, airports; long-distance gas, oil, steam, hot water and other pipelines, including ancillary facilities (pumping, exchange and compressor stations) exceeding a threshold value; long-distance power transmission lines exceeding a threshold value; protective engineering structures.

(r) In the service sector: trade centres and markets exceeding a threshold value; hotels and camping sites exceeding a threshold value; petrol stations; restaurants and cafeterias exceeding a threshold value; bus and railway stations; crematoria and cemeteries.

The government sets the threshold values triggering the need for EIE. Planned activities listed above that are below the threshold values may also be subject to EIE, if they are to be implemented in areas with a special status, as determined by legislation.

The State Environmental Expertise contains three stages: registration of a project, reception of the documents, report of the result. The project developer registers the project requiring an EIE with the Department of State Environmental Expertise of the Ministry of Nature Protection. The developer describes the project (situation, technology, branch). If an EIE is required, the Department of State Environmental Expertise chooses EIE experts in accordance with the type of planned activity, all the costs of the study being borne by the developer. Their report will come back to the Department, which transmits it to each of the concerned departments of the Ministry (Air, Water, Land, Normative), before drawing its conclusion. After that, information will be transmitted to the public. Only then can the State Commission of the Ministry of Urban Development approve any construction related to the project. In 1998, 89 projects were subjected to expertise. The law forbids the operation of any economic unit as well as the implementation of any concept, programme, scheme including the explanation of processes, plan, or master plan without the positive conclusion of an EIE.

Armenia ratified the UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) in 1997.

3.3 Conclusions and recommendations

The disastrous earthquake of 1988 continues to condition territorial planning. In Armenia, this ongoing emergency situation overshadows the widespread difficulties of redefining the role of such planning in a transition economy. While the existence of seismic activity of varying intensity is a powerful starting point for any territorial planning, the more usual problems of clarifying which planning functions should be retained, and how the instruments required by a decentralized market economy should be determined and implemented, still have to be solved.

The absolute spatial planning priority in Armenia, namely to cope with the consequences of the 1988 earthquake, should be maintained until these consequences have been overcome to the extent possible. In addition, it would now be timely to prepare a role for territorial planning in the long term. This preparation does not require substantial funds, but would facilitate the transition to stable planning routines for the future.

Such preparation seems to be required in three main directions. Firstly, a political consensus is needed on the future role of territorial planning. This consensus has to embrace all levels of public administration. It needs to precede the definition of planning instruments, which is the second main direction of preparation. Instruments are required so that planning routines at the different levels of administration can be fully coordinated, and correspond with the administrative (including budgetary) authority of the different levels of management. Thirdly, actual planning decisions will have to be based on information systems, which are sometimes costly, like the development and maintenance of essential and highly desirable information tools of cadastral and geo-referenced information systems. The information tools therefore need appropriate and careful design – i.e. a suitable gestation period. The auxiliary information system or systems should be instrumental to the integration of planning instruments into the sustainable development of the country.

Recommendation 3.1:
The remediation of the areas that were affected by the 1988 earthquake should remain the absolute priority for territorial planning. In addition:

- *A political consensus should be developed on the future role of territorial planning, its relationship to economic development, and its optimal level of decentralization*
- *A consistent system of planning instruments should be prepared for all levels of public administration*
- *An integrated system of information for territorial planning purposes that supports the sustainable development of the economy should be designed.*

The territory of Armenia is seismically active. The competent authorities (the National Survey for Seismic Protection, the Armenian Academy of Science, the Earthquake Engineering Research Institute and others) undertake research and develop standards that are adapted to the conditions found in zones of different seismic activity. The zoning has been undertaken, and a map exists for each zone. Rebuilding after the 1988 earthquake is in progress, but it is doubtful whether the construction standards are being fully applied. In the interest of risk reduction, it is important that they are being fully incorporated into the reconstruction plans in the different zones. Furthermore, constructors should be made aware of their responsibilities in the case of new constructions, and an information campaign should be envisaged in the near future, as a step towards enforcing adequate building standards under Armenian conditions.

Recommendation 3.2:
Construction standards should be strictly followed together with zoning. Enforcement of the standards should be energetically pursued, including an information campaign targeting constructors. The process should be strengthened through the development of appropriate regulations and management tools.

An EIE procedure has been in force since 1995. However, difficulties with collecting and disseminating information on projects, as well as with organizing public participation are hampering its full and satisfactory implementation. The conditions for strengthening public participation require the drafting, adoption and implementation of the respective regulation. The long period of four years required for the approval of procedures for effective public participation makes it clear that the three-stage participation process envisaged is a hindrance to its enforcement. It should therefore be abandoned and another solution should be chosen. It should not be overlooked that the full implementation of an adequate EIE procedure is an important element also for economic development and the promotion of international trade.

Recommendation 3.3:
High priority should be given to the enforcement of all legal instruments required for a full application of the EIE procedure. Towards this end, the system of public participation should be simplified to one or two stages of formal public hearings. *See Recommendation 6.1.*

Chapter 4

INTERNATIONAL COOPERATION

4.1 General objectives for international cooperation

Armenia's major goals for international environmental cooperation are determined by its geopolitical location, the priority of environmental problems, and the need to share efforts with other countries in solving environmental issues. On the basis of these principles Armenia participates in global environmental processes and has signed a number of multilateral environmental agreements (MEAs). At the same time it pays attention to regional cooperation, emphasizing cooperation with countries in a similar economic situation and having comparable environmental problems. National environmental policy takes international environmental policy into account.

A programme for the implementation of the UNECE Convention on Long-range Transboundary Air Pollution, the UNECE Convention on Environmental Impact Assessment in a Transboundary Context, the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity for the period from 1998 to 2002 was adopted by Decree No. 115 of February 1998. In addition, Decree No. 620 of 1998 lays down an implementation plan for the United Nations Convention to Combat Desertification. However, in some cases, the obligations of MEAs have not been incorporated into domestic policies, laws and regulations. See also Chapter 1.

International standards and principles are deemed important for the development of national environmental legislation. An assessment of which legislation should be amended, changed or harmonized to conform with international standards has been prepared. Implementation of this programme is problematic because of State budget limitations. Over the past few years, a number of national strategies on environmental issues, including the NEAP, the NEHAP, the Biodiversity Strategy and the Climate Change Strategy, have been developed taking international standards into account.

Key transboundary issues for Armenia are water pollution and trade problems, including trade in obsolete drugs and pesticides and trade in endangered species.

Armenia cooperates with many international organizations and funding institutions, including UNECE, UNEP, UNDP, OECD, TACIS, FAO, the World Bank, as well as with national governments. Armenia's application to join the WTO is at an advanced stage, and it has also applied for membership of the Council of Europe, but there are still some underlying political problems that might hamper its joining.

The main coordinating and implementation body for all MEAs is the Ministry of Nature Protection. Within the Ministry, there is a Department of International Cooperation. The various departments responsible for the substantive implementation of the respective MEAs have to report twice a year to the Department of International Cooperation on the status of implementation. One of the main goals of the Department is to improve coordination in all international matters. Cooperation on international matters with the Ministries of Energy, Foreign Affairs, Health and Agriculture is satisfactory; cooperation with the Ministry of Economy is not so good.

Armenia is interested in moving closer towards the European Union. The Ministry of Foreign Affairs has a Department of European Integration, and a Partnership and Cooperation Agreement with the EU entered into force on 1 July 1999. It aims at stimulating the harmonization of standards and legislation with the EU, particularly in the area of trade and industry. Currently, cooperation with the EU on the environment mainly concerns information exchange, participation in meetings and seminars, and cooperation in the framework of TACIS. The Agreement contains a specific paragraph on environmental cooperation. It lists a range of issues for

possible cooperation, including monitoring and assessment, pollution, sustainable energy issues, chemicals, waste reduction, biodiversity, climate change, education, etc. Armenia's participation in the "Environment for Europe" process, the UNECE conventions, and bilateral cooperation with CIS and EU countries also reflect Armenia's interest in pan-European cooperation.

4.2 Cooperation in the framework of UNECE and other regional cooperation

Convention on Long-range Transboundary Air Pollution

Armenia ratified the Convention on Long-range Transboundary Air Pollution in 1997. It signed the Aarhus Protocols on Heavy Metals and on Persistent Organic Pollutants in December 1998. It has not signed the other protocols to the Convention, although it is reaching the abatement targets of the older protocols, because of its economic crisis. In December 1999 Armenia signed the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, which takes multiple compounds (NOx, SO_2, NH_3 and VOCs) into account.

Convention on the Protection and Use of Transboundary Watercourses and International Lakes

Armenia is not a Party to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes. All Armenia's rivers flow out of the country because its lies higher than its neighbours. Therefore it exports more water pollution than it imports. Because of this and related concerns about the polluter-pays-principle embodied in the Convention, preparations for its ratification are still problematic. None of Armenia's neighbours has ratified the Convention yet. Armenia nevertheless participated in the negotiations on the Protocol on Water and Health, which it signed in June 1999.

Armenia's rivers are tributaries of the two major transboundary rivers: the Kur (a basin of 700 square km) and the Araks (22 790 square km basin). There are no common management systems or environmental agreements on these rivers Negotiations have started with Azerbaijan and Georgia on a joint project to clean up point sources of pollution, but have not been completed. Armenia has an agreement with Turkey, sharing the use of the transboundary Arak and Akhourian rivers in equal proportions (1 230 million m^3 per year each), but Armenia has not been using its full share, and disputes between the two countries have occurred over their entitlements.

The main pollution problems in Armenia's rivers originate from agriculture and municipal waste generation. Monitoring of water pollution is not well developed and will have to be taken up as water management is improved.

Convention on Environmental Impact Assessment in a Transboundary Context

Armenia ratified this UNECE Convention in 1997, making it the only country in the Trans-Caucasian region to accede to it. This restricts the application of its provisions in the region.

Environmental impact evaluations (EIE) have been carried out in Armenia since 1986. The level of enforcement of the Law is not satisfactory, as not all implementing regulations have been approved, particularly on the issue of public participation. An interdepartmental commission has been established to make amendments to the Law on EIE or to draft a new law. The Commission has however not started its activities so far. See Chapter 3 for a description of practices and problems.

Convention on the Transboundary Effects of Industrial Accidents

Armenia ratified the Convention on the Transboundary Effects of Industrial Accidents in 1997. Government Decision 702 from November 1998 defines regulations for industrial emergencies. All industrial wastes/hazardous substances are being inventoried, with their quality, quantity and different classes of danger. A report has been prepared on the activities undertaken on industrial safety.

Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention)

Armenia was involved in the drafting of the Aarhus Convention and signed it in 1998. There are no real procedures or instruments available yet to regulate public access to information. Armenia currently has some regulations dealing with the accessibility of information but these are mostly declarative. An amendment on public participation to the EIE Law is intended. An Analytical and Information Centre and a Public Relations Department have been set up in the Ministry of Nature Protection.

"Environment for Europe" process

Armenia has been actively involved in the "Environment for Europe" process since the second ministerial meeting in Lucerne, Switzerland. Participation in the process fits well into Armenia's goal to move closer towards the EU, and is thus considered important. Armenia is trying to implement the decisions taken in the framework of the process. It supports the establishment of a regional environmental centre (REC) in Georgia for the Caucasian region, and an agreement on the regional REC was signed between Georgia, Armenia and Azerbaijan in the autumn of 1999. A national report in the framework of "Europe's Environment: the Second Assessment" (Dobris +3) was prepared with financial support from EU/TACIS.

Armenia has adopted the Pan-European Biological and Landscape Diversity Strategy. In its framework, Armenia participates in the development of documents on global environmental networks, a clearing-house mechanism, the global taxonomic initiative, integrating biological and landscape diversity objectives into sectoral policies, as well as in the decision-making processes on the proposed documents.

Other regional cooperation

Armenia has participated in the meetings of the Black Sea Economic Cooperation since 1992. Armenia is particularly interested in projects with a wide scope such as: environmental education, tourism, harmonization of monitoring and information systems, managing mountain ecosystems, cleaner production, etc.

In 1992 Armenia signed the Agreement on Cooperation in the Field of Ecology and Nature Protection, which is being coordinated by the Interstate Ecological Council for the CIS Region. Armenia participates in all activities undertaken in the framework of this Agreement, including various working groups and sub-agreements.

4.3 Global cooperation

Implementation of Agenda 21

Armenia participated in the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil, in 1992. There have been no specific initiatives to implement Agenda 21 in Armenia. However, a process to develop a National Environmental Action Plan process was initiated in 1996 (see Chapter 1).

Climate change

With a population of 0.06 per cent of the world population, Armenia's contribution to global greenhouse-gas emissions in 1990 was about 0.1 per cent, and in 1995 0.02 per cent. Currently, more than 90 per cent of the emissions originate from transport.

Armenia ratified the United Nations Framework Convention on Climate Change in 1993. A national implementation strategy and the first national communication were prepared in 1998 as part of the project "Armenia – Country Study on Climate Change". Also as part of this project, an Information Centre was created, a database was installed, a study on climate change phenomena in Armenia was carried out, a public awareness campaign was started, the Armenian Country Study on Climate Change was prepared and submitted to the

secretariat of the Convention and the First National Communication was presented during the fourth Conference of the Parties in Buenos Aires, in December 1998.

The following specific activities were undertaken:

- An analysis of the development of the economy and its energy sector during 1990-1995
- The development of a national inventory of greenhouse-gas emissions for 5 of the 6 main modules of the IPCC guidelines (energy, industrial processes, agriculture, land-use change and forestry, waste)
- The development of a national strategy for the limitation of greenhouse-gas emissions
- An assessment of vulnerability and adaptation measures for natural ecosystems, water resources, agriculture and health issues related to climate change

Armenia is not included in Annex I to the Convention and has no obligations to reduce its greenhouse-gas emissions. However, it could limit them voluntarily within the framework of corresponding mechanisms for the implementation of the Convention. An emissions limitation strategy has been developed based on the provisions of the Energy Master Plan of the Republic of Armenia for the period up to 2010. The goal is to cut emissions to 70 per cent of their 1990 levels by the year 2010. Two basic scenarios are considered in the Energy Master Plan, one including, the other excluding nuclear energy.

Protection of the ozone layer

Armenia ratified the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer in April 1999. It has not yet ratified the amendments, but will most probably do so in the future, making it an Article 5 country.

There is no inventory of ozone-depleting substances (ODS) yet, although some approximate data are available for the years 1980, 1986 and 1996. Armenia does not produce ODS. An aerosol company is the main importer of CFCs, with distribution to various smaller refrigerator-repair companies. The consumption is less than 0.3 milligram per person. The companies using ODS are ready to change their substances as soon as there is funding to help them. Thus, the importance of ratifying the Convention lies in the need for Armenia to avoid becoming a transit country for CFCs. UNEP/IE will fund a country programme for the phase-out of ozone-depleting substances (US$ 16 000) after Armenia has officially ratified the Convention. A preliminary start on a country programme was already made in 1997 with help from a Finnish trust fund. An ozone centre will be established in the Ministry of Nature Protection.

Transboundary movement of hazardous waste

Armenia ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal in 1999. A Department for Hazardous Chemicals and Waste Management was set up in the Ministry of Nature Protection in 1998. There is no waste law, but developing one is currently the highest priority of the Department. The preparation of the law according to the provisions of the Basel Convention requires the technical monitoring of activities involved in waste import and transport. Currently, it is mainly Government Decision No. 97 of 8 December 1995 that regulates the import and transport of hazardous wastes. A register of hazardous materials has been developed but should be updated according to OECD regulations. A full description of regulations dealing with the collection, transport and treatment of waste, as well as waste data collection, is included in Chapter 7.

Some cases of imports of hazardous chemicals such as obsolete drugs and pesticides have been reported. Without proper legislation, it is not possible to take action against such incidents. Customs have not been trained in detecting the illegal transport of hazardous wastes.

Biodiversity Convention

Armenia ratified the Convention on Biological Diversity in 1993. A Biodiversity Strategy and Action Plan (BSAP) and the First National Report to the Conference of the Parties to the Convention were prepared in 1999. The Government approved a schedule of measures to implement the Convention. The BSAP will be the basis for the national biodiversity policy and will be adopted by the Government. It aims at ensuring the conservation, sustainable use and regeneration of Armenia's landscape and biological diversity. It includes a budget for its implementation, identifying what can be funded in Armenia and what needs international funding, indicating possible sources of finance.

Armenia enjoys high levels of biological and species diversity and has an important international place in terms of agro-biodiversity. There are Red Data Books for flora and fauna, but they are based mainly on population estimates, rather than actual field surveys and reliable counts. The Books will be updated with the help of Japanese experts. See Chapter 5 for a more complete evaluation.

Wetland management

Armenia became a Party to the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention) in 1993. Two sites were designated for the List of Wetlands of International Importance: Lake Sevan and its basin (489 100 ha) and Lake Apri and its bogs (3 139 ha). Lake Sevan, one of the world's largest alpine lakes, and its basin are significant resting and wintering areas for migratory waterfowl. A detailed description of the problems encountered in the Lake Sevan basin and of the related environmental action plan is included in Chapter 8.

In 1998 a project on "Inventory of Armenian Ramsar sites: restoration and rehabilitation of lost or endangered waterfowl habitat" was started with funding from the Ramsar Small Grants Fund for Wetland Conservation and Wise Use. A second Ramsar Small Grant Funds project, "Inventory of Armenian Wetlands: Steps Towards Development of National Wetlands Policy", will be implemented in 2000 (Sw F 40,000).

Other international legal instruments aiming at nature protection

In Armenia's wetlands there are about 22 families and 100 species of wetland birds, 88 of which are protected under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds of the *Bonn Convention on the Conservation of Migratory Species of Wild Animals*. 23 species are endangered. However, Armenia has not yet ratified the Bonn Convention nor the *Bern Convention on the Conservation of European Wildlife and Natural Habitats*.

Armenia has not ratified the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) either. Ratification is not expected in the near future, as Armenia considers the Convention to be expensive to implement. Currently, there is a special office in the Russian Federation that assists countries of the CIS which have not yet ratified CITES, including Armenia, with CITES-related matters. The Ministry of Nature Protection suspects occasional cases of illegal trade. Although customs officials have agreed to check all species being imported or exported, they have not received any training yet and often do not know what to look for.

Armenia ratified the Convention concerning the Protection of the World Cultural and Natural Heritage (*World Heritage Convention*) in 1993, but only cultural sites have been included on the list so far.

Desertification

Armenia ratified the *United Nations Convention to Combat Desertification* in 1997. A National Action Programme addressing control of land distribution, recultivation of eroded land, reclamation of salinated lands and restoration of their natural productivity is being prepared. Armenia has received US$ 32 000 from the

Convention's secretariat for this purpose. A Commission on implementation of the Convention headed by a Deputy Minister of Nature Protection has been set up.

Chemicals management

Armenia signed the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade in 1998. Armenia is also involved in the negotiations on persistent organic pollution and cooperates on chemical-related issues with UNITAR and UNEP Chemicals. It does not have a chemical substances law, but developing one has a high priority.

Nuclear safety management

Armenia has ratified a number of international agreements on nuclear protection, including the Treaty on the Non-Proliferation of Nuclear Weapons (1991), the Convention on Early Notification of a Nuclear Accident (1993), the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (1993), the Vienna Convention on Civil Liability for Nuclear Damage (1993), the Convention on Nuclear Safety (1997), the Convention on Physical Protection of Nuclear Material (1993) and the Comprehensive Nuclear Test-Ban Treaty (1993).

Armenia also signed an agreement with the International Atomic Energy Agency (IAEA) for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons in 1993. IAEA is managing a major Nuclear Safety Programme in Armenia, for which the UNDP Country Office Armenia provides administrative support. The Programme involves 13 different projects to support Armenia's Nuclear Power Plant Medzamor, including safety, regulation, management, monitoring and research. TACIS, the United States, France and the Russian Federation also fund nuclear safety measures in Armenia.

4.4 Technical cooperation and international funding

Foreign direct investment

Although Armenia is one of the more advanced former Soviet States in terms of market reforms, it has been relatively unsuccessful in attracting foreign investment. This is generally attributed to the conflict with Azerbaijan over the region of Nagorno-Karabakh and the resulting blockade of most of the communication routes that served Armenia in the Soviet era, and to the closure of the Armenian-Turkish border. Although a ceasefire has been in place in Nagorno-Karabakh for four years, and the transport routes via Georgia and the Islamic Republic of Iran are operational even if under-used, the impact of the Nagorno-Karabakh conflict continues to hamper Armenia's economic development.

According to the EBRD, net foreign direct investment inflows to Armenia were just 19 million dollars in 1995, 22 million in 1996 and 26 million in 1997. FDI inflows to Armenia in 1998 were equivalent to just 1.6 per cent of GDP, while the FDI stock was an estimated 70 million dollars. It should be noted that figures for FDI differ considerably between sources, e.g. FDI figures from Armenia's Ministry of Statistics, State Register and Analysis are higher than the EBRD figures. A substantial current increase in FDI is being reported by some sources. The very low general investment rate (8.8 per cent of GDP according to the EBRD) in Armenia contrasts with a relatively large volume of official development assistance (ODA) to Armenia (as a percentage of GDP, the largest of the whole of central and eastern Europe). Table 4.1 includes an overview of programmes drawn up in the Ministry of Nature Protection that are financed by external donors.

The main sectors that have received FDI so far are telecommunications, beverages, banking, mining (mainly gold), tobacco and pharmaceuticals. The main investors have been Canada, France, Greece, United States, Russian Federation, Germany, the Syrian Arab Republic, the Islamic Republic of Iran and the United Kingdom.

The legal environment for foreign investment is relatively favourable in Armenia. Under the 1994 Law on Foreign Investments, non-residents can invest in Armenia in any form (except buying land), including establishing or purchasing enterprises, buying shares and other securities, leasing and winning concessions for the use of land and natural resources. IRIS Caucasus Centre (USAID-funded), in cooperation with UNDP Armenia, carried out an "Investigation of Factors Inhibiting Foreign Direct Investment in Armenia" in 1999. The International Finance Corporation (IFC) opened an office in Armenia in February 1999. A detailed review of the regulatory environment for FDI was carried out in the autumn of 1999 by the Foreign Investment Advisory Service (FIAS) of the World Bank/IFC.

The Government is making efforts to attract more FDI, including through the privatization process. Early in 1998, a presidential commission was established to create favourable conditions for foreign investors at the early stages of their activity in Armenia and specifically to lessen investors' exposure to bureaucracy. The Armenian Development Agency was set up as a so-called "one-stop shop" for foreign investors.

Table 4.1: Ministerial programmes financed by external donors

Project title	Budget (Th. US $)	Duration		Donor organization
1. Armenia Country Study on Climate Change	350	10.09.1996	30.04.1999	GEF
2. Armenia - Lake Sevan Environmental Action Plan	485	01.01.1996	15.05.1998	WB
3. Strengthening the Management Structure of the Ministry of Nature Protection	130	15.05.1997	30.06.1999	UNDP
4. Forestry Sector Development	380	01.06.1994	01.05.1997	UN FAO
5. National Environmental Action Plan	200	01.07.1996	31.11.1998	WB
6. Coal Resources Usage and Assessment Programme	3,000	26.12.1995	26.12.1999	USAID
7. Country Programme for the Phase-out of Ozone-depleting Substances	16	25.05.1997	After adoption of the Ozone Layer Convention and Montreal Protocol	UNEP/IE
8. Biodiversity Strategic and Action Plan	175	01.10.1997	31.05.1999	GEF
9. Preparation of a Full Project for the in-situ Conservation and Sustainable Use of Agro-biodiversity in Armenia	97	20.06.1998	31.03.1999	GEF
10. Inventory of Armenian Ramsar Sites: in search of ways for restoration of the lost and rehabilitation of endangered waterfowl habitats	23	06.04.1998	06.09.1999	Ramsar Small Grants Fund
11. Armenian Forest Resources Assessment	200	01.07.1998	31.03.1999	SIDA
12. Removing Barriers to Energy Efficiency in Municipal Heat and Hot Water Supply	210	19.03.1999	19.03.2000	UNDP/GEF
13. Integrated Plan for Water Resources Management	1,000	01.07.1999	01.07.2001	WB
14. National Action Program to Combat Desertification for Armenia	40	01.10.1999	01.12.2000	UNEP

Source: Ministry of Nature Protection.

Multilateral cooperation and funding

United Nations Development Programme. UNDP is substantially involved in environmental issues in Armenia. Initially, the UNDP environment programme was meant to complement World Bank efforts already initiated, as well as to facilitate and support the implementation of projects of other United Nations agencies, such as the

IAEA projects on nuclear safety. For the period of 1997-2001, through the Country Cooperation Framework (CCF), UNDP Armenia has identified four fields of action:

- governance and development management
- job creation and sustainable livelihoods
- strengthening of the social sector
- environmental conservation and management.

Three major project areas under the environmental conservation and management component were identified: environmental management, donor awareness for Lake Sevan and forest sector development. In addition, a project looking at national mechanisms for financing environmental expenditures with a focus on the development of economic instruments might be developed.

UNDP also assisted in the development of the National Environmental Health Action Plan (NEHAP), together with the World Health Organization (see Chapter 13). The implementing agency for this project was the Environmental Health Department at the Ministry of Health. In the framework of this project, a desk study on morbidity and mortality in relation to local environmental problems in Armenia has been completed. A first draft of the NEHAP is ready and the development of a geographic information system for the NEHAP is in progress.

A forestry sector capacity building project is being prepared and presented to donors to raise funds. It aims at institutional strengthening of the Hayantar administration, developing partnerships between the State and the private sector and introducing new management systems.

A US$ 1.5 million project on sewage treatment and water supply is being planned by UNDP to improve legislation and the regulatory framework for the protection of water resources and to do a feasibility study on sewage waste-water treatment. It is currently being presented to donors to raise funds.

The 1997-1999 UNDP project on strengthening the management structure of the Ministry of Nature Protection (US$ 130 000) has been finalized. This project aimed to provide technical assistance to the Ministry to improve environmental management and natural resource use and build management capacity in the Ministry. The project included the development of a management strategy and a structural model of the Ministry, the training of staff in English and in computer skills, and improving the communication system in the Ministry.

The International Conference on Lake Sevan in 1996 was sponsored by UNDP with US$ 50 000. The Conference was co-organized by the Ministry of Nature Protection and the French Embassy in Armenia. It aimed at bringing all national, scientific and technical stakeholders together with international experts to assess the Lake's situation and envisage solutions for its restoration.

The environmental rehabilitation component (US$ 90 000) of the Integrated Support to Sustainable Human Development (ISSHD) project is another environmental project executed by UNDP. This component aims at building the capacities of the regional forestry institutions and communities to carry out reforestation in the Lori region. The World Food Programme is contributing (US$ 100 000) to the project within the framework of the Food for Work Programme. The ISSHD project emphasizes poverty reduction and community development in the four most crisis-affected parts of Armenia.

A UNDP project proposal on strengthening the system of environmental monitoring has been prepared at an estimated cost of US$ 500 000. The project will improve and develop global chemical and radiation pollution monitoring, including biological testing, in Armenia. Donors for the project still have to be found.

Another substantial part of UNDP Armenia's work for the environment is its involvement in the implementation of four GEF projects:

- A Country Study on Climate Change (US$ 350 000). This project enabled activities for the preparation of a national strategy on climate change.
- The National Biodiversity Strategy and Action Plan, and the First Report to the Parties to the Convention on Biological Diversity (US$ 174 800).
- The preparation of a Full Project for the In-situ Conservation and Sustainable Use of Agro-biodiversity in Armenia (US$ 97 100), completed in June 1998. The Full Project is estimated at US$ 1 093 100. It aims at an integrated approach to in-situ conservation of plant agro-biodiversity in Armenia and at removing barriers to the conservation of agro-biodiversity. GEF is prepared to make a contribution, but donors are still being sought to share the costs.
- Removing Barriers to Energy Efficiency in Municipal Heating and Hot Water Supply (US$ 210 120) as a follow-up to the first GEF climate change project.

Two further GEF project proposals are being prepared:

- The Lake Gilli Restoration Preparation Project (US$ 20 000, approved in early 2000)
- The Conservation of Highly Threatened Armenian Forest Ecosystems (US$ 22 900)

United Nations Environment Programme. Together with the Russian Federation and Belarus, Armenia participates in a UNEP project on the harmonization of environmental legislation. A regional UNEP Global Resources Information Database (GRID) office for the three Caucasian countries is established in Georgia. GRID has co-funded the development of the 1998 Armenian State-of-the-Environment Report.

United Nations Industrial Development Organization (UNIDO). UNIDO will start implementing a project worth US$ 500 000 on a variety of issues including energy efficiency, renewable energy, and the setting-up of a cleaner production centre.

World Health Organization (WHO). Cooperation with WHO is reviewed in detail in Chapter 13.

World Meteorological Organization (WMO). A WMO project worth US$ 629 000 is being planned to reinforce the capacity of Armhydromet. It aims to collect, manage and store data on the quantity and quality of surface and groundwater, calculate the water balance and forecast changes and ensuing impacts, and assess the effect of pollution on water bodies. The project will have two phases of about three years each.

Food and Agriculture Organization of the United Nations (FAO). A forestry strategy was prepared with FAO assistance. Phase I was implemented in 1994-1996 (US$ 380 000), and phase II in 1996-1997 (US$ 62 000).

World Bank. The World Bank in Armenia is primarily involved in poverty alleviation, private sector development and sustainable development. Enterprise development, agriculture and energy are the sectors receiving most funding. The World Bank also invests in transport and infrastructure, health, social investments and the judiciary. All projects require a financial input of at least 10 per cent of the total cost from the Armenian Government. Around 30 per cent of all projects include an environmental component. Specific environmental projects include the following:

- The National Environmental Action Plan (US$ 200 000 from the Institutional Development Fund)
- The Lake Sevan Environmental Action Programme (US$ 485 000), which is coordinated with NEAP. The Lake Sevan Environmental Action Programme is co-funded with grants from Finland, the Netherlands, Sweden, Switzerland and Armenia.
- The Integrated Water Resources Management Plan (US$ 1 million contributed by the Netherlands through the World Bank). The project started in August 1999 and aims to help the Government prepare an integrated and multi-sectoral strategy for the economically and environmentally sustainable management of water resources. It will strengthen the institutional capacity of agencies responsible for water management through training workshops and the transfer of knowledge and information, aim at developing a social consensus on

the framework, principles, policies and strategies for the sustainable management of water resources, and provide an overall framework for World Bank and donor support in the water sector.

- The Irrigation Rehabilitation Project (US$ 43 million of IDA credit and US$ 8 million grant by the IFAD). The main objectives of the project are to assist Armenia in maintaining its level of agricultural irrigation and to improve the country's water resource management. The project consists of four major components: the rehabilitation of irrigation schemes and the Ararat Valley groundwater network, pilot projects for water distribution and Water Users' Associations over an area of 10 000 ha, financing the maintenance costs of the irrigation infrastructure, and technical assistance, including the establishment of a project implementation unit, training and assistance to improve irrigated crop production.
- The Dam Safety Project (US$ 25.5 million). The objective of the project is to protect the population and the socio-economic infrastructure downstream of the dams facing the highest failure risks.

The World Bank is currently preparing an environment and natural resources management programme worth US$ 19 million, of which 5 million will be a GEF grant, IDA will contribute 10.5 million, 2 million will come from other countries, and the Government of Armenia will add 1.5 million. These figures are still tentative.

The World Bank is also implementing a Municipal Development Project, which aims at providing short-term emergency improvements in the drinking water supply system in Yerevan, improving the efficiency, management, operation and delivery of water and waste-water services for the Yerevan area, and laying the basis for the sustainable involvement of the private sector in the management of these services. For details, see Chapter 8.

European Union. The 1998 EU TACIS Action Programme for Armenia comprises projects in three selected areas, namely human resources development, private sector development and the public investment programme (energy sector). The programme was financed through an EU grant of ECU 7.6 million. Other actions were financed separately through small project programmes (totalling ECU 2.4 million), the Inter-State Programme and other horizontal programmes.

EU TACIS is involved in environmental projects in Armenia only in the framework of the so-called Inter-State Programme. At least two newly independent States have to be involved. Therefore it is often difficult to estimate how much funding has been spent in which country. Projects from the TACIS Inter-State Programme with relevance to Armenia are:

- The widening of the Environmental Action Plan (EAP) in the NIS and Mongolia 1998-2000. The general goal of this programme is to improve the process of identification, preparation and implementation of projects that are designed to improve the environment and to obtain investment for as many of these projects as possible. The project is linked to the Project Preparation Committee (PPC). In Armenia, in the framework of this programme, training on project proposal preparation was carried out in February 1999. In addition, priorities for pre-investment were identified for implementing the Lake Sevan component of the NEAP.
- The TACIS Environmental Awareness Raising Programme in the NIS and Mongolia 1997-1998. The general components of this programme are NGO capacity-building, parliamentary support, media awareness training and school methodology development. Activities under this programme in Armenia have not been completely satisfactory.
- The TACIS Monitoring and Evaluation Programme: Development of Common Environment Policies in the NIS and Mongolia 1997-1999. Its overall goals are to further develop and effectively implement the NEAPs, strengthen environmental policy-making and management capacity, thereby improving EAP implementation at national level, contribute to regional initiatives and coordinate actions to address regional transboundary problems. In Armenia, the Programme concentrated on guidance during the drafting of the final version of the NEAP.

TACIS, jointly with USAID, is funding the Transcaucasian REC in Tbilisi, Georgia. TACIS assisted in the preparation of a national report for the Dobris +3 assessment and is involved in work on energy, particularly nuclear issues, in cooperation with IAEA and the United States. In the future, a water monitoring project for the Kur river might be developed and support will be given to the implementation of the NEAP. Environmental

cooperation between the Ministry of Nature Protection and the TACIS office has been somewhat impeded by the fact that the Government of Armenia has not identified the environment among its top priorities.

The EBRD has not disbursed any specific funding for environmental issues in Armenia. However, environmental concerns are taken into account as a component of all EBRD loans and grants. In Armenia, the EBRD focuses on the institutional and operational strengthening of telecommunications, supporting the restructuring of the energy sector, building up the financial sector, strengthening small and medium-sized enterprises, and identifying investments related to the privatization of large enterprises.

Cooperation with countries

United States of America. Under the USAID Strategic Program for Armenia, the strategic objectives of "A More Economically Sustainable and Environmentally Sound Energy Sector" have clear environmental components. Under this objective the following projects have been carried out or are envisaged:

- The Coal Resources Usage and Assessment Programme (US$ 3 million) started in 1995 and finished in 1999.
- An environmental assessment of the entire Armenian energy sector was carried out. This measure will meet the condition specified by the World Bank and the Japanese EXIM Bank for the release of a US$ 95 million loan to help rehabilitate transmission and distribution in the energy sector.
- The future provision of gas leak detectors and gas quality equipment, along with training, in order to help maintain the nation's gas pipeline system.
- The transfer of US$ 12 million from the United States Department of Energy, in order to improve fire and operational safety at the Medzamor nuclear power plant.
- The financing, through the American Bar Association, of a local office in Armenia to assist advocacy groups to identify and deal with environmental problems through the democratic process.

USAID may plan for additional efforts in the future in areas such as increasing institutional awareness through environment-related training for judges, inspectors, media, etc. and promoting more efficient waste disposal and water delivery as well as the development of environmental legislation.

Germany. Armenia is interested in expanding its existing cooperation in economic matters to environmental issues. The exchange of information on environmental issues will be the first step in this process. Armenia received a German grant of DM 20 million for the construction of two water treatment facilities.

Japan. The Japanese government has started technical cooperation on biodiversity in Armenia. New Red Data Books on Flora and Fauna will be compiled and some equipment (computers, printers, etc.) has been installed in the Ministry of Nature Protection. Further cooperation might develop in the future, possibly also on mining and waste.

Sweden. The Swedish International Development Agency (SIDA) implemented a project on Armenian Forestry Evaluation in 1998-1999 (US$ 200 000).

United Kingdom. The United Kingdom has disbursed a small grant (US$ 5 300) for a pilot project on environmental management training for regional and local authorities in 1999. If this project is successful, a more substantive project might be developed.

In May 1997, the Governments of Georgia and Armenia signed the Agreement on Cooperation in the Field of the Environment and Natural Resources Protection. Once the Agreement is ratified by Parliament, a full programme of activities will be developed.

In 1997, Armenia, Greece and the Islamic Republic of Iran signed a Memorandum of Understanding with an environmental component. A special agreement on emergency management, health and the environment will be signed.

Also, France provides substantial bilateral aid to Armenia, including funding that benefits Armhydromet. Switzerland has provided some aid as well. In addition, Armenia has signed a number of bilateral agreements on environmental issues with the Russian Federation and the Syrian Arab Republic.

4.5 Conclusions and recommendations

Overall, Armenia has been successful in building its international cooperation network in the field of the environment since its independence. It has already ratified a number of multilateral environmental agreements and there is a great interest in moving closer to the European Union and the international community in general. Armenia has been successful in attracting foreign funding and technical assistance to develop strategies for various environmental problems and to start implementing some of its international environmental commitments.

Given the current economic depression and the wide-ranging demands on limited natural resources, major environmental protection investments or activities in Armenia cannot be carried out in the short or medium term without significant external partnerships. The task ahead of implementing international environmental norms and standards is considerable. It will require adequate legislation, better integration of environmental and other policies, greater cooperation between ministries, and will be costly. Effective implementation of international agreements will require substantial administrative efforts. Because of the scarce means available, it will be important to prioritize wisely. Both the number of qualified staff and the amount of adequate information need to be increased. See Recommendation 1.2.

Many different entities are usually involved in implementing and managing internationally funded environmental projects, such as the funding organization or country, international and national consultants, a number of departments from different ministries, NGOs and other stakeholders. Setting up a project implementation unit in the Ministry of Nature Protection would facilitate the effective coordination of all international programmes and projects. The capacity of the staff working in this unit should be developed in terms of language training, training on project proposal development and training in substantive aspects of international environmental policy, management and enforcement. An overview of current international assistance for the environment and strategies for attracting new funding should be prepared. This consideration reinforces the conclusions of Chapter 1 that gave rise to Recommendation 1.5.

The harmonization of national environmental legislation with international norms and standards and the true implementation of multilateral environmental agreements are in the interest of both Armenia and the international community. In this context, the lack of international environmental information in general, the lack of international environmental agreements translated into Armenian, the lack of Armenian legislation translated into English or Russian, and severe financial limitations to improve this situation are problematic for the Ministry of Nature Protection. Without such translations it is difficult to compare and harmonize legislation and to raise awareness. In addition, there is a lack of professionals trained in international environmental policy, law and economic issues in the Government as well as among the judiciary, NGOs, research institutes, etc.

Awareness should be raised about international environmental conventions, policies and environmental topics and their links with many social and economic issues at the national level. This would facilitate the integration of international environmental norms into national socio-economic policies and sectoral areas such as forestry or mining. The key needs are for translation, computers with Internet access, and training in international environmental issues within the Government (national and regional) and among the general public.

Recommendation 4.1:
Awareness of international environmental policies, conventions and issues and their interrelationship with social and economic issues at the national level should be raised within the Government and among the public. Funding should be sought to translate international legislation into Armenian and Armenian legislation into English, and to train officials in the Armenian Government, judiciary and other stakeholders in international environmental issues.

Armenia has made some efforts to strengthen environmental cooperation with its neighbours. The recent agreement with Azerbaijan and Georgia on the establishment of the Regional Environmental Centre for the Caucasus and the bilateral agreement with Georgia are good examples. At the moment, most of the foreign funding for regional projects is channelled via Georgia. Armenia could play a more active role, in biodiversity and water management for instance. Regarding transboundary water issues, Armenia should try to develop common management systems with its neighbours on the Kur and Araks rivers and should ratify the Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

Recommendation 4.2:
Armenia should work at strengthening its environmental cooperation with neighbouring countries, particularly in the areas of biodiversity and water. Armenia should ratify the Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

Armenia has a problem with illegal imports of hazardous substances such as obsolete drugs. It has recently ratified the Basel Convention. The implementation of the Convention requires the development of national legislation addressing the imports and exports of waste and specific training for customs officers. The new Department for Waste and Hazardous Substances needs assistance in this area. International assistance could be sought for this purpose.

Recommendation 4.3:
National implementing legislation for the Basel Convention should be developed and training for customs officers should be organized. *See Recommendation 7.1.*

There are some important international conventions or protocols that Armenia has not yet been able to ratify. Ratification of the major multilateral environmental agreements should be seen as a priority, if it can be demonstrated that ratification is beneficial for the country. In this context, ratification can catalyse the improvement of environmental performance at national level and can open ways to attract foreign assistance. Armenia signed the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, the Protocol on Heavy Metals and the Protocol on Persistent Organic Pollutants to the Convention on Long-range Transboundary Air Pollution. It has not ratified any of the older Protocols to the Convention. In the area of nature protection, it has not ratified the Bonn Convention on the Conservation of Migratory Species of Wild Animals, although many migratory birds protected under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds come to Armenia's wetlands. The Convention on International Trade in Endangered Species of Wild Fauna and Flora and the Bern Convention on the Conservation of European Wildlife and Natural Habitats are important conventions that can help secure a more effective protection of Armenia's biodiversity.

Recommendation 4.4:
Armenia should ratify and enforce the recent Protocols to the Convention on Long-range Transboundary Air Pollution, the Bonn Convention on the Conservation of Migratory Species of Wild Animals, the Convention on International Trade in Endangered Species of Wild Fauna and Flora and the Bern Convention on the Conservation of European Wildlife and Natural Habitats.

PART II: MANAGEMENT OF POLLUTION AND OF NATURAL RESOURCES

Chapter 5

FOREST, BIODIVERSITY AND NATURE MANAGEMENT

5.1 Present state of nature

Habitats

Armenia is located at the junction of the Circumboreal, Irano-Turanian and Southern Caucasic floristic regions, where mountainous landscape prevails. The climate ranges from sub-tropical in the lowlands to alpine in the high mountains. This results in a great variety of habitats and consequently in high biological diversity. The main habitat types are deserts, semi-desert, mountainous dry vegetation, steppe and meadow, forest, and wetland. Chapter 6 and Table 6.2 include the topographical and land-use characteristics of the corresponding planning zones, while their habitat characteristics are listed below.

Deserts. True deserts cover only a small area of Armenia, and are mainly situated below 900 m of altitude in the Ararat Valley. The best studied desert system is that close to the town of Gorovan. Deserts include threatened habitats, and a number of endemic species would disappear if these habitats were to continue to decline. Fungi are represented by genera *Agaricus, Montagnea, Tulostoma, Disciseda.* Some higher plants are specific to deserts and relatively rare elsewhere in Armenia. The distinctive vegetation structure and composition are associated with saline and chalk substrates in the Ararat Valley (*Calligonum polygonoides, Achillea tenuifolia, Seidlitzia florida, Rhinopetalum gibbosum, Ceratocarpus arenarius, Salsola spp., Kalidium caspicum, Halostachys caspica, Halocnemum strobilaceum, Gypsophila spp., Halanthium rarifolium*). The distinctive invertebrate fauna, including several endemic species (particularly at Gorovan), is represented by *Pharaonus caucasicus, Cardiophorus araxicola, Sphenoptera khnzoriani and S. vediensis.*

Semi-deserts are often covered by ephemeral plants in spring; xerophytes grow in these habitats (both plants and bushes); flowering vegetation grows in some lowland areas (*Artemisia fraganas, A. araxina, Ceratocephala falcata, Anisantha tectorum, Capparis spinosa, Zygophyllum fabago, Rhamnus catharticus*). There are invertebrates from different regions (including species of Mediterranean, Iranian, Caucasian and Crimean origin). Some of the same species live in steppe habitats (*Phytodrymadusa armeniaca, Nocarodes armenus, Dictyla subdola, Geotomus punctulatus, Amphicoma eichleri, Cantharis araxicola, Tomomyza araxana, Bombilius schelkovnikovi, Shadinia akramowskii, Gabbiella araxena, Pupilla bipapulata, Zodarion petrobium*). Among amphibians, there are *Bufo viridis* and *Hyla arborea*. Some reptiles are specifically associated with small patches of desert habitat with xerophyte vegetation (*Lacerta raddei, L. strigata, Ophisops elegans, Testudo graeca, Eumeces schneideri, Mabuya aurata, Elaphe hohenackeri, Telescopus fallax, Eryx jaculus, Vipera lebetina, Malpolon monspessulanus, T. vermicularis, Elaphe quatuoilineata, Eirenis collaris, E. punctatolineatus, Phrynocephalus persicus, Eremias pleske, E. strauchi*). About 50 bird species are recorded, the most common of them are the pheasant (*Phasianus colchicus*), the black francolin (*Francolinus francolinus*), the rufous wheatear (*Oenanthe xanthoprymna*). Desert and semi-desert mammals are found mainly in the south of the country (common vole, beech marten, fox, long-eared hedgehog, noctule bat and grey long-eared bat).

Steppes. Mountain steppes are the dominant ecosystem of Armenia, and occur throughout the country at altitudes of 1 200 to 2 000 m (sometimes as high as 2 500 m). Vegetation cover is varied, but particularly important plants include fescue (*Festuca sulcata*) and feather grass (*Stipa spp.*). Fungi that can be found are *Pleurotus eryngii, Agaricus, Macrolepiota, and Coprinus*). Higher plants are represented by *Stipa lessingiana, S. pulcherrima, S. capillata, Festuca sulcata, F. ovina, Bothriocloa ischaemum, Agropyrum cristatum, Astragalus microcephalus, A. laguris, Onobrychis cornuta, Bromopsis variegatum, Phleum phleoides, Koeleris cristata.* Invertebrate diversity is low, but there are several rare and threatened species (*Bradyporus dilatatus,*

Montana armeniaca, Eumerus sogdianus, Bruchidius armeniacus, Cryptocephalus moravi). Among amphibians the most common are *Bufo viridis, Rana ridibunda, R. macrocnemics*. There are a number of reptiles: *Lacerta armeniaca, L. dahli, L. valentini, L. nairensis, L. strigata, L. agilis, L. caucasica, L. apodus, Ophisiops elegans, Vipera erivanensis, V. raddei, Coronella austriaca, Eryx jaculus, Telescopus fallax, Natrix natrix, N. tessellata.* More than 30 birds species are recorded, mainly passerines and falcons. Fox, wolf, coypu, marten, greater horseshoe bat, wild goat, Armenian mouflon and brown bear represent mammals.

Sub-alpine and alpine meadows are typically found above 2 000 m of altitude, and support a wide floral diversity. Sub-alpine meadows often support a distinct variety of grasses, particularly in northern regions. Alpine meadows (over 2 700 m) are rich in Poaceae (such as *Poa alpina*) and the carpet vegetation of such meadows represents an unusual and interesting habitat. *Discomycetes* and *gasteromycetes* (*Helvella, Morchella, Peziza, Calvatia, Geastrum, and Bovista*) represent cap mushrooms. Higher plants that grow there are *Festuca varia, Poa longifolia, P. alpina, Phleum alpinum, Phleum alpinum, Trifolium, Onobrychis transcaucasica, Dactylis glomerata, Festuca gigantea, Linum hypericigfolium, Sibbaldia parviflora, Myosotis alpestris, Alchemilla, Carex.* Distinctive invertebrate fauna can be found (*Carabus stjernvalli, C. tamsi, Dorcadion spp., Deltomerus khnzorian, Trechus armenus, T. dzermukensis*, as well as *Bombus* spp., *Terymus auratus, Trihia armenica*). Amphibians that live there are *Rana macrocnemis, R. ridibunda, Bufo viridis.* The most common reptiles are *Vipera erivanensis, V. darevskii, Lacerta valentini,* and *Coronella austriaca.* Between 10 and 15 bird species have been recorded (Caspian snowcock *(Tetraogallus caspius)*), choughs *(Pyrrhocorax graculus, P. pyrrhocoraxi),* Lammergeier *(Gypaetus barbatus*), accentors *(Prunella ocularis, P. collaris),* wallcreeper *(Tichodroma muraria),* snowfich *(Montifringilla nivalis).* Rodents, including mice and voles, represent mammals.

Forests. At less that 10 per cent, forest cover is relatively low in Armenia. Armenian forests are predominantly broad-leaved (97 per cent), and are dominated by oak, beech and hornbeam. Other species occasionally found in forests include juniper, pine and yew. Forest habitats are found on mountain slopes between 500 and 2 400 m of altitude, although beech and oak forests are concentrated at moderate altitudes (1 300-1 600 m). A range of animals is associated with these forests, including brown bears and wild boars.

Four major forest types, and associated tree species, are described below:

Oak forests, represent about a third of forest cover (some 90 000 ha) and are widely distributed across the country. Of the four oak species (*Quercus spp.*) found in Armenia, two (broad-leaved and Georgian oak) are typical of forests. Of these, the broad-leaved oak is the more frost-resistant species and is found throughout the country at altitudes as high as 2 600 m. In contrast, Georgian oak is typically restricted to altitudes of 500 to 1 400 m, and is typically found in the north and in the Zangezour region. Other species which typically grow in oak forests are ash (*Fraxinus excelsior*), hornbeam (*Carpinus betulus*), Georgian maple (*Acer ibericum*), cork elm (*Ulmus suberosus*), and field maple (*Acer campestre*). A third oak species (*Arax oak*) is now declining as a result of climatic warming and human impacts.

Beech forests, dominated by oriental beech (*Fagus orientalis*), represent about a third of forest cover. They are widespread in northern Armenia, particularly on north-facing slopes at altitudes of 1 000-2 100 m. Other species found in beech forests include Caucasian lime (*Tilia cordata*), Litvinov beech (*Betula litwinow*) and spindle tree (*Euonymus europaeus*), and there is substantial grass cover in these forests.

Hornbeam forests are less common than those of beech and oak, and occur at altitudes of 800-1 800 m. Other trees found in these forests include oak, field maple, common ash, Caucasian pear (*Pyrus caucasicum*) and Oriental apple (*Malus orientalis*).

Dry scrub forests are found in both the north and the south of the country at altitudes of 900-1 000 m in the north, but at much higher altitude in the south (1 800-2 000 m). These forests support around 80 species of xeric trees and shrubs, all of which are drought-resistant and light-loving. As well as thorn forests, dominated by juniper (*Juniperus* spp.), broad-leaved forests also occur (characterized by species such as pistachio (*Pistacia mutica)*) Georgian maple and almond (*(Amygdalus fenzlianum*), among others). A range of shrubs is also found in these forests, including buckthorn (*Rhamnus catharticus*), cherry (*Prunus spp.*) and jasmine (*Jasminium fruficans*).

Many fungi species are supported in these habitats, including 757 species of cap mushrooms; 314 species are found in mixed deciduous forests and 266 have been identified in thorn forests. There is a high diversity of invertebrates, including a quarter of beetle species recorded in the country. The invertebrates of northern forests typically resemble those of Caucasian and European regions, whilst those of the south resemble Mediterranean and Iranian fauna (*Ciddaria firmata, Bupalus piniarus, Ancylochira araratica, Salpingus castaneus, Hypophloeus pini).* Among mammals, there are the wild goat, the wild boar, the Persian squirrel, the European mole, the wood mouse and the forest dormouse.

Damage to Armenia's forest resources has been severe since the 1930s, when industrialization and collectivization got under way. Extensive forest clearing caused soil erosion and forest degradation has continued in recent years. Forest areas close to population centres became the main source of fuelwood during the winters of 1991-1993 (about 50 per cent of household energy).

Important forest areas run across the mountain ranges between Armenia and Georgia, in the Noemberian region. The area located between the Dilijan State Reserve in Armenia and the Borjomi Reserve in Georgia, in particular is of high potential conservation importance. Several forest species, once widespread in Armenia, are now limited to these forests, and further fragmentation of their habitat would pose a serious threat to their survival. These species include the brown bear, the wolf, the wild cat and several species of forest mountain steppe birds of global conservation importance.

Azonal habitats. The main azonal ecosystems in Armenia are wetlands, with a rich floristic diversity. In addition to aquatic systems and marshlands, the vegetation of open rocks is also azonal, and different species are supported depending on the type of rock substrate. Such species include higher plants (*Astragalus, Acantholimon, Lonicera iberica, Rhamnus pallasii, Cerasus incana, Spiraea hypercifolia*), invertebrates (*Lestes sponsa, Puella lanulata, Orthetrum cancellatum, Enochrus melanocephalus, Lymnaca stragnalis, Planorbis planorbis*), amphibians and reptiles (for example, the grass snake Natrix natrix) and mammals such as coypu, and water rat.

The most important wetland habitat is the Lake Sevan basin. Lake Sevan contains 80 per cent of Armenia's water resources and thus regulates the country's water balance. In the period 1933 to 1981, the water level decreased significantly, mainly due to downstream hydroelectric power plants and uncontrolled water offtake for the irrigation of agricultural land. Consequently, its temperature has increased and water circulation has slowed down, leading to higher eutrophication.

In view of the significant changes that occurred, the Lake Sevan basin's habitats suffered from:

- increasing green and blue algae blossoms
- the destruction of the main trout and other fish breeding sites
- a decreasing capacity to provide support to bird populations.

The reduction in Lake Sevan's water level was temporarily halted from 1982 to 1990, when 250 to 270 million m^3 of water flowed in from the Arpa River each year. The water level thus increased by 1.2 m (measured in 1990). Since then, the level has begun to sink again. A further decrease of about 2.2 m was measured in 1995. According to the First National Report on the Biodiversity of Armenia, a six-metre rise in the water level would be necessary to stabilize the ecosystem. (For more details on the problems with Lake Sevan and management plans, see Chapter 8.)

Three internationally important stopover areas have been identified along the bird migration routes in Armenia. These are the remnants of wetland habitats along the former Gili Lake basin, the artificial water reservoirs and fish farms in the Armash area in Ararat valley, and the Arpi reservoir in north-west Armenia.

Species diversity

Armenia's ecosystems contain a high variety of plant and animal species. There are no exact data on their populations at the national level. The First National Report on the Biodiversity of Armenia provides

information either on the number of species in general or on specific habitats. Therefore, taxonomic groups are used for assessing the richness of the biological diversity. Armenia's plant diversity is presented in Table 5.1.

Table 5.1: Plant diversity in Armenia

Group	Number of species
Total	**8 800**
Algae	388
Fungi	4 166
Lichens	300
Mosses	430
Vascular plants	3 555

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

Algae occur both in soil and in water bodies. In total, 143 species of terrestrial and 245 species of aquatic algae have been recorded. About 4 200 fungi species are known, of which 1 182 are macromycetes that include 284 edible (mushrooms) and 59 poisonous species. Lichens are found on a range of substrates including rocks, trees, soil and moss and as parasites. They are not considered to be of economic importance, although some species could be used as a source of antibiotics and as environmental indicators of air quality.

Mosses occur mainly in mountain and forest habitats. About 108 species are considered to be rare and should therefore be included in the Red Data Book. The most diverse and abundant group of higher plants are Angiosperms (about 3 500 species), representing almost 50 per cent of the flora of the Caucasus. The animal diversity of Armenia includes 17 000 invertebrates, 29 fish, 8 amphibians, 53 reptiles, 349 birds and 83 mammal species. Their presence in various ecosystems proves the importance of all Armenian habitat types (Table 5.2).

Table 5.2: Fauna of Armenia *

Number of species

Group	Habitat types				
	Deserts and semi-deserts	Steppes	Meadows	Forests	Azonal habitats
Fish	-	-	-	-	29
Reptiles	33	31	9	23	6
Amphibians**	5	4	3	6	-
Birds	28	33	12	69	203
Mammals	62	72	24	50	-

Source: Ministry of Nature Protection.

* Number of animal species according to broad habitat type .

**Amphibians are generally connected to water bodies that are located within other habitat types.

The status of Armenia's species is reviewed and discussed in the Red Data Books on flora (published 1990) and fauna (published 1987). The latest reliable estimates of the status and distribution of species in Armenia are 15 years old.

The highest numbers of endangered plants in Armenia are found within the floristic regions where human pressure and the consequent loss of natural habitat are high (Table 5.3). These regions include the Ararat valley, where only 35 per cent of the area once covered by natural ecosystems are conserved. The remaining 65 per cent are today converted to agriculture. In the Vayk, Zangezur, and Meghry regions the percentage of remaining natural habitats is similarly low.

Table 5.3: Number of rare and endangered plant species by region

Region	Endangered plant species	
	Number	*as % of total*
Yerevan	144	37.2
Meghri	114	29.4
Vayk (Daralagyaz)	98	25.3
Zangezur	93	24.4
Idjevan	71	18.3
Sevan	48	12.4
Lori	47	12.1
Shirak	39	10.1
Aparan	26	6.7
Verin Aakhurian	25	6.4
Aragatz	19	4.9
Ghegam	14	3.6

Source: Red Data Book of Endangered Species (1990).

There is limited information available on the current status of animal species. The number of species in Armenia listed in the International Red List of Threatened Animals (1996) is included in Table 5.4. There have been significant changes in the distribution of many species of high conservation importance since the publication of the Red Data Book. Examples include the mouflon (*Ovis ammon gmelini*), the leopard (*Panthera pardus tulliana*) and the pasang (*Capra aegagrus aegagrus*), whose area of distribution is very reduced. The brown bear has abandoned some of its traditional habitats to avoid human disturbance.

Table 5.4: Number of threatened animal species found in Armenia

Number

Group	Internationally threatened species	Lower risk or data deficient species
Total	**24**	**30**
Invertebrates	6	7
Fishes	1	4
Reptiles	4	4
Birds	7	5
Mammals	6	10

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

Endemic species

About 106 species of endemic plants are recorded. Some of them are regional endemic, and also found at a limited number of sites in neighbouring countries (for example, *Campanula massalsky* grows also in Turkey and *Cousinia gigantolepis* can be found in northern Iran). It is estimated that there are between 150 and 200 relict species. Some of them are well adapted to today's conditions (*Fagus orientalis*). Others are widespread but associated with particular habitats (Caucasian rosebay). Some relict species can be found in specific sites (*Platanus* orientalis and Dryopteris filix-mas). Some relict fungi are found in deserts and steppes, including *Podaxis pistillaris* and *Battarea phalloides*.

Of the 17 500 vertebrate and invertebrate species recorded, 329 are endemic. These include a wide range of invertebrates (including *Phytodrymadusa armeniaca, Nocarodes armenus, Olophrum Aragatzense, Amphycoma eichleri, Cantharis araxicola, Tomomyza araxana, Bombilius schelkovnikovi, Shadinia akramowskii*, and *Gabbiella araxena*), as well as a number of vertebrate species and sub-species. Nine species and sub-species of fish are endemic (*Salmo isshkhan* and its four sub-species, roach, Schneider species, Sevan koghak, barbell, white bream). Of the 53 reptile species found, over 13 per cent are endemic. Also, some endemic bird and mammal species are recorded, but a number of them can be found in neighbouring countries (Armenian gull, mole vole, the Armenian mouflon, etc). Only a few relict animal species are recorded (roach, whitewinged scoter, etc).

Protected areas

The first protected areas were established in 1958. These were the Khosrov, Dilijan, Shikahogh State Reserves and several State reservations. Since then, Armenia's protected area network has been extended with several State reservations and the Lake Sevan National Park in 1978. Apart from the Lake Sevan National Park, national protected areas are strongly geared towards forest conservation, while other ecosystems are not so well represented.

The recent Law on Specially Protected Natural Areas defines four categories: State reserves, State reservations, national parks and nature monuments (Table 5.5).

Table 5.5: Protected areas in Armenia

	Number	Total area (km^2)	as % of national territory
State reserves	5	685	1.5
State reservations	22	842	3.5
National parks	1	1 500	5.0
Nature monuments	-	-	-

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

According to this Law, Armenia's **State reserves** should be considered as IUCN category Ia (see Table 5.6 below for a list). They are established to provide high-level protection for important habitats and species. The human use of their natural resources is prohibited, except for scientific research. However, in many cases, only a small portion of State reserves has enjoyed a significant degree of protection, while large parts have been affected by the exploitation of natural resources, grazing, industrial development or urban development. This situation applies in particular to the Dilijan State Reserve, where many people live and an industrial area was developed in the core zone of the protected area, leaving only a few habitats relatively undisturbed. Another example is the Erebuni State Reserve, an area of international importance for the conservation of the endemic wild relatives of domestic crops, where urban development has reached the boundary of the reserve, and the lack of a buffer zone is resulting in significant losses of natural habitats.

State reservations were established to protect rare and important habitats and species, as well as to improve the balance between economic use and nature protection (Table 5.6). Therefore, some economic activities are allowed, but must be conducted in an environmentally friendly manner. The boundaries, management responsibilities and organisational structure of State reservations must be defined by special documents. The same problems, as those related to State reserves (mostly the over-use of natural resources), are also reported for State reservations.

Lake Sevan National Park is the only **national park** in Armenia, with a core protection zone extending to the entire watershed. The National Park combines zones with State reserve status (strict conservation), State reservation status (conservation and sustainable use), as well as recreational and industrial zones.

Table 5.6: State reservations and State reserves in Armenia

	Area km^2
State reservations	
1. Areguni Juniper Forest	33.1
2. Akhnabat Yew Grove	25.0
3. Hazel-nut	40.0
4. Banx Pine	4.0
5. Goravan Sands	2.0
6. Her-Her Juniper Forest	61.4
7. Djermuk	38.6
8. Giulagarak Pine	25.9
9. Platan	60.0
10. Rose Bay	10.0
11. Margahovit	50.0
12. Aragats Kare Lich	3.0
13. Arzakan and Meghradzor	145.0
14. Idjevan	78.0
15. Ghandzakar (Verin Aghdan)	68.0
16. Ghetik	60.0
17. Eghegnadzor	42.0
18. Goris	19.0
19. Bokhakar	27.9
20. Vordan Karmir	2.0
21. Ankavan	34.0
22. Djermuk Wareshed	70.0
State reserves	
1. Khosrov	292.0
2. Dilijan	290.0
3. Shikahogh	100.0
4. Sev Lich	2.4
5. Erebuni	0.9

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

No **nature monuments** have so far been established in Armenia. Regulatory instruments for their implementation has not been developed, nor has this been done for the inventory and conservation and

management guidelines. The Ministry of Nature Protection is drawing up a list of priority sites to be proposed as natural monuments.

5.2 Pressures on nature

Agriculture

Agricultural land covers a total area of 1 391 400 ha (0.4 ha per inhabitant), of which 16.4 per cent is arable land. In 1997, the agricultural sector accounted for about 27.9 per cent of GDP, and employed about 41 per cent of the active labour force. The land reform in 1991 resulted in the privatization of most arable land and of livestock, with an estimated 320 000 new farms (see Chapter 11).

Fertilizer use shot up in the 1980s. According to Armenia's 1998 state-of-the-environment report, 80 000 tonnes of 34 different types of fertilizers were applied in the Lake Sevan basin from 1980 to 1988. In addition, average pesticide use in Armenia was 9 kg per ha, but there was no control over its use on private lands. At present, problems arising from the use of agrochemicals in Armenia are increasing, since all lands have been privatized and there are no regulations for their use. Due to the recent economic, financial and political problems in the country, the use of agrochemicals has declined sharply, but it could rise again as the economy recovers. Special attention should be paid to nitrate fertilizers because they accumulate in the environment and in food.

The transition from a centralized to a market economy, together with the energy crisis, has changed some agricultural practices, and this has had an adverse impact on the environment. The first impact comes from the demand for animal feed. Before independence, the bulk of animal feed was imported. After independence, the privatization of agricultural land and the blockade meant that animal feed was scarce. Feed was not imported during 1992-1995; hence farmers had to rely on hay, pastures and forests for grazing.

Rainfall is inadequate for cultivation in many areas, and irrigation is widespread. Soil erosion is a major problem, affecting 60 per cent of the agricultural land. For more detail on environmental problems linked to agriculture, see Chapter 11.

Forestry

According to World Bank estimates, the total standing wood volume per hectare in 1993 on forested areas was 125 m^3 roundwood. The reason for such a very low volume for this type of forest - which could be twice as high - could lie either in inadequate forest management or in fellings higher than officially permitted or both. According to forestry regulations, all high forests are subject to natural regeneration. Surveys from the 1960s onwards showed that 60 per cent of naturally regenerated forests were completely damaged, mainly due to grazing. It is reported that illegal felling has reduced the growing stock again in recent years. State forest resources are shown in Table 5.7.

Table 5.7: State forest resources

	1978	1983	1988	1993
		(Thousand ha)		
Total area of State Forest Estate	**407.5**	**420.3**	**423.3**	**459.9**
Forest area	269.0	282.8	291.5	334.1
Conifers	10.4	16.5	21.5	26.1
Broad-leaved	238.2	245.2	249.4	280.7
		(Million m^3)		
Total standing volume o.b.	**31.14**	**33.25**	**37.22**	**41.74**
of which:				
Mature and overmature	7.58	10.89	13.16	14.08
Total mean increment per year	0.31	0.38	0.43	0.45

Source: NEAP, 1998.

Forest plantations serve as a substitute for natural forests. They are sources of wood, provide shelter for wild animals and protect soils. Afforestation has decreased in recent years (Table 5.8).

Table 5.8: Forest plantations

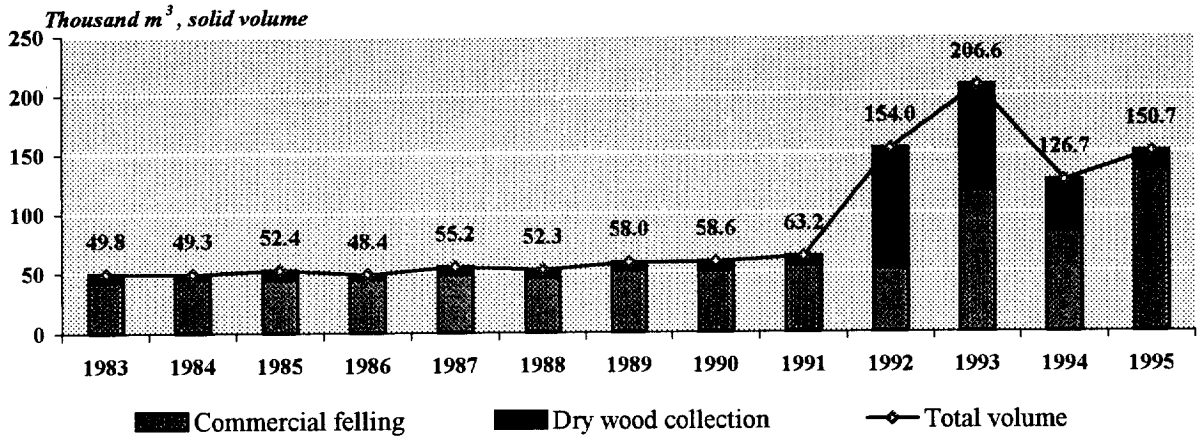
Thousand ha

	1978	1983	1988	1993
Closed plantations	19.4	29.1	35.3	36.8
Young plantations (not closed)	29.6	23.6	16.0	13.4

Source: NEAP, 1998.

During the past 70-80 years, Armenia's forests have been generally managed for conservation and protection purposes. Therefore, they are cut only when trees become weak and overmature. Wood from such trees is not technically useful. However, it is possible to maintain conservation management objectives and use the forest's productive capacity at the same time. This could be done by cutting the trees in an earlier stage of regression before the wood decays, when quality is still satisfactory for technical use. Trees can be selected for cutting in various ways (e.g. crown transparency assessment method). These areas should be reforested no later than two years after felling. Felling in recent years is presented in Figure 5.1.

Figure 5.1: Annual regular cuttings



Source: NEAP, 1998.

Commercial fellings have increased since 1983. In 1996 the total amount of commercially harvested wood was reported to be 120 000 m^3. This did not include dry wood collection. The State-owned forest enterprise ('Hayantar') carries out nearly all removals, although in 1995 and 1996 about 10 per cent was harvested by other organizations.

The main **non-wood forest products** of Hayantar are hay, livestock, forest fruits, Christmas trees, honey, medicinal plants and game. The management of Hayantar employed 26 per cent of its permanent staff, in the period 1985-1989. Forest fruits and nuts are produced in the forests and are therefore considered the property of Hayantar. This production occupies an estimated 10 000 ha and accounted for 10 per cent of all non-wood incomes in 1996. Where fruit production is important, particular attention is given to the management of the forest to ensure good growth of the understorey fruit plants. Hayantar also grows some of them as plantation crops. Most of these resources are presently under-used (no reliable inventory or monitoring data are available).

The following wild fruit and nut species are of substantial interest both for market production and for the conservation of genetic resources:

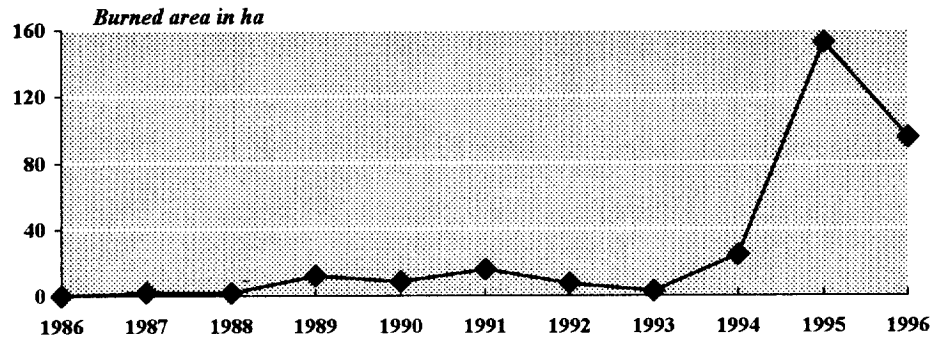
1. Apple	*Mallus orientalis*
2. Pear	*Pyrus caucasica*
3. Mountain ash	*Sorbus aucuparia*
4. Hawthorn	*Crataegus caucasica*
5. Plum	*Prunus divaricata*
6. Apricot	*Armeniaca vulgaris*
7. Almond	*Amygdalus fenzliana*
8. Cherry	*Cerasus avium*
9. Hazel	*Corylus avellana*
10. Walnut	*Juglans regia*
11. Cornelian cherry	*Cornus mas*
12. Seabuckthorn	*Hipophae rhamnoides*
13. Rose	*Rosa sp.*
14. Medlar	*Mespilus germanica*

In the former Soviet Union, forest management was planned by Moscow-based committees, which had offices in Armenia. The management followed ten-year plans. The same approach is currently followed by Hayantar, but it is reported that the plans are not put into practice.

Wood harvesting is mainly based on the assortment method (trees are cut into short assortments in the forest before transport). Transport is mainly manual, especially on mountainous terrain. Animal power, agricultural tractors and winches are also used. A considerable proportion of machines and equipment is outworn and nearly all of them are outdated.

Forest fires have not been a major problem in Armenia in the past, although since 1993 they have increased both in number and in area burnt (Figure 5.2). Nevertheless, forest fires are not considered to be a real problem. There is no special forest fire-fighting organization in Hayantar.

Figure 5.2: Forest fires



Source: NEAP, 1998.

There are 1 200 pest insects and 200 disease-causing organisms. The most harmful insects are *Ocneria dispar*, *Euproctis chrysorrhoea*, *Tortrix viridana*, *Malacosoma neustria*, etc. The most harmful disease-causing organisms are *Microsphera alphitoides* and *Melampsora pinitorqua*. These organisms invade 15 000 – 25 000 ha of forests each year.

Hunting and fishing

The records of granted and used hunting licences in the period 1994-1996 show that the number of hunters is growing (Table 5.9). For some species, the number of licences grew several times (female quail, duck). Additionally, poaching is considered a significant problem, resulting mostly from the country's economic

problems. Since monitoring data on game populations are not available, it is not possible to assess the actual threat to biodiversity from hunting.

Table 5.9: Hunted species and number of hunting licences

	Number of licences					
	Granted			Used		
	1994	1995	1996	1994	1995	1996
By species						
Snipe	120	180	297	112	137	199
Quail	942	..	3 625	521	..	3 060
(Quail and duck)*	..	1 780	..	..	1 611	..
Duck	723	..	2 866	449	..	2 210
Pigeon	..	80	509	..	27	509
Partridge	..	300	200	..	24	-
Hare	..	..	200	..	..	84

Source: NEAP, 1998.

* Only in 1995 are quail and duck registered together.

Lake Sevan supports extensive commercial fishing, representing 90 per cent of national fisheries. The five-year periodical catch records from 1966 to 1995 indicate a constant change in species composition: the population of Sevan trout has dramatically decreased, that of koghak as well, while the populations of whitefish and goldfish have increased. This is explained by habitat changes caused by water offtake from Lake Sevan. Although, in 1996, the Ministry of Nature Protection established a fishery licensing and contract system, illegal catches pose a serious threat to water species populations.

Extraction of mineral resources

Armenia is rich in mineral resources, especially in non-ferrous metals (molybdenum, copper, lead, zinc, gold, silver), as well as in non-metal minerals such as perlite, diatomite, marble, basalt, granite, tuff. About 45 per cent of Armenia's industry is based on molybdenum exploitation and processing. According to the data of the American University of Armenia's Environmental Research and Management Centre (ERMC/AUA), one of the driving forces of land degradation appears to be the extraction of construction stone, in an area of at least 3 196 ha. See Chapter 10 for details on the environmental problems of the management of mineral resources.

Transport

Existing road and railroad networks are not considered major threats to Armenian habitats, except in fragile sub-alpine and alpine ecosystems, but their further development in a non-sustainable manner could lead to serious habitat fragmentation. According to ERMC/AUA projections, about 15 000 to 20 000 ha will be used for road construction in 2001. See also Chapter 12.

5.3 Nature conservation policy and management

Legal framework

The Supreme Council adopted the Principles of Legislation on Nature Protection, in 1991. It served as a basis for the national environmental policy and related legal instruments. The main further legal instruments regulating the management of natural resources and the conservation of biological diversity in Armenia are:

- The Law on Specially Protected Natural Areas (1991)
- The Law on Environmental Protection and Nature Use Charges (1998)
- Government Resolution on Sevan Fishery (1996)

- The Land Code (1991)
- The Underground Resources Code (1992)
- The Water Code (1992)
- The Forest Code (1994).
- The Law on Flora
- The Law on Fauna.

The Law on Specially Protected Natural Areas outlines the procedures for establishing protected areas and their management principles. It aims to maintain the balance of ecosystems, preserve nature monuments, conserve biodiversity, control the use of natural resources and promote environmental education and public awareness. The Forest Code regulates the conservation, protection and management of forests, taking into account their ecological, social and economic significance as determined on a scientific basis.

Armenia has ratified the following international conventions on the conservation of the natural and cultural heritage (see Chapter 4 for details):

- The Biodiversity Strategy and Action Plan (1999)
- The Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar, 1971)
- The Convention on Biological Diversity (Rio de Janeiro, 1992)
- The Convention concerning the Protection of the World Cultural and Natural Heritage (Paris, 1994)
- The Convention to Combat Desertification (Paris, 1994)
- The United Nations Framework Convention on Climate Change (Rio de Janeiro, 1992).

Institutional framework

The main institution for the implementation of environmental policy and management is the Ministry of Nature Protection with its regional environmental authorities. The Ministry of Agriculture and the Ministry of Health with their networks of regional offices also bear some responsibility for the management of nature. The central offices of these ministries are responsible for policy development and the drafting of regulations. The Ministry of Nature Protection is responsible for the introduction of an ecological survey and inventory, monitoring and management of biodiversity, development of guidelines for sustainable use of natural resources, and for reviewing the implementation of legislation relating to the environment. The Ministry is also responsible for a number of protected areas, and supervises the activities related to the use of natural resources of other government agencies.

The Protected Areas Department of the Ministry of Nature Protection (See Figure 1.3 in Chapter 1) is the main actor in nature conservation, together with the Inspection Department. Regional environmental inspectorates carry out nature protection control. The mandate of the Ministry includes issuing licences for the use of natural resources, against payment of resource use fees. These fees, as well as all associated regulations, are defined by the Ministry and approved by the Government. See also Chapter 2.

The largest department of the Ministry of Nature Protection is the Forestry Department, which supervises the State Enterprise Hayantar. According to the World Bank, Hayantar employed 1 614 seasonal workers and had 1 014 permanent employees in 1996. Forest protection is implemented through the Hayantar State Forest Service, consisting of 31 forest offices. Hayantar is responsible for all forestry-related activities, including advisory services, plant production, forestry planning and operations, public and technical information, forestry statistics.

The Ministry of Nature Protection supervises all protected areas in Armenia. This is either done directly by the Ministry (as in the case of Lake Sevan National Park, Erebuni and Sev Lich State Reserves), or it is delegated to Hayantar (part of the Ministry), or the Ministry of Agriculture. Hayantar manages three State reserves and 16 (out of 22) reservations. Six State reservations are currently under the jurisdiction of the Ministry of Agriculture.

The Armenian Hunters' and Fishermen's Association is responsible for the management of 13 hunting areas that have been established since 1961. The Association's main objectives are the protection and sustainable use of animal resources. Hunting licences require the permission of this Association. The total allowable number of game for hunting is approved by the Ministry of Nature Protection.

National Environmental Action Plan

The National Environmental Action Plan (NEAP) should serve as one of the basic documents for the efficient conservation and sustainable management of natural resources. Although it tackles most forestry and biodiversity problems (lack of both a forest and biodiversity inventory, improper road planning and construction, need to review the network of protected areas, deficiencies of the Red Data Book, and others), it does not identify the institutions in charge and does not set a time frame. See Chapter 1 for a comprehensive assessment of the NEAP.

Biodiversity Strategy

The Biodiversity Strategy and Action Plan were prepared in 1999. They spell out the measures for the implementation of the Convention on Biodiversity. Special attention is given to the sustainable use of natural resources, institutional strengthening for biodiversity management and the protection and evaluation of the impact on natural resources.

Forestry policy and strategy

Forest policy was revised and adopted in 1996 to meet the environmental criteria for economic use, rural development and land use. A corresponding national forestry strategy was prepared (as part of a FAO Technical Cooperation Project). Its major objectives are:

- the integration of Armenian forests into the national economy,
- the afforestation, regeneration and development of rural forestry,
- the improvement of the effectiveness of the forest management,
- the conservation and protection of the environment,
- forest protection against illegal cuttings, fires, grazing, etc.
- forest protection against pests and diseases,
- forest regeneration and plantation,
- setting up a State forest registry.

Nature protection education and research

Natural sciences are part of the national curriculum for secondary schools. Ecology or nature conservation is not specifically mentioned in the curriculum, but most primary and secondary schools organize field trips and visits to protected areas or botanical gardens. Of particular interest is the recently established "Centre for the Protection of Armenia's Flora and Fauna" (under the Institute of Botany of the National Academy of Science) at the botanical gardens of Yerevan. One of the main objectives of this Centre is to provide educational programmes for school visits.

The conservation and sustainable use of natural resources are included in the curriculum of the Faculties of Biology, Geography and Chemistry of Yerevan State University. The National Pedagogical Institute, the Agricultural Academy and a number of private higher education institutes, including the Yerevan University of Economics and Law, the Armenian Sector of the International University of Environmental Policy and "Haybusak" Private University, also deal with ecology. A Forestry Faculty was established in 1996, but it lacks staff, equipment and modern teaching material.

The main scientific institutions competent for biodiversity research are:

- The National Academy of Science, with the Institutes of Botany, Zoology, Bacteriology, Hydro-Ecology and Fisheries, Agro-chemistry and Hydroponics, and the Centre of Noosphere Research
- The Institutes of Land Cultivation, Soil Science, Fruit and Grape Cultivation, and Applied Bio-technologies of the Ministries of Agriculture and of Industry
- The universities (Yerevan State University, Agricultural Academy, Medical University, and Teaching Institute).

Most of the scientific work on biodiversity has been done on a permanent research station and a 40 ha pilot plot, located at an altitude of 3 200 m on Mount Aragat. The plot has been maintained since 1962. Most of the research has focused on evolution patterns, assessments of human impact on alpine vegetation and developing mechanisms for habitat conservation.

The role of NGOs, public awareness and stakeholder participation

The NGOs dealing with environment have cooperated with the Department of Protection of Biological Resources of the Ministry of Nature Protection, and are active in the development of biodiversity conservation activities and project proposals. They have a common interest in preserving biological diversity.

The Nature Protectors' Society is probably the oldest NGO concerned with the conservation of biological diversity in Armenia. Its members include 66 eminent researchers from Armenian academic institutions. The Society operates on a voluntary basis, and collaborates with local experts and government authorities. A number of NGOs are also known to be active in the general field of ecology and conservation of natural resources.

According to the First National Report on the Biodiversity of Armenia, public media do not cover environmental issues satisfactorily. Due to the population's limited environmental education and serious economic problems, public awareness is felt to be less oriented to sustainable patterns of use of natural resources and their conservation than to other aspects of life.

5.4 Conclusions and recommendations

The development of new environmental policy and management in general and of biodiversity and nature management in particular were not a priority of Armenian policy immediately after independence. The measures taken have therefore been carefully selected to meet the most pressing needs. The continuation of this strategy requires more efforts in all directions.

In the development of legal instruments, the existing legislation on biodiversity and forestry includes the basic conservation principles and directives, but not the basis for their efficient implementation. As a large number of implementing regulations are required, it might be helpful to take stock of all of them, in order to determine their interrelationships, from which priorities could be derived.

Also of special importance for legal instruments seems to be the anticipation of the effects of forest land privatization on forest management. Ownership is a decisive criterion in forest management. Agricultural land is already privatized and the forest sector will soon be privatized too. In addition to its importance for State enterprises, the sustainable use of natural resources will also have to be part of the responsibilities and rights of private owners. The existing legal instruments for nature protection are not yet adapted to private ownership.

International legal instruments help the implementation of nature protection policies, but here again, implementation plans are a prerequisite. Among the international conventions ratified by Armenia, most of the implementing requirements are met for the Convention on Biodiversity (the National Biodiversity Strategy and Action Plan has been developed, as has the First National Report). The implementation processes of other ratified conventions are in the preparatory phase, but should soon be completed. In this connection, it should also be noted that Armenia is a country of unique biodiversity richness. The importance of its protection and conservation is internationally recognized. Fulfilment of its international obligations will help Armenia to reach the objectives of its environmental policy. See also Recommendation 4.4.

Recommendation 5.1:
A priority list should be established of all legal instruments that are required for the implementation of existing laws aiming at biodiversity and nature management, in particular the newly adopted Laws on Flora and Fauna. The process of harmonizing the nature protection and forestry legal systems with relevant laws concerning private ownership should be initiated.

The establishment of a biodiversity inventory and of related monitoring are the main prerequisites for a successful implementation of both nature protection and forestry policies. Due to the lack of exact biodiversity data, current management plans do not provide a reliable basis for a sustainable use of natural resources and its control. It also poses a problem for the further implementation of related international agreements. The Ministry of Nature Protection should solicit cooperation from all State and scientific institutions that deal with natural resources, when developing and conducting biodiversity inventory and monitoring. Suitably qualified Hayantar staff could carry out much fieldwork in this project, and environmental NGOs could also help.

Recommendation 5.2:
The Ministry of Nature Protection should develop and set up the biodiversity inventory and monitoring systems, in order to provide a reliable information basis for sustainable nature conservation and forestry policies.

The existing Red Data Book is based on species records from the 1970s and early 1980s. Due to lack of financing, it was published in 1990 only, but is no longer sufficiently reliable on the present field situation. According to reports, it does not contain a significant number of species that should have been included. For this reason, an update is necessary for the efficient protection of biodiversity resources. It is planned in cooperation with Japan (see also Chapter 4). As for the preceding recommendation, the cost-efficiency of the update could be increased if use were made of relevant knowledge of State and scientific institutions and NGOs.

Recommendation 5.3:
The Red Data Books should be updated in cooperation with all governmental and non-governmental institutions holding relevant expertise and information.

Protected area management is of substantial importance for biodiversity and nature protection. The current diffusion of responsibilities may be a complicating factor. The Ministry of Nature Protection and the Ministry of Agriculture are involved. Within the former, the responsible body is the Department of Protected Areas in some cases, while it is Hayantar in others. Competence in protected area management should be reconsidered between the institutions in charge. A preferable solution might be to make the Ministry of Nature Protection fully responsible for nature protection management, with corresponding internal harmonization.

Recommendation 5.4:
The Ministry of Nature Protection and the Ministry of Agriculture should review the arrangements governing responsibility for the management of all protected areas. See Recommendation 11.3.

The network of protected areas encompasses mainly sites selected for forest protection. This implies that the network is not representative of Armenia's habitat types. However, biodiversity conservation should include all Armenian habitat types to protect and preserve the rich variety of Armenian genetic resources.

Recommendation 5.5:
The network of protected areas should be extended to cover all characteristic habitat types in Armenia. See Recommendation 11.3.

Ex-situ measures are not sufficiently incorporated into the policy of biodiversity protection. They are especially important for the conservation of indigenous, rare and endangered genetic resources.

Recommendation 5.6:
Biodiversity protection should include ex-situ measures, with special emphasis on establishing and maintaining botanical and zoological gardens, nature museums, collections in competent institutions, dendrological parks, animal breeding centres and nurseries.

With the exception of Lake Sevan National Park, most of the protected areas lack adequate management plans and qualified staff due to limited financing. The current situation and management practices on the ground do not comply with the law. Regulations and administrative structures have been defined for three State reserves only (Dilijan, Sev Lich and Khosrov) only. The successful management of protected areas requires special documentation to be established for each area, including management and conservation strategies and plans, as prescribed by nature conservation laws.

Recommendation 5.7:
Management and nature conservation strategies and plans should be created or updated for each protected area.

Armenia's agro-biodiversity is a valuable global resource of wild relatives of current crop species and forms. See Chapter 11 for a detailed discussion of agro-biodiversity. It also provides a strong basis for the development of sound agro-forestry systems, especially in the case of forest species of edible fruits. These species provide other benefits too, e.g. they serve as a source of wood supply, they help prevent soil erosion and they afford yield protection (multiple-use trees). These possibilities could encourage private landowners to develop agro-forestry systems that, as already shown especially in the Mediterranean region, may have favourable results in terms of both economics and environmental protection. Such systems, scientifically adjusted to and applied under Armenian conditions, might be one of the appropriate solutions for sustainable rural development.

Recommendation 5.8:
The Ministry of Nature Protection should encourage scientific institutions to consider the development of agro-forestry systems in Armenia.

Forest management affects an important part of Armenian nature. Its further development is therefore of great importance. Maintaining and, possibly, increasing the area under forest is one of the key target variables for forest management, particularly during the current economic depression. Significant stretches of forests that were left to natural regeneration did not do so due to grazing. This means that natural forest regeneration does not guarantee successful forest growth, and, therefore, these forest areas should also be reforested. If properly managed, the cutting potential of Armenia's forest could become a major asset in its sustainable economic recovery.

Although non-wood forest values (ecological, recreational, medicinal, protective, etc.) are very important both for Armenia's environment and its economy, they have not been assessed. The rate of establishing new forest plantations has been decreasing in recent years. Forest plantations provide wood, serve as shelter for animals, prevent soil erosion, etc. All this points to a need to redefine the objectives and methods of forest use.

According to World Bank experts, the most important prerequisites for more active and economic forestry are better information about the forestry resource, improved forest management and a network of biodiversity conservation areas. A reconsideration of forest management practices should include an assessment of the need to develop a capability to fight forest fires, as well as of the possibilities for modernizing current pest and disease control.

Recommendation 5.9:
A comprehensive evaluation of forest management should be undertaken to optimize the sustainable use of wood as well as the non-wood benefits of the forest.

The development and efficiency of biodiversity and forest management depend on adequately qualified experts. The existing management structures lack well-qualified staff in particular.

Recommendation 5.10:
It is necessary to update education and training in the management of natural resources, in particular of biodiversity, protected areas and forest management.

Chapter 6

LAND MANAGEMENT AND SOIL PROTECTION

6.1 Land resources and use

Structure of resources

Armenia's total area is 29 734 square kilometres (for geographical details, see Chapter 3). Armenia is an ancient centre of civilization. A large part of its land is built up with settlements and infrastructure. Prior to the collapse of the Soviet Union, Armenia was mainly an industrial country since conditions for agriculture are difficult in this mountainous country. Much of the cultivated land is located on slopes steeper than 7 degrees. The use of ordinary agricultural technology is possible on only 34 per cent of arable lands.

The structure of land use is shown in Table 6.1. It should be noted that land use data differ depending on their source. The data in the table are obtained from the Department of Soil Protection in the Ministry of Nature Protection. They are based on the land register, which does not always reflect land use correctly.

Table 6.1: Structure of land resources, 1999

	1 000 ha	*%*
Total area	2 974.3	*100.0*
Agricultural land	551.0	*18.5*
Forestland	352.0	*11.8*
Land under settlements	65.8	*2.2*
Land under industry and infrastructure	95.0	*3.2*
Natural and historic protected territories, land for sports and recreation*	230.0	*7.7*
Reserve lands	1 660.5	*55.8*
Water surfaces	20.0	*0.7*

* including Lake Sevan area, i.e. 124.5 Thousand hectares

Source: Soil Resources, 1999.

Agricultural land is the largest single category – for details on agricultural land use, see Chapter 11. There are five main landscape types (also defined as planning zones), generally located at different altitudes. Typical of each of these landscape types is a certain set of conditions, including soil conditions, and a particularly widespread type of land use (Table 6.2 – for habitat characteristics, see Chapter 5). They are:

- semi-desert with some desert patches
- dry steppe
- steppe
- forest
- meadows

The highest natural productivity is typical of chernozems and several types of meadow soils in the mountains.

Table 6.2: Types of soils, their characteristics and planned use

Planning zone	District	Soil type	Area		Altitude	Temperature	Precipitation	Dominant slope	Landuse
			1000 ha	*%*	*m above sea level*	*Mean year*	*Mean year (mm)*		
Total			**2 616**	**100**					
Mountain steppe and meadow	Aragatzotn, Ararat, Gegharkunik, Lori, Kotayk, Syunik, Vayots Dzor, Taush	Mountain meadow; meadow steppe	629	24	2 200-4 000	2.5-3.0	750-1 000	Greatly sloping land. Almost 3/4 of the land has slopes exceeding 7 degrees and 1/2 exceeding 12 degrees.	Approximately 1/2 of the zone is regarded as productive land. The zone is used for grazing livestock (pasture land) and the production of hay.
Forest	Aragatzotn, Ararat, Gegharkunik, Lori, Kotayk, Syunik, Vayots Dzor, Taush	Cinnamonic forest; soddy calcarareous forest; brown forest	712	27	500-2 400	4.0-11.0	450-750	The slope angles of this group are similar to group 1: 3/4 of the land has slopes exceeding 7 degrees and 1/2 exceeds 12 degrees.	1/2 of the zone is covered by forest, 1/4 of the land is used for agricultural purposes. The agricultural land is used for pasture and hay production (60%) and crops/orchard (40%).
Steppe	Aragatzotn, Ararat, Gegharkunik, Lori, Kotayk, Shirak, Syunik, Vayots Dzor, Taush	Mountain chernozem; meadow chernozem	797	30	1 300-2 450	3.0-7.0	450-750	The slope angles of this group are divided with 1/3 below 3 degrees, 1/3 between 3 and 7 degrees and 1/3 above 7 degrees.	Agricultural production occupies 2/3 of the land, of which one half is used for crops and the other half for pasture hay production. The remaining 1/3 of the land is too rocky or eroded to be productive.
Dry steppe	Aragatzotn, Ararat, Gegharkunik, Lori, Kotayk, Syunik, Vayots Dzor, Taush	Mountain chestnut	242	9	1 250-1 900	8.0-10.0	320-470	The slope angles of this group are similar to group 3: a little more than 1/3 has slopes below 3 degrees, and 1/3 presents slopes above 7 degrees.	Agricultural production occupies 3/4 of the land, of which 1/2 is used for pasture hay production, 40% for crops and 10% orchards. The remaining 1/4??? of the land is too rocky or eroded to be productive.
Semi-desert	Aragatzotn, Ararat, Armavir, Yerevan	Semi desert brown; irrigated brown; salinated alkaline paleo-hydromorphic	236	9	850-1 250	10.5-11.4	250-300	The majority of the land is flat with 3/4 presenting slopes less than 3 degrees. Only 15% of the land has slopes exceeding 7 degrees.	A little more than 1/2 of the land is used for agricultural production, of which 1/2 for crops, 1/4 for orchards perennial and 1/4 pastures. The other half is either too rocky (70%) or too saline/alkaline to be productive.

Source: NEAP, Land Resources (share of agricultural land recalculated), author.

Most arable land is located in the Ararat valley and in other river valleys. Semi-desert brown soils, solonetz and solonchaks of low natural productivity are found in the valleys, especially the large ones. Soil management in these regions requires irrigation and other types of reclamation (see Table 6.3). Also, soda solonchaks, widespread in the Ararat valley, require specific, complicated reclamation technologies.

Table 6.3: Irrigation, 1995

	Land area* (1 000 ha)		Irrigated area as % of total
	Irrigated	Non-irrigated	
Total area	**281.4**	**276.5**	**50.4**
Aragatzotn	34.2	29.7	53.5
Ararat	39.4	2.4	94.3
Armavir	54.0	0.0	100.0
Gegharkunik	23.4	73.7	24.1
Lori	16.6	36.3	31.4
Kotayk	27.0	21.2	56.0
Shirak	29.5	55.5	34.7
Syunik	16.4	34.6	32.2
Vayots Dzor	11.5	12.4	48.1
Taush	23.9	10.7	69.1
Yerevan City	5.5	0.0	100.0

Source: Ministry of Agriculture.

* Refers to arable area and orchards.

6.2 Degradation, state and quality of land resources

Erosion

Erosion is one of the most widespread and dangerous natural processes for soils in Armenia. The slopes as such promote soil erosion. Besides, erosion is intensified by certain agricultural practices (see Chapter 11 for a detailed presentation), as well as by uncontrolled wood cutting. The impact of deforestation on erosion is substantial in the north-east (Idgewan and Talush). The development of erosion is shown in Tables 6.4 and 6.5.

The degradation of mountainous chernozems is very alarming since 43 per cent of them are subject to erosion to some extent. The annual humus losses of chernozems amount to about 8 million tonnes. On average, 45 per cent of agricultural lands are estimated to be actually eroded, while 80 per cent of lands are prone to erosion. In such regions as Ararat, Aparan, Vayk, Eghegnadzor, Sisan, Kapan, Meghri, 90 per cent of lands show signs of erosion, including 60 per cent of pastures. Irrigation has caused erosion on 5-6 per cent of irrigated lands.

The total eroded area has increased by 1.9 per cent during the past 20 years. Damage from land erosion in the late eighties amounted to at least some 130 million roubles a year or about 7.5 per cent of the gross agricultural product.

Table 6.4: Extent of soil erosion within the natural soil zones, 1998

Planning zone	Soil type	Area	Extent of erosion: None		Slight		Medium to severe	
		1000 ha	*1000 ha*	*%*	*1000 ha*	*%*	*1000 ha*	*%*
Total		**2,616**	**1,367**	***52***	**733**	***28***	**515**	***20***
Meadow	**Total**	**629**	**427**	***68***	**123**	***19***	**79**	***13***
	Meadow steppe	346	256	*74*	58	*17*	32	*9*
	Mountain meadow	283	171	*60*	65	*23*	47	*17*
Forest	**Total**	**712**	**276**	***39***	**232**	***32***	**204**	***29***
	Cinnamonic forest	133	95	*71*	30	*23*	8	*6*
	Carbonate forest	15	12	*80*	2	*13*	1	*7*
	Brown forest	564	169	*30*	200	*36*	195	*35*
Steppe	**Total**	**797**	**488**	***61***	**218**	***27***	**91**	***12***
	Mountain chernozem	718	415	*58*	212	*30*	91	*13*
	River valley terraces	48	42	*88*	6	*13*	0	*0*
	Exposed lacustrine soils	18	18	*100*	0	*0*	0	*0*
	Meadow chernozem	13	13	*100*	0	*0*	0	*0*
Dry steppe	**Total**	**242**	**32**	***13***	**110**	***46***	**100**	***41***
	Mountain chestnut	242	32	*13*	110	*46*	100	*41*
Semi-desert	**Total**	**236**	**144**	***61***	**50**	***21***	**41**	***18***
	Semi desert brown	152	62	*41*	49	*32*	41	*27*
	Irrigated brown	53	53	*100*	0	*0*	0	*0*
	Salinated and alkaline	29	29	*100*	0	*0*	0	*0*
	Paleo-hydromorphic	2	1	*35*	1	*44*	0	*22*

Source: National Environmental Action Plan, 1998.

Table 6.5: Extent of soil erosion by type of soil

1000 ha

Planning zone	Soil type	Area	Extent of erosion: None	Slight	Medium to severe
Total		**558**	**414**	**129**	**15**
Forest	Brown forest	77	42	50	8
Steppe	**Total**	**299**	**252**	**44**	**3**
	Mountain chernozem	264	218	43	3
	River valley terraces	27	26	1	0
	Exposed lacustrine soils	0	0	0	0
	Meadow chernozem	7	7	0	0
Dry steppe	Mountain chestnut	82	31	45	6
Semi-desert	**Total**	**100**	**99**	**1**	**0**
	Semi desert brown	43	42	1	0
	Irrigated brown	53	53	0	0
	Saline and alkaline	4	4	0	0
Cultivated land as % of eroded land		*21*	*30*	*18*	*3*

Source: National Environmental Action Plan, 1998.

Soil fertility and compaction

Soil compaction is observed on many agricultural lands. This process occurs on meadows during livestock grazing in early spring. On arable land, it is caused by the use of heavy agricultural machinery. Solidification is known sometimes to reach a depth of 60 cm on cultivated land. (See also Chapter 11 on this subject.)

In addition to erosion, the non-application of fertilizers (see Table 6.6) – or other means of restoring nutrient reserves – is responsible for the observed decrease of nutrient substances in soils. However, as soil fertility depends on many factors, reduced fertilizer application may not affect agricultural productivity substantially (Table 6.7). (See also Chapter 11.)

Table 6.6: Fertilizer use, 1985-1994

1000 tonnes

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Ammonium nitrate (34-36% N)	125.6	132.9	103.9	91.6	98.8	62.4	35.9	3.2	2.7	2.8
Urea (46%)	40.7	38.9	40.2	32.4	8.6	8.4	22.8	0.6	-	-
Superphosphate (18% P)	155.3	168.2	149.4	115.8	84.7	32.0	26.1	-	-	-
Potassium (40% K_2O)	28.8	29.6	24.9	21.4	11.1	16.9	1.9	-	-	-

Source: National Environmental Action Plan, 1998.

Table 6.7: Change in crop areas and yield before and after independence

	Crop area (1 000 ha)		% change	Yield (tonnes/ha)		% change
	1986	1992-94		1986	1992-94	
Cereals	133.2	189.5	*42.3*	2.4	1.5	*-38.0*
Vegetables	18.0	21.9	*21.8*	31.8	20.0	*-37.0*
Gourds	3.9	2.8	*-28.2*	16.3	14.1	*-13.7*
Potatoes	20.3	30.6	*50.9*	13.0	12.6	*-3.0*
Fruits	52.1	33.5	*-35.7*	3.8	3.1	*-19.5*
Grapes	25.7	25.1	*-2.3*	8.1	6.5	*-19.5*
Tobacco	3.8	0.5	*-86.8*	2.9	2.8	*-2.5*
Fodder	267.1	134.0	*-49.8*	10.2	8.9	*-12.5*

Source: National Environmental Action Plan, 1998.

Drainage, irrigation and salinization

Irrigation increases production of agricultural crops significantly in the semi-desert and dry steppe zones. For example, wheat productivity on "bogar" (non-irrigable arable lands) amounts to 20-30 quintals per ha, while, with irrigation, it is 40-60 quintals. In 1985, meadow soils as well as reclaimed solonetz and solonchaks were mainly irrigated. There were some 29 000 ha of salinized alkaline soils of natural origin in the semi-desert zone. A significant part of these soils was cultivated with the help of irrigation, drainage and chemical reclamation (soda solonchaks). After the collapse of the USSR, the surface of really irrigated lands began to decrease (280 000 ha in 1995, 217 000 ha at present). There is no new large-scale irrigation, and few new farmers cultivate irrigated lands. The destruction of irrigation systems is reported to have led to villages being abandoned.

Irrigation is most widely developed in the Ararat valley, which generates 50 per cent of agricultural produce. Out of its approximately 80 000 ha of arable lands, 53 000 ha of meadow soils are irrigated. About 30 000 ha can still be irrigated. In addition, 5 000 ha of salinized lands and solonetz are cultivated. The irrigation norm for one

watering is 800-1 000 cubic metres per ha. For grain crops, 4-5 waterings are required, for melon 6-7. Irrigation norms imply the application of 4650 cubic metres per ha a year. Drop irrigation was tested on experimental plots for grain crops, with negative results.

Irrigation requires drainage, since the rise of groundwater above a critical level (2.5-3 m) prompts secondary salinization of soils. During recent years, many drainage systems have been destroyed or not operated efficiently. Till 1998, there were no funds to restore them. The groundwater increased up to the critical level, and secondary salinization of soils began. Salinized soils occupy about 42 000 ha in the Ararat valley.

Approximately half of all irrigated lands are drained by open channels, and half by subsurface drainage. Vertical drainage exists in small areas, but operates only in 10-20 per cent of them. The water conveyance efficiency is 0.7. The mineralization of drainage waters is 1-2 g/l and does not cause serious ecological problems. At the same time, drainage water discharges to rivers could change the chemical composition of river water, and water pollution may result if they contain fertilizer and pesticide residues.

There used to be about 1 500 square kilometres of swamps in some regions in the Araks valley, caused by a high groundwater level and an artesian water dam. The swamps were drained and transformed into agricultural lands in 1953-1955, which led to a decrease in malaria morbidity. The destruction and inefficient operation of drainage constructions on some irrigation systems of the Ararat valley led to a rise in the groundwater level and waterlogging of vast territories. Waterlogging, in turn, led to the occurrence of malaria in these regions: 1 167 cases were registered in 1998 (see Chapter 13). For a presentation of interrelationships between drainage, irrigation and salinization with agriculture, see Chapter 11.

Soil pollution

Most pollution of soils with heavy metals in Armenia results from the use of fuel and mining activities, but in some cases contamination has natural causes (higher content of heavy metals in soil-forming rocks). Before transition, 60 per cent of related contaminants were generated by mobile sources - now the figure exceeds 90 per cent. About 30 000 ha of lands are polluted with lead, copper and molybdenum, a result of mining in north-eastern Armenia. Copper concentrations exceed 150 mg/kg on approximately 50 per cent of this territory. Contamination with lead occurs near roads and in settlements. The average standard lead concentration in soil is 32 mg/kg, but it increases to 100-300 mg/kg near roads. Soils near large cities, Yerevan especially, are totally contaminated. In the vicinity of thermal power stations, USAID research discovered soil contamination with polychlorinated biphenyls.

About 250 000 tonnes of industrial waste including 2 000-2 500 tonnes of dangerous waste are generated annually. Soil pollution related to hazardous waste generation, treatment, storage and disposal are covered in Chapter 7, which also refers to contaminated industrial sites.

Use of pesticides and fertilizers

At the end of the eighties, about 6 000-7 000 tonnes of agrochemicals were used annually (Chapter 7, Table 7.4). 800 000 tonnes of 34 types of fertilizers were used in 1980-1988 in the Sevan Lake basin alone. The average pesticide use amounted to about 9 kg/ha in the State agricultural enterprises. The amount used on private plots is unknown. The rules for the use of mineral fertilizers were not observed and much was lost in transport and storage. This led to the pollution of soils, water and agricultural produce. Armenian specialists estimate that, at that time, chemical pollution of agricultural lands led to cardiac and respiratory diseases, diseases of the nervous system, thyrotoxicosis and dermatitis. Child morbidity was 2-3 times higher than that of adults.

Out of 3 560 soil samples taken in 1977-1983, only 21 showed a high pesticide concentration. In 1985, high concentrations of chlororganic pesticides – i.e. DDT, officially forbidden in 1970, and DDE – were registered in 20 per cent of 368 samples, which had been taken from arable lands in the regions of Ararat, Oktemberian, Etchiniadzin, Artashat, Tumanian, Gugarak and Noemberian. DDT concentrations on cultivated lands in the

Ararat region amounted to 0.02-0.04 mg/kg under potatoes, and to 0.06-0.4 mg/kg under fruit trees, while DDE residues are found at rates of 0.45 mg/kg, and DDT and DDE residues in grape orchards at levels of 0.35 mg/kg. Where the onion was cultivated, the highest DDT and DDE concentrations were registered at 0.3-0.85 and 0.08-0.8 mg/kg, respectively.

Similarly, DDT and DDE concentrations of 2.2-2.3 and 0.8-1.0 mg/kg respectively were found in the soil of apricot gardens in the Oktemberian region. DDT and DDE were not observed under beet and rye in the Etchmiadzin region, but they were found under tomato and grapes. DDT concentrations of 0.08 mg/kg were observed in the Afrtasbat regions but there were no DDE traces. DDT in the Gugarak region under rye amount to between 0 and 0.1 mg/kg. DDT and DDE concentrations were 0.15-0.25 mg/kg and 0.22-0.4 mg/kg, respectively, under potatoes and cabbages. These compounds were not observed in the Noemberian region.

There are some problems with pesticide monitoring. Out of 69 793 analyses, 2.56 per cent of samples showed pesticide pollution, including 2.18 per cent of food products (see Chapter 11).

At present, only 40 000-50 000 tonnes of mineral fertilizers are applied (i.e. less than 3 per cent of the previous level, some estimates are even lower). Sawdust is used as a substitute for fertilizers. At the same time, the use of pesticides by individual farmers cannot be assessed, neither with regard to their amount and quality, nor with regard to their compliance with any standards.

Also since the 90s, the use of pesticides has drastically reduced (Chapter 7, Table 7.4). Already in 1995, a high content of pesticides was found in only three out of the 129 samples (one was taken from agricultural lands and two from urban areas) that were analysed by Armenia's State Hygiene and Epidemiological Surveillance Service (SHESS). In 1996, two out of 200 soil analyses showed a high pesticide concentration, 17 a high heavy metal content, 17 bacterial pollution and 20 pollution with helminths. SHESS observed high pesticide contents in 2.4 and 0.5 per cent of two sets of soil samples, respectively.

Landslides, mud flows and other exogenous geological phenomena

Some geological processes are an important factor of land degradation. It can be estimated from various data sources that about 175 000 ha of arable land are affected by such processes. This area may grow by at least another 5 per cent by the end of the year 2000. The economic losses resulting from negative geological events are estimated at US$ 100 million. The economic damage due to two major landslides (Odzun and Khakardzin in 1994) amounted to about one billion drams.

The arable lands affected are exposed to the following risks:

- 70 000 ha - to landslide processes (3 500 so far recorded, 2 500 mapped, 950 studied and 400 studied in detail)
- 40 000 ha - to solifluction, defluction and avalanches
- 30 000 ha - to erosion, surface washout and denudation
- 20 000 ha - to linear fluvial and flood accumulation
- 10 000 ha - to 'technogenic' processes
- 5 000 ha - to chemical denudation

Deforestation

Deforestation began in the thirties, at the start of the collectivization and industrialization of the country. The energy shortage in Armenia after independence led to intensive wood felling. As a result, during the past ten years, about 26.2 per cent of beech woods have become coppice woodland, and only 10.3 per cent of beech woods have preserved their high density. Only 1.3 per cent of oak forests have a high density, and 4.5 per cent have a low density. 31.3 per cent of oak forests are in a critical state.

Fuelwood was used most intensively during the winters of 1991-1993. In Yerevan alone, 60 000-80 000 trees were felled. This also affected air quality. In recent years deforestation has been most intensive near the border with Azerbaijan. The impact of deforestation on erosion is mostly manifest in the north-east (in Idghevan and Talush).

Grazing has further degraded the forest, partly as a consequence of pasture degradation. Grazing of forests is prohibited, but the pine and poplar plantations around Sevan are full of cattle. Forest fires destroy from 20 to 100 ha annually. The age structure of woods (average age is 90 years) may in the future not only lead to a reduction in wood resources, but also entail increased erosion.

Military activities have contributed to wood felling, the destruction of vegetation cover and soil erosion. Unique pine forests in the Kopan region have been destroyed, causing more erosion. However, quantitative estimates of the military impact on the environment and, in particular, on land resources are not available.

Impact of human activities

Built-up land occupies 193 100 ha. Mines and mining areas occupy 3 196.1 ha, of which mines proper occupy 1 437.3 ha. About 417.3 ha of mining developments are flooded with groundwater. Recent estimates show that agricultural land will be reduced by 30 000 ha in favour of settlements and industrial development, and by 15-20 000 ha because of road construction.

It is estimated that anthropogenic land degradation affects about 8 275 ha overall, including 5 324 ha which were formerly used for agriculture but are now withdrawn from agricultural rotation. 2 951 ha should be improved.

6.3 Policy and management of land resources and soil protection

Political priorities and programmes

Article 10 of the Constitution stipulates that "the State shall ensure the protection and reproduction of the environment and the rational use of natural resources". The analysis of party programmes shows that only one of them devotes a substantial part to the problems of the state of the environment. Some mention the importance of these problems; the rest include only popular slogans.

Various relevant State programmes and projects exist. Some are carried out with international cooperation. The following are the most relevant national programmes:

- The "Agro-biodiversity" programme aimed at the conservation and use of wild varieties of cultivated plants. The programme is ready, but requires funds for its implementation
- An agrarian policy programme has been developed
- NEAP
- The Land Restoration Programme

A drainage reconstruction programme started with the assistance of the World Bank. Only a small part of financial assistance obtained from the EU, the World Bank and some other organizations for the development of agriculture is spent on the amelioration of land use and soil protection. In addition to these programmes, relevant projects are also linked to international conventions and cooperation (see primarily Chapter 4).

Legal mechanisms and instruments

The main legal instruments currently in force for nature protection (including the use of soil and land resources) are listed in Chapter 1. In addition to the laws, The Government issued 23 decisions concerning land protection and 7 decisions on protected territories during 1990-1999.

The Land Code forbids construction on arable land, which belongs to the State. Such land can be rented.

Protection measures for Sevan Lake include limitations on the use of land, pesticides, mineral fertilizers and water for irrigation. In the national park, land can only be rented, for up to 5 years. A project exists to raise the water level of Sevan Lake. (For further details, see Chapter 8.)

Institutional arrangements

The following governmental institutions are involved in land resource and soil pollution management at the national level:

- The Ministry of Nature Protection (see below)
- The Ministry of Agriculture (see below)
- The Real Property State Unified Cadastral Department is responsible for the legal and financial cadastre of all land categories
- The Ministry of Finances controls land assessment
- The Ministry of Urban Development is responsible for land and waste management in settlements
- The Ministry of Health monitors soil, water and air pollution, and enforces hygiene standards through the State Hygiene and Epidemiological Surveillance Service (SHESS)
- The Ministry of State Register and Statistics
- The Department of State Standards

The responsibilities for land regulation and land-use management are included in Table 3.4.

The structure of the Ministry of Nature Protection and its main functions are presented in Chapter 1. Its main tasks naturally extend also to land resource and soil management, e.g. recultivation of eroded lands, amelioration of salinized lands and restoration of their natural productivity. Ecological expertise is also performed by the Ministry of Nature Protection (for a description, see Chapter 3).

Within the Ministry of Agriculture, the following structures deal with land resources and soils:

- The Department of Land Development and the State Institute of Land Planning deal with the mapping of land resources, the issuance of land passports and the planning of measures to prevent land degradation
- The State Land Inspectorate monitors land privatization, the registration of landowners, the adequate use of lands and land pollution
- The Department of Land Reforms and Privatization deals with land privatization
- The Institute of Soil Sciences and Agrochemistry deals with soil research
- Agrogitaspure organizes support for farmers on different issues, including land management and soil protection.

A Special Committee was created in November 1997 to coordinate the activities of different ministries in land reform. The Committee is made up of representatives of the Prime Minister's office and of the Ministries of Agriculture, Finance and Economy, Justice, Nature Protection, and Urban Development, together with the Real Property State Unified Cadastral Department. Land management institutes are being created. Their number, names and functions differ.

The responsibility of regional administrations (*marzpets*) in managing *Marzes* include:

- direct land management, the lands being under the jurisdiction of self-governed communities, including the sale or lease of reserve lands
- the preparation and registration of land passports
- ensuring an optimal balance between lands of different use categories
- assistance to farmers

- the collection of statistics on land use, yields and agricultural production.

Marzpets carry out their work with the help of regional representatives of different ministries and agencies, including:

- Regional inspectors of the Ministry of Nature Protection
- State land inspections by the Ministry of Agriculture
- Agrogitaspure
- Sanitary-epidemiological and hygiene inspections by the Ministry of Health
- the Real Property State Unified Cadastral Department with 21 offices in various *Marzes* and regions (to be increased to 40).

There are structures in the regions that report to the governors: Committees on Agriculture and Environmental Protection. They are not subordinate to the Ministry. At the same time there are Regional Inspectorates on Environmental Protection subordinate to the Ministry of Nature Protection. Their relations are unclear. See also Chapter 1.

The preparation and implementation of projects affecting the use of land and coordination of these plans with Marz authorities are the responsibility of local self-governed communities. In principle, they judge the need for the construction or reconstruction of irrigation systems and help in implementing environmental protection measures. In many villages, there are also water users' associations with special responsibilities for irrigation and water distribution (see Chapter 8 for details).

Economic instruments

Economic instruments applied to the use and protection of soil and land resources include investments in nature protection, taxes and charges for the use of natural resources such as soils and water, land price regulations, and fines for the violation of nature protection legislation and rules of land use. (For details, see Chapter 2.) Capital investments in the conservation of land resources are decreasing both in absolute value and in relation to total investments in nature protection.

At present, the market price of arable land in different regions ranges from 1-2 dollars to 5-6 dollars per square metre. Land prices in the Ararat valley stand at 4.3 million drams per ha of irrigated land and 0.5 million drams for a hectare of "bogar". Water prices also affect land use (for details, see Chapter 8).

Only limited, short-term (maximum 12 months) credits are accessible to farmers via the Agricultural Cooperative Bank. The interest rate amounts to 36 per cent in drams or 24 per cent in United States dollars.

Monitoring, information, research

Pollutants are monitored by subdivisions of the Department of Sanitary-Epidemiological Control, the State Ecological Inspectorate, the State Land Inspectorate and the Ministry of Agriculture. A Special Committee deals with the land register. It possesses the technology, while others develop the methodology.

Five land categories are used in the land cadastre, depending on soil features. On the basis of special studies, potential products were defined for each agroclimatic zone, leading to an estimate of the 'cadastral value' of land. Soil fertility and the state of the soils were also taken into account. Table 6.8 contains an example of such estimation. This cadastral land value is used in the regulation of land use – currently, however, only to a very small extent.

Prior to the collapse of the USSR, provisions for scientific research relevant to land use and soil protection were adequate. In Armenia, the Institute of Soil Sciences and Agrochemistry, the Institute of Land Management and

other scientific institutions operated in this field. A soil map of Armenia has been compiled on a scale of 1:100 000, making Armenia the only State of the world with a national map on that scale.

In addition, the Central Union Scientific Institutions or regional institutes undertook some research. Their activity in Armenia has ceased completely, while the current activities of the other research institutes mentioned are now reduced to 10-30 per cent of their previous level. On the other hand, the American University in Armenia has started work in many fields such as land assessment, land degradation and geographic information systems (GIS).

Table 6.8: Cadastral value of land classes in Ashtarak area

Land class	Cadastral value (1 000 drams/ha)
1	146
2	88
3	64
4	47
5	15

Source: Real Property State Unified Cadastral Department (RPSUCD)

Role of NGOs

Before independence, only official non-governmental organizations existed in Armenia. During the past 8 years, their number has sharply increased; their activity has been facilitated and become more diverse. About 70 ecological NGOs now operate in Armenia. Many of them deal with the issues of land resources protection and use. Some of them are:

- The Association of Assistance to Sustainable Development
- The Geographic Society of Armenia
- The Botanical Society
- The Society of Animal Protection
- The Armenian Agrarian Peasants Union
- Computers to Save the Earth
- The Burokan non-governmental organization (for ecological education)
- Agrobiodiversity (for training of experts in product quality)
- The Association of Ecotourism

Non-governmental organizations have succeeded in the field of ecological education and training, they have worked out new approaches to indicators of social (human) development and created an Irrigation Atlas of Armenia. At present, NGOs interact with different ministries (see also Chapter 1).

Privatization and its consequences

In the former Soviet Union, all land was State property and was given, for unlimited periods, to State organizations, collective farms, State farms and private persons for household needs. In Armenia, land privatization was decreed in 1990, and the privatization process was rushed forward. Land privatization is practically complete today. Arable and communal lands were privatized, but not pastures (see Chapters 3 and 11 for details).

Land privatization was not accompanied by changes in the provision of machinery, fertilizers, or agricultural product purchase from farmers. In spite of a decrease in pesticide and fertilizer application and a decrease in drainage, the quality of the crops has increased. This is explained by better land processing and attention to plants than under the previous land management regime.

Along with the privatization of land, privatization also occurs elsewhere and is accompanying or causing enormous political and economic changes in Armenia. The consequences for individual farmers are dramatic. Water, including irrigation water, is expensive, agricultural machinery is insufficient, purchase or rent is financially inaccessible at present. As a result, 35-40 per cent of arable land is not ploughed. Irrigation lands are reduced by 25-27 per cent, sometimes even more, according to experts. Vineyards have diminished by 60-70 per cent because they require water. In general, traditional land use – or land management – is frequently (but not always) replaced by other types, requiring less expenditure. This has consequences for land management. For example, the reduction in rotation together with fertilizer deficiency may accelerate fertility reduction and increase soil degradation.

6.4 Conclusions and recommendations

The land resources and soil situation in Armenia, as well as their management and protection are not particularly critical. There is a clear perception of the importance of soil protection, and much has been done in legislation and institutional arrangements to adapt practices to the new socio-economic situation. Qualified scientific personnel is available.

Nevertheless, the situation is far from ideal and requires specific attention and a set of measures on the protection and amelioration of soils and land resources. Existing problems are associated in the first instance with the current economic crisis and the lack of finance, but also with the absence of clear ecological priorities in State policy, deficiencies in the legal and normative basis (especially with respect to enforcement of laws and standards, and monitoring), and neglect of activities of vital importance for land resource management and soil protection (skills at all levels of management, the scope of scientific research, information).

The level of priority attached to environmental protection, and in particular land and soil protection, requires political will, adequate legal prescriptions and action programmes, as well as dynamic institutions to push the agenda forward. At present, the general coverage of environmental issues in political programmes and statements is disappointing. While the ongoing economic depression in Armenia can be expected to dominate the public expression of social priorities, public interest in environmental protection might be higher than seems to be generally assumed. Under all circumstances, the Ministry of Nature Protection has a clear interest in raising public awareness of environmental issues and should therefore not only carry out public opinion polls, but also envisage measures that are likely to raise public interest in the environment.

Among the measures that are required is the strengthening of public participation in environmental decision-making processes, starting with the drafting of such regulations for the EIE process (see Chapter 3). Further measures may be necessary in the area of environmental information, where a comprehensive publication plan may help stimulate public interest. The creation of a user group for environmental information is a low-cost measure that should involve different levels of administration together with NGOs.

Raising the profile of environmental issues on Armenia's political agenda also means integrating environmental concerns into sectoral development plans. Here, coordination between ministries and other administrations is required -- a difficult issue at present unsolved in Armenia. The creation of a council for sustainable development could perhaps remedy the situation – if it is given enough authority and composed of all the major political actors in the country. The council could in particular propose a scheme of responsibilities, streamlining the activities of the various ministries, agencies and institutions that are monitoring the state and use of natural resources, managing cadastres, and carrying out inspections.

Recommendation 6.1:
The Ministry of Nature Protection should take all possible initiatives to strengthen the priority level of environmental policies in general, and of land resource and soil protection in particular, by:

- *proposing the creation of a council for sustainable development*
- *initiating programmes for monitoring and strengthening public interest in environmental issues*
- *and by increasing further public participation in environmental decision-making.* *See Recommendation 3.3.*

A substantial part of the legal basis for general environmental protection and nature management has been created. It is now time to turn also to more specific problems, and to the revision of legal instruments that have not produced the expected results or created new problems. The existing normative documents on land use and soil protection need to be updated. The 1991 Land Code together with the Land Tax Act which has been drafted and will soon be submitted to Parliament should provide for the necessary periodicity and the needed monitoring of the state and use of soils, incorporate new concepts for pollution control, etc. The normative basis should be adapted as required to international practices like those of the European Union.

Privatization has changed many aspects of the organization of agriculture, with consequences for land management and soil protection. Some land degradation is associated with the structure of land use. Disturbances in crop rotation are caused by the high cost of energy. The degradation of irrigation lands and of drainage, the state of seed reserves, the storage conditions and specific features of agricultural product sales are also problematic. The restoration of more adapted types of land use, the selection of species for cultivation and product development, the promotion of seed-producing farms, the reopening of export markets, the organization of internal and external trade in agricultural products, investment in enterprises for the storage and transport of agricultural products, and, finally, access to reasonable credit facilities for both farmers and trade companies (the interest rates charged on credits in dollars seem to be without any economic justification and prohibitive) - all need the implementation of complex measures, and possibly also the development of new legal schemes promoting cooperation between farmers (see Chapter 11).

Recommendation 6.2:
Revision of the existing legal and economic instruments governing the management of land use and soil protection should be considered a priority.

Economic conditions are obviously a huge concern in all areas. They explain the concentration on fund-raising in all branches of public administration, including institutions for land and soil management. There is no easy solution to the problem in sight. Many small measures will have to be employed, which would point into two directions. Firstly, the most economical measures need to be taken in order to achieve the desired results. One possibility to this end may be to differentiate land taxes, if the users demonstrate that they apply resource-saving technologies, or take steps to protect the environment.

Secondly, all defendable fund-raising activities should be evaluated. It may be possible to generate income in the national parks and other protected areas, where the situation is particularly complicated. This is due partly to the lack of budgetary resources, but partly also because they forego possibilities for income-earning activities, like the organization of some tourism. These activities require permission from the Government, as, for instance, national parks are 'budgetary institutions'. It should be possible to find a consensus between all administrations involved to enable the park authorities to carry out acceptable economic activities, limited in time, which could generate revenue for financing basic needs.

Recommendation 6.3:
A revision of land taxes and payments for land use should be considered, differentiating them for all land users, depending on whether they apply resource-saving technologies or carry out activities to protect nature. A framework for economic activities by 'budgetary institutions' should be developed to help guarantee minimum activities for land and soil protection.

The existing programmes and projects aiming directly at land improvement and soil protection are insufficient. They do not spell out the measures to be taken, nor do they assess the resources needed for their implementation and the funding possibilities. Moreover, they do not foresee an evaluation of the economic, social and ecological impact of their intended results. The clarification of what needs to be done and the establishment of priorities among the specified measures are urgent, even if their implementation will take more time. The proposed revision of the NEAP at an early occasion (see Chapter 1) would be a convenient framework into which the specification of action required for land improvement and soil protection could be integrated.

Protected areas are subject to special rules. For instance, special requirements exist for the management of Lake Sevan National Park and its surroundings. Earlier, all lands belonged to the State, then to the Forestry Committee. The National Park was created in 1978, the Forestry Committee was transferred to the Ministry of Nature Protection in 1995, and only in 1998 were the lands given to the park authority. Part of the land had been privatized earlier, but many owners have not yet received their land passports. Small huts were built along the coastline, many of them illegally. The task is to put all this in order in a socially acceptable manner. The National Park must be delineated more precisely, so as to exclude privatized lands and include a number of forest areas which belong to the park's forest fund. See also Chapter 5.

Recommendation 6.4:
A comprehensive programme for land improvement and soil protection should be given priority. It should include specific action, its timing and means of implementation, on the basis of an analysis of needs and effects of the measures. The programme should be coordinated with all relevant administrations and with the proposed revision of the National Environmental Action Plan. See Recommendations 1.5 and 11.6.

Some problems of soil and land resources protection could be overcome if modern techniques or technologies were used on privatized lands. However, these lands are characterized by the small size of plots and the very limited financial resources of individual farmers. Consequently, achieving this objective does not only require adapted technology, but also imagination. Research and development are required prior to actual investments, and should be promoted in addition to the introduction of economic measures facilitating investments.

Recommendation 6.5:
Research and development, as well as the production of special agricultural machinery adjusted to use in mountains and on small plots, should be promoted by the Ministries of Agriculture, Nature Protection and Finance. Likewise, the introduction of soil protecting technologies in land use and cattle breeding should be supported. Investments in these activities should be encouraged by legislative and fiscal measures.

Science and research into land and soil issues have a prestigious past in Armenia. Unfortunately, financial difficulties force the relevant institutes to work at 10-30 per cent of their potential. As a result, skilled staff leave, and a sound generation structure cannot be maintained. For example, there used to be 10 to 15 theses annually at the Armenian Institute of Botany; now there are 1 or 2. Such a situation may lead to the irreversible degradation of scientific potential, with serious economic and social consequences. While this observation is generally valid, it is of particular importance for soil and land management, as the solution of many problems is research-intensive. A strategy to stop the trend and eventually reverse it could perhaps initially concentrate on an intensification of scientific exchanges and information, including the organization of joint research projects. For historical and linguistic reasons, the intensification of contacts and joint works could primarily be organized in the framework of the Commonwealth of Independent States. In addition, the wider international scientific community should be encouraged to cooperate with Armenian scientists to halt this dangerous development.

The system of monitoring and environmental information needs to be improved also from this point of view. An assessment of the monitoring system is required, leading to a substantial development of the network and the organization of the work. Renewal and modernization of the network will require investments in measurement, analysis and communication technology. Apart from monitoring information, data collection methods need urgent modernization in order to produce reliable information that is necessary for all users, including scientific users. See Chapter 1 for a fuller discussion of these problems.

Recommendation 6.6:
The exchange of scientific information on land and soil protection problems should be intensified, and the work on joint scientific projects promoted from all possible sides. Structures of the Commonwealth of Independent States (like the Intergovernmental Parliament, the Commission of Environment Protection, the International Association of the Academy of Sciences) should be used to this end, as should the international science community at large.

Training and education also need to be stimulated. The upper level of managers in ministries and agencies for land and soil protection is highly qualified. However, the decentralization of tasks to regional and local levels of public administration that accompanies the transition to a market economy also creates the need for land and soil protection capacity at those levels. There is also a lack of knowledge among farmers, many of whom now have to take decisions that have an impact on soil quality and land use, and nature protection in general. Adequate schemes for gradually generating that knowledge and management capacities where they are most needed are non-existent.

Recommendation 6.7:
It is necessary to work out and gradually establish a system for the education and training of specialists in soil protection and land management. To this end, the most urgent needs for experts at all affected levels need to be established, and possibilities for training in Armenia and abroad identified. *See Recommendation 11.2.*

Chapter 7

HAZARDOUS CHEMICALS AND WASTE MANAGEMENT

7.1 Structure and recent development of industry

Armenia is rich in mineral resources of industrial significance, including polymetallic ores containing gold, silver, rare earths, copper and molybdenum, and construction materials (granite, tuffs of different colours and ornamental stones) (for details, see Chapter 10). During 1985-1990, when Armenia was one of the industrial republics of the former USSR, industrial facilities occupied 5.5 per cent of its territory. The main industrial sectors processed domestic as well as imported raw materials. They included ore mining, metallurgical, chemical, engineering industries, and production of electronics, construction materials, textiles and food. In 1990 the main economic sectors in Armenia were mining and manufacturing industries, contributing almost one third to gross domestic product (GDP). Among the big industrial enterprises were the Poliplast and Nairit synthetic rubber plant, copper-production facilities in Kapan, a copper-molybdenum plant in Kadjar, a gold-mining plant in Ararat, a cement factory in Razdan, and integrated chemical plants in Yerevan and Vanadzor.

Before 1990, about 5 000 different chemicals were produced, exported, imported or used in Armenia. The products were mainly exported to Russia and industry depended on fuel and raw material imports from there. For example, there were three chemical plants in the Lori region:

- Vanadzor Chemical Plant JSC, with annual production capacities for calcium carbide of 15 000 tonnes, for synthetic corundum of 30 tonnes and for melem of 400 tonnes. It also produced jewels and different crystals for specific use.
- Vanadzor Chemical Fibre Plant JSC, with annual production capacities for acetate filaments (8 000 tonnes) and acetate tapes for cigarette filters (7 000 tonnes).
- Polymerkley JSC, producing over 100 different polymer glues, packaging and adhesive tapes, hermetic sealing stuffs, anti-corrosion coatings and varnishes, paints and organic solvents.

Between 1990 and 1994, production decreased by more than 50 per cent, mainly for the following reasons:

- Many enterprises were damaged or destroyed in the earthquake of 1988, including the Nuclear Power Plant, which had been the main energy supplier for industrial enterprises
- The collapse of the former Soviet Union interrupted vital trade links
- War and blockade of the country, reinforcing unfavourable conditions for foreign investment before 1995
- Lack of knowledge, expertise and financial resources for the transition to a market economy
- Lack of training in the development of new, environmentally sound technologies and in setting favourable conditions for new enterprises

The volume of industrial production started to increase again from 1993. By 1997 it had reached 149 per cent of its 1993 level. Some enterprises, after years of idleness, resumed production at 10-20 per cent of their original capacity. The structure of industry shifted from heavy and chemical industry to food processing, due to the availability of raw materials and the presence of a (domestic) market. On the whole, the contribution of the industrial sector to GDP shrank to just below one quarter in 1997 and came second to agriculture.

The privatization of industry started in 1995 and was actively supported by governmental policy (see also Chapter 3). By January 1998, about 1 250 enterprises had been privatized, the majority of which were small or medium-sized. Due to an open-door policy for private investment, large State-owned enterprises can be bought

by funds coming from foreign direct investment (FDI). After a sluggish start, foreign investment increased between 1995 and 1998, from US$ 18 million, to 35 million, 52 million and 2 186 million in 1998.

7.2 Waste risks and generation by type

Industrial waste

In Armenia, industrial wastes are divided into five categories depending on their degree of toxicity (see Table 7.1). There is no statistical information concerning the generation, treatment or disposal of biomedical wastes.

Table 7.1 : Classification of wastes

Class	Classification	Waste types
I	Extremely hazardous	Chlorine benzyl, perchlorcarbon, thorium, organochloride compounds, sulphuric and phosphoric acids, mercury, insecticides, etc.
II	Highly hazardous	Petrochemical catalysts, copper mining residues, bromine compounds, arsenic, aniline dyes, synthetic glues, etc.
III	Moderately hazardous	Used catalysts, hydrochloric acid, semiconductor waste water, titanium and wolfram reprocessing wastes, lacquer and dye wastes, etc.
IV	Least hazardous	Wastes from galvanic processes, semiconductor wastes, chemical and metallurgical wastes, etc.
V	Non hazardous	All non hazardous substances not included in the fourth item

Source : State of the Environment, Armenia, 1998.

Industrial waste statistics are not very reliable. In 1985-1990, about 36.5 million tonnes of wastes were generated each year, including 33.0 million tonnes of rock wastes from mining operations, 1.2 million tonnes from the building industry, 300 000 tonnes from the food industry; 110 000 tonnes from wood processing and 100 000 tonnes from chemical and petrochemical industries as well as 1.5 million tonnes of municipal wastes. About 20 000 tonnes of industrial wastes were hazardous, containing heavy metals, organic solvents, oil products and pesticides. The main generators of such wastes are manufacturing establishments, as well as small service sector enterprises, workshops, garages, etc.

In 1995/1996, 251 000 tonnes of industrial wastes were generated, of which about 16 000 to 18 000 tonnes were hazardous. These included 2 000 to 2 500 tonnes of highly toxic wastes, containing heavy metals from galvanic industry. The main generators of industrial and hazardous wastes are: Nairit Rubber Plant, Rubin, Chimmanratel, Doghgorts Chemical Plant, Haielectro, Yeraz, Haivoski jewellery plant, Yeraz Car Manufacture, Kajaran copper-molybdenum mining plant, Agarak copper-molybdenum mining plant, Kapan ore reprocessing plant, Avtogenmash machine production company and Luis machine production company. At present more than 220 million m^3 of tailings from copper, molybdenum and gold production are stored in special tanks. See also Chapter 10.

Till 1997, all legal entities were legally obliged to report on the generation, transport and disposal of wastes, including their transboundary movement. A classification was set up in 1996. Since 1997, data are collected according to the various categories. Subsequently, the Ministry of State Register and Statistics again started to collect information on waste generation, storage, treatment/elimination by industry, recycling, and on reuse and disposal in 1997 and 1998. The data collected are presented in Table 7.2.

The data included in Table 7.2 actually underestimate waste generation, as they do not cover enterprises that did not report – a frequent deficiency in waste statistics of countries in transition. The 1998 Human Development Report stated that 600 tonnes of hazardous wastes were generated in 1997, which is less than the data in the above table for toxicity classes I to III.

Table 7.2 : Generation of industrial wastes, treatment, use and disposal, 1997 and 1998

Tonnes

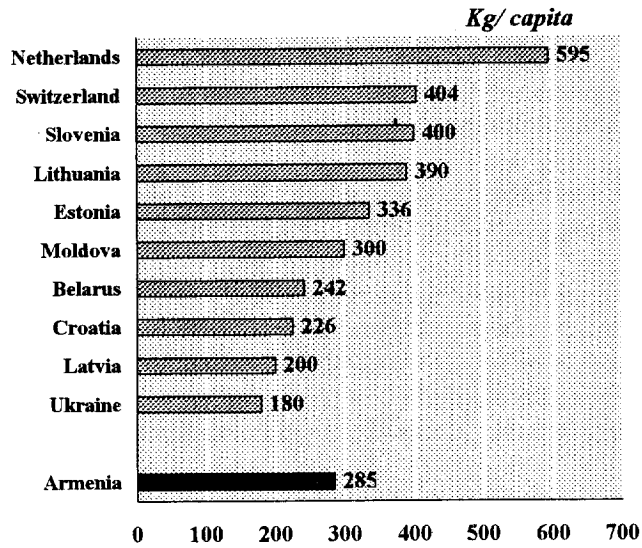
Category of toxicity	Generation		Treatment/ elimination, incl. stored wastes		Landfilling		Reuse/recycling	
	1997	1998	1997	1998	1997	1998	1997	1998
Total	**95 163.0**	**33 043.9**	**293.5**	**437.5**	**16 680.5**	**1 658.1**	**375.3**	**188.3**
as % of total generation			*0.3*	*1.3*	*17.5*	*5.0*	*0.4*	*0.6*
Category I	0.3	-	-	-	0.4	-	-	-
Category II	466.2	388.5	283.2	435.0	-	-	-	-
Category III	180.3	132.1	-	-	-	131.6	-	-
Category IV	74.2	393.5	1.2	2.2	6.1	374.1	1.0	15.6
Category V	94 442.8	32 129.8	9.1	0.3	16 674.1	1 152.4	374.3	172.7

Sources: Ministry of State Register and Statistics.

Municipal waste

According to data for 1985-1990, about 1.3 to 1.5 million tonnes of municipal waste are generated per year, of which 20 per cent in rural areas. This amount is equivalent to 370-430 kg per capita a year. Recent data for 1996 and 1997 are in the range of 247-285 kg per capita a year. Figure 7.1 compares Armenia's annual generation of municipal waste per capita with that of selected ECE countries. It shows that Armenia's figure is similar to that of other countries in transition. A 1997 estimate suggests that about 4.632 million m^3 of municipal waste are landfilled annually, of which 3.711 million from urban and 0.921 million from rural settlements.

Figure 7.1: Municipal waste generation in selected countries, mid-1990s



Source: EPR, Slovenia, Lithuania, Rep. of Moldova, Croatia, Latvia.

The municipal waste contains about 85 per cent of domestic waste and the rest is non-hazardous industrial waste. The composition of municipal waste in Hrazdan and Yerevan is shown in Table 7.3. The content of food residues has decreased by 9 per cent and that of soil, silt and debris increased by 12 per cent since 1990.

Table 7.3 : Solid waste components in Hrazdan and Yerevan

Percentage

Waste constituents	Hrazdan	Yerevan	
		Before 1990	After 1990
Paper, corrugated paper	11.9	11.6	18.0
Food residues	32.7	40.9	30.0
Wood, leaves	6.0	6.7	2.0
Textiles	2.7	2.8	2.0
Resinous substances, leather	1.7	2.0	1.0
Polymers	2.4	2.0	2.0
Bones	1.7	1.8	1.5
Ferrous metals	1.8	1.9	0.2
Non-ferrous metals	1.3	1.2	0.1
Glass ware	5.5	5.4	4.0
Rock and broken glass	16.2	7.6	11.2
Soil, silt ...	16.2	16.1	28.0

Source : Country Overview - Armenia, The European Union's TACIS Programme, Ministry of Nature Protection.

Contaminated sites

Armenia does not have an inventory of contaminated sites and land. Almost all industrial waste sites at the chemical, mining and metal industries are contaminated with heavy metals, chlororganic compounds, cyanic and nitrogen substances. For example, it is estimated that an area of about 20 km^2 around the gold extracting and production plant in Ararat is contaminated with heavy metals and arsenic, exceeding the maximum permissible concentration several times. The site of the copper and molybdenum plant in Kadjaran is also contaminated with these metals. Abandoned sites of chemical plants in Vanadzor and Yerevan are contaminated with chemicals. There is another example of an uncontrolled industrial waste dump in the Hrazdan canyon, where soil is contaminated with tungsten, chromium, copper, lead, molybdenum, cadmium, and antimony.

Accumulated hazardous obsolete chemicals, including unused pesticides and medicines, also represent health and environmental risks. As chemical industry considerably decreased its capacity, some plants ceasing their production, there are many abandoned contaminated industrial sites, requiring clean-up. An inventory of such sites, listing chemicals as well as their degree of risk, does not exist.

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

- Risks of soil and groundwater contamination with heavy metals and other hazardous substances in the vicinity of landfills, especially where industrial and municipal wastes are dumped together
- Spreading of substances containing heavy metals and evaporation of toxic organic substances at open and uncontrolled municipal waste landfills
- Hygienic-epidemiological risks related to rodents (cholera, tularaemia, hepatic and other diseases) (see also Chapter 13)

The storage of hazardous industrial wastes at industrial premises has resulted in:

- Contamination of the grounds of industrial facilities and their vicinity: air pollution, surface and groundwater contamination and contamination of soil
- Negative health impact of air pollution on workers.

Use of agrochemicals

In the 1990s, all pesticides were imported. During 1994-1999, no data on pesticide use were collected. It is believed that the following economic and technical circumstances prompted uncontrolled use:

- Worsening of the economic situation, resulting in the discontinuation of official imports of pesticides
- Absence of certification for agrochemicals, which are being sold in unidentified containers
- Absence of enforcement mechanisms, including monitoring schemes, for the implementation of existing legal provisions and regulations concerning landownership and safety of foodstuffs, prescribing very strict standards on concentration of agrochemicals in soil and food
- Lack of training of new farmers in the use of agrochemicals.

Table 7.4 : Pesticide use, 1988-1994

Tonnes

Use	1988	1989	1990	1991	1992	1993	1994
Herbicides	183	247	183	113	16	17	7
Insecticides	535	779	510	536	61	50	60
Fungicides	5 523	6 145	4 590	2 838	928	504	340
Zoocides	40	30	37	28	2	5	1
Preparation for seed treatment	14	17	13	14	7	2	3

Source: Ministry of Nature Protection.

Obsolete chemicals, including unused pesticides and medicines, should be identified and treated in an environmentally sound way and then disposed of, taking into account their chemical and physical characteristics. But up to now such activities have covered only the development of information systems to inventory storage sites, kinds of hazardous substances and their quantities. This process should be accelerated and installations for the disposal of these hazardous chemicals (for example, incinerators) should be built.

7.3 Collection, sorting, recycling, treatment and disposal

Municipal waste

Municipal wastes are collected by dustcarts and transported to dumps. It is estimated that Armenia would need 700 such dustcarts, but it has only 540 old ones. Most of them are worn-out and require substantial repair or replacement. About 380 actually operate, of which 130 in Yerevan. Municipal waste is collected once a week or once every two weeks.

Waste is not sorted either before or after collection, nor is any waste treated. Only glass bottles are recycled. In the past, food scraps were collected separately and used as additives for animal feed. About 900 villages are not covered by any municipal waste management. In Armenia municipal waste collection, removal and road cleaning are carried out by the communal State enterprises, and in the towns of Vanadzor and Giumri by specialized State enterprises.

In Yerevan, four communal State enterprises and one cooperative leasing enterprise provide municipal waste services. There are no facilities for incinerating or treating municipal waste at industrial installations. So far, the environmental impact of new facilities for municipal waste treatment or disposal has not been assessed and Yerevan does not have a waste management plan. More than half the cost of collecting, separating and treating waste and of landfills is covered by the State budget. The rest is covered by the monthly fees of 100 drams paid by the city's residents. The total sum collected annually from the population in Yerevan is 460 million drams, which amounts to 40-45 per cent of the city's overall waste management costs. Almost all municipal waste is deposited in uncontrolled landfills and dumping sites. The landfills cover about 1 500 ha. Armenia has 45 urban municipal waste landfills and 429 rural landfills. Landfills are situated from 2 to 18 km from towns. None of

them complies with the sanitary requirements. Municipal waste from Yerevan is dumped at one big landfill covering 60 ha equipped with bottom lining, and two other dumps for waste from the western part of the city. The landfills are not specially prepared or equipped, for example to prevent leaching of hazardous substances.

Landfills are levelled and covered with soil when judged necessary by their staff. If wastes are not covered by soil because of a lack of bulldozers/tractors, for instance, they are incinerated at the sites in the open air. In many cases, different toxic pollutants evaporate from the sites. In general, landfills do not meet hygiene standards and norms that are prescribed by the Regulation on the Sanitary Norms and Standards for the Construction and Management of Landfills. As municipal wastes are disposed of together with industrial wastes, the areas surrounding the landfills, in particular the soil and groundwater, are frequently contaminated with heavy metals and organic compounds. Table 7.5 lists the dumping sites and their characteristics.

There is also a problem of lead contamination in Yerevan from industrial emissions and exhaust gases from cars using leaded petrol. The uncontrolled use of pesticides and fertilizers has also resulted in the contamination of land, including arable land.

Table 7.5: Dumping sites served by the State Enterprise of the Ministry of Urban Development

Urban area	Territory (ha)	Waste quantity Annual (10^3 m^3)	Waste quantity Total (10^3 m^3)	Staff (Number)	Condition	Distance from town (km)
Total	**106.3**	**1 082.8**	**28 957**	**41**	**Unsatisfactory**	**10.1**
Abovian	4.0	69.7	2 160	2	Unsatisfactory	7.5
Alaverdi	3.0	5.9	130	2	Unsatisfactory	7
Ashtarak	0.5	30.1	360	2	Unsatisfactory	6
Artik	3.0	25.5	180	2	Unsatisfactory	5
Armavir	8.0	46.5	1 440	2	Unsatisfactory	6
Artashat	4.0	36.1	540	2	Unsatisfactory	17
Biureghavan	Abovian	12.0	372	-	Unsatisfactory	11
Gavar	3.0	24.8	770	2	Unsatisfactory	12
Giumri	10.0	177.5	5 510	3	Unsatisfactory	15
Goris	4.0	34.4	1 066	2	Unsatisfactory	10
Dilijan	4.0	31.7	980	2	Unsatisfactory	18
Echmiadzin	7.0	69.0	2 140	2	Unsatisfactory	10
Ijevan	3.0	21.3	660	1	Unsatisfactory	14
Kapan	3.0	53.6	536	2	Unsatisfactory	17
Hrazdan	6.0	79.0	2 450	2	Unsatisfactory	2.5
Masis	2.8	40.5	810	1	Unsatisfactory	8
Martuni	3.0	15.5	480	1	Unsatisfactory	0.5
Charentsavan	5.0	39.3	1 220	2	Unsatisfactory	9
Jermuk	3.0	17.6	264	1	Unsatisfactory	10
Sevan	4.0	29.2	905	2	Unsatisfactory	18
Sisian	1.5	20.3	304	1	Unsatisfactory	10
Spitak	3.0	29.6	920	1	Unsatisfactory	7
Stepanavan	1.5	29.4	320	1	Unsatisfactory	7
Vanadzor	13.0	127.0	3 400	3	Unsatisfactory	18
Kajaran	2.0	17.3	540	-	Unsatisfactory	7

Source: Solid and Hazardous Wastes, NEAP.

Industrial waste

Box 7.1: Processing of tailings at Ararat Gold Recovery Company

The Ararat Gold Recovery Company is a joint venture with the Canadian company First Dynasty Mines. Some characteristics of the production process:

- Capacity stands at 1 500 000 tonnes of tailings per year and about 1 tonne of gold per year in the form of alloy "Dore" containing 27-35 per cent of gold; 66-74 per cent of silver and 1.0 per cent of admixtures
- Content of gold in the tailings is 1-1.4g per tonne, and content of silver 3.4-3.8g per tonne
- The degree of gold extraction is 50-58 per cent and of silver extraction 30-35 per cent during recovery
- The availability of raw materials for recovery is estimated to be sufficient for 8 years

The main stages of the technological process are:

- During the preparation of slurry, tailings are transported to a re-pulping tank and mixed with water to produce a slurry containing 48-55 per cent of solids, which is delivered to the grizzly, where oversize materials and separated lumps of dirt are screened out.
- The leaching process includes the pumping of the slurry from dump sites about 7 km away to leach tanks, where they are mixed with sodium cyanide (NaCN) to dissolve the gold and obtain a gold cyanide solution. The concentration of the cyanide is 300 mg/l; pH of the solution is 10.5-11, which is reached by adding CaO to the solution to prevent the emission of highly toxic hydrogen cyanide. $Pb(NO_3)_2$ is added to oxidize admixtures which could react with cyanide. Compressed air is supplied to increase the dissolved oxygen, which speeds up the leaching process. Leaching time is 36 hours.
- Active carbon is used for the adsorption of gold from the gold/cyanide solution.
- Enriched coal is pumped to a vibrator screen and separated from the solution. The coal is washed by a 3 per cent solution of hydrochloric acid and water. The gold is extracted from the coal in a column with a solution containing 2 per cent of NaOH and 2 per cent of NaCN under pressure.
- Coal is dried and reactivated and returned to the process.
- Gold and silver are extracted from the solution by electric sedimentation. Tailings from this process are recycled to the bleaching stage to recover the remaining gold.
- Cathode deposit is mixed with flux and melted in an electric furnace. The final product is called "Dore" (see above).
- The cyanide solution is treated with $Ca(OH)_2$ and a 15 per cent solution of sodium hypochloride. The concentration of cyanide remaining in the solution is 10-20 mg/l. The solution is pumped to the tailing sites and used for the preparation of slurry.

The composition of the wastes from this company is given in Table 7.6. An environmental assessment of the processing is included in Chapter 10.

Table 7.6: Waste average composition, 1999

	%
SiO_2	59.3
Al_2O_3	7.8
CaO	4.2
MgO	8.7
Na_2O	1.0
K_2O	0.7
Fe_2O_3	4.1
FeO	2.2
As	0.2

Source: Ararat Gold Recovery Company, AGRC-Ararat

In 1987, about 6 per cent of industrial wastes were either used as secondary materials at the generating plant or sold to other enterprises. At present, treatment and recycling of industrial wastes have almost ceased. Data concerning the treatment and recycling of industrial wastes, including hazardous wastes, are included in Table 7.2. As can be seen from that table, only small quantities of mainly non-hazardous industrial wastes (toxicity category V) were used as secondary raw materials or recycled in 1997 and 1998 (0.4 and 0.6 per cent respectively). During the past few years, hazardous chemicals and obsolete medicines have accumulated and

been stored in pharmacies, hospitals or warehouses, without any control. Almost all industrial wastes, including industrial wastes from small and medium-size enterprises, have been stored at industrial sites or landfilled together with municipal wastes.

Some industrial wastes, such as polymer wastes and residues, could easily be recycled. Rubber wastes are used for the production of glues at Nairit, rubber residues generated at the tyre production plant are used for manufacturing other articles from rubber, wood residues are sold to employees for home heating. Tailings are also reused at the Ararat Gold Recovery Company (see Box 7.1).

7.4 Waste policy and management

Legal aspects

There is no special law on municipal and industrial waste management. The current legislation includes Government Decision No. 97 of 8 December 1995, dealing with the transboundary transport of hazardous wastes, including their import, export and transit. Armenia has ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, and approved the Prior Informed Consent (PIC) procedure. Different regulatory documents and norms for waste management are under preparation. Provisions concerning waste management are contained in the following legal instruments:

- Law on Sanitary Epidemiological Safety (adopted on 12 December 1992) and Decision No. 518 on the Provision of State Hygiene Epidemiological Surveillance Service (adopted 12 October 1993) (for details see Chapter 13)
- Presidential Directive on Governmental Structure and Regulation Framework, issued 15 January 1996, specifying e.g. responsibilities of the provincial chief administrator for waste management
- Government Decision No. 51 on municipal property, which establishes municipal ownership over landfills
- Law on the 1996-97 programme for the transfer of State Enterprises and Unfinished Construction, encouraging the privatization of waste management services (adopted on 20 March 1996)
- Decision No. 405 on State inventory of wastes, requiring the collection of information on the generation, transport and disposal of wastes, including their transboundary movements (approved on 17 October 1997)
- Instruction Manual on the registration, taxation and safe disposal of wastes, as approved by the Ministry of Nature Protection in 1997
- Government Decision No. 92 as the basis for developing new regulations on municipal waste collection and disposal
- Government Decision No. 864 of 30 September 1998 on the levying of taxes and fines for the use of surface water, groundwater and mineral water, for air and water pollution and for the dumping of industrial wastes
- Government Decision No. 1702 of 11 November 1998 concerning an ecological passport for industrial enterprises.

Policy objectives

Municipal and industrial waste management is a priority in the country. Recently there has been a slight improvement in Armenia's economic situation, as industrial activities recover and measures favouring the creation of small and medium-sized enterprises begin to yield results. Moreover, Armenia is taking a more active part in international cooperation on waste management. Consequently, it can be expected that more efforts will now be made to develop and implement a national industrial waste management strategy.

The following policy objectives for the management of hazardous and non-hazardous wastes are formulated in the National Environmental Action Plan and other governmental documents:

- To prepare and implement a legal and regulatory system of waste management
- To improve the institutional structure for waste and hazardous chemicals management
- To set up a database on waste management, taking into account recent national practice and experience gained from international cooperation
- To improve the collection, sorting, recycling and transport of municipal waste

- To increase the share of the population that is served by municipal waste management systems
- To improve sanitary conditions and to meet standards and norms for municipal waste landfills and industrial wastes disposal sites and introduce their monitoring
- To use more efficiently land for dumps/landfills, including interregional sharing of facilities
- To introduce levelling and soil compacting at all municipal dumps
- To increase the machinery for municipal waste collection and treatment
- To increase the share of recycled industrial, mainly hazardous, wastes, by increasing the responsibility of industrial enterprises
- To build an installation for the treatment of hazardous wastes, and to organize a control system for their generation, treatment and disposal
- To support enterprises in the industrial and municipal waste management system with economic measures such as tax waivers for the import of equipment, subsidies, international technical assistance and grants
- To raise the awareness and improve the education of the public in waste management and enable its more active participation in decision-making processes

Institutional arrangements

The Hazardous Chemicals and Waste Management Department of the Ministry of Nature Protection is responsible for developing an overall system for the collection and analysis of information on the safe management of chemicals and the generation, storage, recycling and disposal of municipal and industrial wastes. It is envisaged to create a data bank on waste management, including type and composition of wastes, sources of waste generation, and quantities of wastes accumulated at the plants at the beginning of the year, generation during the year, storage on site, transfer to other enterprises, treatment on industrial sites, disposal at dumps, including controlled landfills, and the amount of recycled wastes. All statistical data are collected by using a special form, and the State Inspectorates for Nature Protection are involved in controlling data reliability. The database would be located at the Hazardous Chemicals and Waste Management Department.

Current legislation does not require permits, licences or limits for the disposal of municipal or industrial wastes. Inspections take place to verify whether enterprises meet sanitary and hygiene norms and standards for hazardous substances. There are also sanitary norms and standards for the construction and management of municipal landfills. At present these are not met. The frequency of inspections depends on the production capacity of the enterprise. The regional inspectorate has the right to enter an enterprise for inspection at any time.

During 1997-98 the centralized waste management system was decentralized and the communities and private companies have undertaken waste management activities. The landfills of all towns, except Yerevan and Dastakert, are within the authority of the State Enterprise of the Ministry of Urban Development. About 193 ha of landfills are under its responsibility. In Yerevan, the municipality is responsible for the collection and disposal of municipal waste. It is envisaged to set up a joint-stock company based on the State Enterprise, which is being privatized.

The Centre for Ecological and Noosphere Studies of the National Academy of Sciences is involved in the management of contaminated sites. Activities are planned to develop technologies for remediation or cleaning-up of the sites contaminated with heavy metals, cyanic and nitrogen compounds and pesticides.

The following institutions are involved in the safe management of hazardous chemicals:

- The Institute of General Hygiene and Occupational Diseases deals with standardization related to hazardous chemicals, including development of norms and standards for their maximum permissible concentrations and emissions as well as permissible exposure limits in the air of the work environment
- The Research Centre of Agriculture and Plant Protection tests the ability/properties of pesticides, including new products and preparations, to protect crops from diseases and pests
- The Institute of Environmental Hygiene and Preventive Toxicology deals with research and development in monitoring the migration of pesticides in the environment (air, soil, water and biota)

- The State Hygiene and Epidemiological Surveillance Service and regional and local Hygiene and Epidemiological Control Centres deal with the sanitary control of landfills
- The Soil Sciences and Agrochemistry Institute carries out research into the rational use of agricultural chemicals and their impact on the environment.

Management instruments and projects

To improve knowledge of industrial waste treatment and generation, the ecological passport contains information on the kind of hazardous chemicals and hazardous wastes the enterprise produces. It also includes their chemical and toxicological properties and measures to prevent industrial accidents involving hazardous substances and wastes.

The use of highly toxic and biologically undegradable pesticides was banned: aldrin (since 1970), DDT (1970), dieldrin (1985), heptachlor (1986), chlordimeform (1978), dinoseb (1986), granozan (1981), mercurhexan (1981), mercurbenzene (1986), pentachlorphenol (1986), and 2,4,5-T (1970).

Charges are imposed on the use of natural resources and the emission of dangerous substances to the environment (for details, see Chapter 2). There are no charges for the disposal of non-hazardous wastes generated in the mining industry. For municipal waste, a disposal charge of 100 drams per month per person is levied.

Total expenditures for waste treatment and disposal (compare Table 2.6) increased by 9 per cent in 1998 compared with 1997, while for hazardous wastes the increase was 3.5 per cent. However, about 90 per cent of expenditures went to hazardous waste treatment and disposal in 1997 and about 85 per cent in 1998. According to the data from the Ministry of State Register and Statistics, total payments charged for the disposal of industrial and municipal wastes amounted to 1.5 million (actually collected 400 000 drams) in 1998 and to an estimated 1.4 million drams during the first nine months of 1999. The trend in the expenditures for the repair and maintenance of old, and the introduction of new equipment for waste treatment is also up. In 1997, 800 000 drams were spent on this and, in 1998, 19.4 million drams.

There are no organizational schemes or national and/or local planning for solid waste management at any level. The situation is the same regarding hazardous waste. Owing to the current lack of fuel and finance, hospital waste is no longer incinerated. Surgery waste is buried in cemeteries and surgery-related waste is dumped together with domestic waste.

National management plans for the disposal of hazardous waste were developed by the Ministry of Nature Protection in cooperation with the United Nations Industrial Development Organization (UNIDO). Their overall objective is to facilitate the environmentally safe disposal of hazardous wastes in Armenia and develop a short-term (five-year) action plan to resolve the current problems, as well as assist in the formulation of a strategic national policy plan regarding the disposal of hazardous wastes over the next 15 years.

The project envisages the following:

- Review of existing information on where, how much and what types of clinical/biological, and hazardous agro-industrial wastes are generated
- Review of current plans for recycling and exchange of industrial wastes
- Preparation of a five-year action plan for the interim management of medical/biological and hazardous industrial wastes
- Estimation of industrial, hospital and hazardous industrial waste generation over the next 15 years
- Specification of an optimal match of waste generation with recycling, treatment and disposal (RTD) technology, leading to an estimation of the required capacity of RTD technology, as well as its location and financing needs, and a 15-year strategic plan, describing what RTD technology is required, when and where
- Specification of the control system required for hazardous wastes (law/regulations, responsibilities, legal status of hazardous waste sites, financing mechanisms)
  Development of comprehensive recommendations for a national hazardous waste disposal policy.

The primary actor will be the Ministry of Nature Protection. It is envisaged that a future Armenian cleaner production centre will assist industry in developing and implementing environmentally sound technologies, including the processes for reusing/recycling hazardous wastes.

Another project on waste management is a project proposal developed by the United Nations Development Programme (UNDP). Its main purposes are:

- Improving the legislative and regulatory frameworks for waste management
- Strengthening the institutional structure for waste management
- Improving technologies for waste treatment and use
- Improving municipal waste disposal facilities in Yerevan, Gumri and Vanadzor.

The implementation of the UNDP and UNIDO projects will depend on donors, who have not yet been found.

7.5 Conclusions and recommendations

The Armenian Government is making efforts to improve the existing system of waste management, by developing new concepts and an adequate policy particularly for the management of hazardous chemicals and wastes. In spite of these efforts, and owing to the rather complex situation, much remains to be done before visible results can be achieved. Further efforts would have to be made at the same time to develop a framework for waste management, and to make waste recycling, collection, treatment and disposal safer.

Armenia does not yet have a specific law on hazardous chemicals and wastes management, but legislation is under development. This work should be completed swiftly, since scattering individual provisions for waste management over a large number of different legal instruments also makes them difficult to enforce. The development of this legislation should incorporate a strategy to minimize waste generation at its source. It should therefore encourage the introduction of cleaner technologies at the earliest possible time, as well as the sorting and recycling of waste, especially hazardous industrial waste. The sheer amount of work ahead, together with its urgency, might require an increase in the resources available in the Ministry of Nature Protection for waste management.

Recommendation 7.1:
The Ministry of Nature Protection in cooperation with relevant ministries and institutions should speed up the development and implementation of a law on waste management and a law on the management of hazardous chemicals.. Such laws should include institutional arrangements for their enforcement. *See Recommendation 4.3.*

Recommendation 7.2:
A regulation should be issued as quickly as possible to guarantee the strict control of waste transport and transboundary waste traffic.

The successful implementation of a strategy to minimize the generation of waste at the source, including municipal wastes, requires the participation of the public at large. Experience shows that it is unlikely that this will be obtained quickly. A public information campaign, as well as the preparation of long-term education programmes, should precede more practical measures, like the separate collection of different waste materials.

Recommendation 7.3:
The Government should consider launching a wide public information campaign to promote the minimization of waste at the source. It should be complemented by educational and training programmes to prepare the separate collection of municipal wastes.

Successful waste management requires reliable information on a large number of waste issues and risks. A beginning has been made, notably for the development of a waste management database. Given the considerable resources required to develop information in general, it would be wise to concentrate efforts on the most pressing issues. For Armenia, these are:

- Applying modern statistical methods to obtain reliable statistics on the generation of wastes, with special emphasis on hazardous industrial wastes and medical wastes
- Establishing an inventory of soil contaminated sites
- Conducting a survey of obsolete chemicals in, for instance, closed industrial premises
- Collecting data on the hygiene conditions of landfill sites that enable the risk of groundwater pollution to be determined
- Resuming the compilation of data on the use of agrochemicals

Recommendation 7.4:
The collection and dissemination of reliable data on the most important environmental risks related to hazardous chemicals and waste management should be seen as urgent tasks. A register of enterprises which store and generate hazardous wastes, including their qualitative characteristics, should be urgently developed.
See Recommendations 10.5 and 13.6.

Urgent practical measures are required in current landfilling. At present almost all municipal waste is landfilled. There is no separate collection, sorting or treatment of waste. Almost all industrial hazardous and non-hazardous waste is stored either at industrial sites or landfilled together with municipal waste. The landfills are not specially prepared or equipped. They generally break hygiene and environmental standards. The environmental impact of new facilities for municipal waste landfills is not assessed. There are no facilities for municipal or hazardous waste incineration, or for medical waste or obsolete chemicals. Waste collection is not extended to all human settlements. Practices at landfills frequently do not protect the underlying groundwater aquifers or adjacent surface areas from air pollution.

These problems are well understood by Armenia's waste managers. A national management plan for the disposal of hazardous waste has already been developed by the Ministry of Nature Protection in cooperation with UNIDO. Another project on waste management is being developed in cooperation with UNDP. The priority seems to be to draw up and implement a prioritized plan to progressively improve control of actual landfilling, starting with the abolition of the most risky practices (no joint disposal of hazardous and municipal waste, daily cover, prevention of leaching, gas recovery). While these measures need to be taken urgently, they do not obviate the need to establish an action plan towards state-of-the-art treatment of hazardous and municipal wastes. The practice of segregating waste at source should be introduced and any ultimate joint disposal of already segregated waste avoided (hazardous and municipal waste at least).

Given the size of the country and the conditions prevailing there, the action plan will probably have to include the construction of incinerators, starting with incineration of medical wastes and hazardous chemicals. The development of this action plan should be coordinated with the revision of NEAP (see Recommendation 1.5).

Recommendation 7.5:
The implementation of urgent measures to improve landfilling practices should be paralleled by the development of a comprehensive action plan, including specification of funding requirements and means, for the establishment of a conclusive system of waste treatment in the long run.

Armenia has no waste incineration plant. As it suffers from a lack of primary energy sources and relies on fossil fuel imports, the possibility of co-incineration of high-calorific waste, such as used tyres, plastic or solvent residues, for example in the three cement plants, should be studied. Alternatively, the safe final treatment abroad, according to the Basel Convention, should be investigated.

Recommendation 7.6:
The possibility of incinerating high-calorific waste in the cement plants should be assessed. Their incinerators must have efficient equipment to treat the exhaust gas.

The uncontrolled use of agrochemicals, in particular pesticides, constitutes a specific risk to human health and the environment. The worsening economic situation, insufficient training of farmers in the use of agrochemicals, the absence of certification for agrochemicals, insufficient enforcement of existing legal and

regulatory provisions, and the lack of monitoring of the content of pesticides and fertilizers in the soil are the main problems to be overcome.

Recommendation 7.7:
The Ministry of Nature Protection, the Ministry of Agriculture and the Ministry of Health and Social Security should strengthen their control of the application of fertilizers and especially pesticides in agriculture, for instance by training new farmers in the adequate use of these substances and monitoring the content of pesticides in food and soil.

Chapter 8

MANAGEMENT OF WATER RESOURCES AND QUALITY

8.1 The state of waters

Water availability and climatic conditions

Armenia is generally considered as moderately rich in water resources. However, the resources are unevenly distributed throughout the territory. 200 000 people (about 6 per cent of the population) live in areas where the shortage of water seriously hampers regional economic development (Figure 8.1).

The climate in Armenia is continental with hot dry summers and cold winters. Rains fall essentially in winter, as snow, and in spring. Hot summer temperatures (above 35°C) lead to a high seasonal use of water for irrigation, cooling and washing at a time when precipitation is scarce. In response, reservoirs store water during the wet season, and release it over the vegetation period.

Average annual precipitation is 18.4 billion m^3, of which 12.2 billion m^3 evaporate and 6.2 billion m^3 run off as real surface water resources. The annual recharge of groundwater is estimated at 4.0-4.2 billion m^3, of which 1.2-1.6 billion m^3 re-appear as springs within the country, and 1.0-2.8 billion refill the underground reserves. Internal resources are therefore around 8-9 billion m^3/year. Also, Armenia holds the right to use the water of the transboundary rivers Araks (1.9 billion m^3/year) and Achurjan (1.0 billion m^3/year) in equal shares with Turkey. These flows, or about 1.5 billion m^3/year, are accounted for in Armenia's water balance. In total, about 10.5 billion m^3 of renewable water resources would be available in the country each year. Other sources of information estimate that total available water resources are only 8 billion m^3/year, and that underground resources have declined by 8-10 per cent over the past 50 years.

Quality and quantity of groundwater

Table 8.1: Underground water resources in Armenia

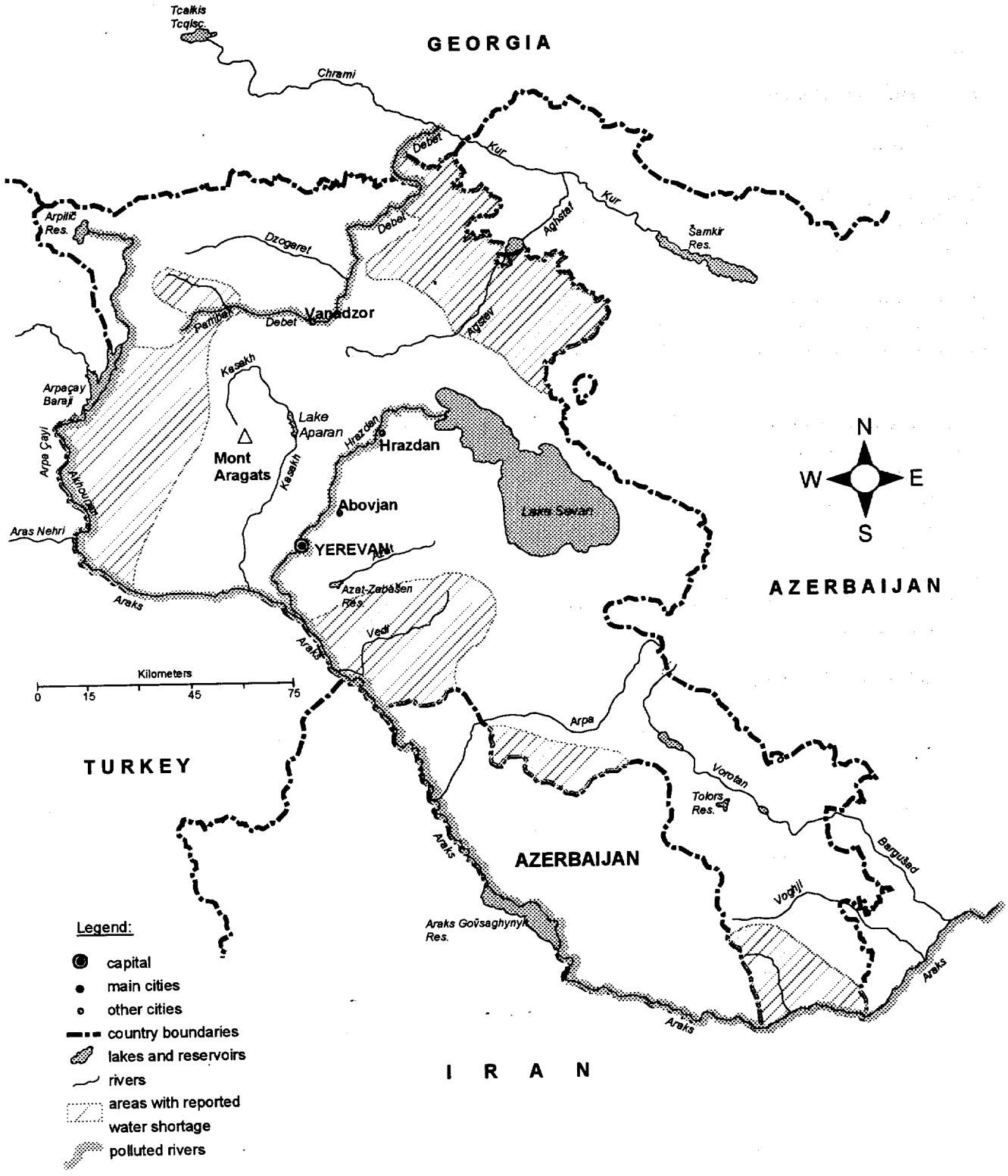
m^3/second

Catchment area	Groundwater resources			
	Total	Springs	Wetland areas	Underground flows
Total (m^3/sec)	126.18	50.26	44.92	31.00
(billion m^3/year)	3.97	1.58	1.42	0.98
Achurjan*	11.63	4.55	2.73	4.35
Kasbach	13.50	4.08	2.16	7.26
Hrazdan*	14.75	8.46	4.19	2.10
Azat*	6.33	4.28	1.92	0.13
Vedi*	1.24	0.46	0.46	0.32
Arpa	11.23	4.19	4.19	1.67
Voroton	17.24	5.44	8.01	3.79
Vochei	4.25	2.31	1.88	0.06
Megri	1.63	0.61	0.80	0.22
Debet	16.04	3.57	11.28	1.19
Agstev	5.68	1.30	2.41	1.97
Hakhoum	0.47	0.26	0.15	0.06
Tavus	0.36	0.12	0.21	0.03
Khndzorut	0.92	0.30	0.56	0.06
Lake Sevan	20.91	9.15	3.97	7.79

Source: NEAP.

* Rivers draining to the Ararat Valley.

Figure 8.1: Hydrographic Network of Armenia



Around 70 per cent of all groundwater resources drain to the Ararat valley (Araks River, see Table 8.1). The aquifers in the Ararat valley are partly artesian and are situated at a depth of 40 to 300 m. The lower aquifer is mainly used for drinking-water supply, and the upper (down to 40 m) only for agriculture. Other large groundwater resources are found in the valleys of the Achurjan and the Kashach Rivers (see Figure 8.1).

In some regions of the Ararat valley where swamps have been drained, the groundwater level tends to fluctuate on average by 1 metre, sometimes rising to the surface. Drainage systems were built in the 1950s to eradicate malaria, but deteriorated because of a lack of sufficient maintenance. In some places, marshes and waterlogging reappeared, as did malaria (see also Chapter 11): in 1998, 1 167 cases of malaria were reported. Since 1998, work has been carried out to start rehabilitating the drainage system.

Groundwater resources are in general of a high quality, providing 98 per cent of water supplied to the public. Deep groundwaters are well protected from pollution, as the aquifers are covered with thick clay layers and are under pressure (artesian aquifers). Only in a few locations is the groundwater unsuitable for drinking purposes, like in the Ararat valley because its mineral content is too high. However, it seems that mine tailings, in particular in the Alaverdi region, could potentially contaminate groundwaters with heavy metals (Cu, Pb, Zn). Spring water is also of good quality and in general suitable for drinking purposes. However, springs are more vulnerable to surface pollution such as bacterial and chemical pollution from agricultural and industrial activities, or domestic waste water. While originally good, the groundwater is contaminated further in the distribution systems, causing water-borne diseases; this is one of the key problems with water in Armenia (see more details in the next section).

Quality and quantity of surface waters

Table 8.2: Main rivers in Armenia

River name	Tributary	Altitude		Length	Watershed area	Average flowrate	Annual runoff
		at source	at river mouth	(km)	(1 000 km²)	(m³/sec)	(million m³/y)
Achurjan	Araks	2 020	950	186	9 670	31.80	847
Kashach	Sev Jur	2 200	830	89	1 324	6.75	213
Hrazdan	Araks	19	820	141	2 560	22.60	714
Azat	Araks	3 100	815	56	572	6.40	202
Vedi	Araks	2 720	810	58	633	2.02	64
Arpa	Araks	3 200	530	128	2 630	21.50	679
Vorotan	Araks	3 045	270	178	5 540	21.50	679
Vochci	Araks	3 910	300	86	1 175	9.60	303
Megri	Araks	3 300	500	36	274	3.23	102
Pambak	Debet	1 810	870	86	1 380	8.96	283
Dzoraget	Debet	2 260	870	67	1 460	16.60	531
Debet	Khrami	870	305	92	4 080	37.00	1 169
Agstev	Kura	2 980	210	133	2 500	2.18	290

Source: NEAP.

Rivers. The rivers are mountainous. Only 14 rivers are longer than 35 km. Of the about 200 other-streams and brooks less than 10 km long, many are not permanent. Table 8.2 summarizes the characteristics of Armenia's main rivers.

The rivers are fed by melting snow, rainfall and groundwater rising to the surface. In spring (April, May, June) the flow is around 55-70 per cent of the yearly total. It peaks in May. In summer (July, August) and autumn (September, October, November), when water demand is at its maximum, the available portion of the yearly flow is in the order of 20-25 per cent. In winter (December, January, February, March) the flow is around 10-12 per cent of the yearly total.

Many surface waters and rivers have an international character. Armenia lies completely in the Kura River basin. The Araks River marks the border between Turkey and Armenia, and further between Iran and Armenia, before flowing into Azerbaijan, where it flows into the Kura River. The Araks river basin covers 22 790 km^2 in Armenia and drains 76.6 per cent of the territory through the Achurjan, Kashach, Metsamor, Hrazdan, Azat, Vedi, Arpa and Vorotan rivers. The tributaries flowing directly into the Kura River in the north-east (i.e. via the Debet, Pambak, Agstev, Hakhum and Tavush rivers) drain less than 23 per cent of the country. The outflow to Georgia through the Debet River is estimated at 890 million m^3/year and the north-eastern outflows through various rivers to Azerbaijan at 555 million m^3/year. In the south-east, the total direct outflow to Azerbaijan through the tributaries of the Araks River (Arpa, Vorotan, Vochci, etc.) is estimated at about 1 791 million m^3/year.

Water quality has improved over recent years because of the economic crisis and the reduction in industrial and agricultural activities. Figure 8.1 shows the parts of rivers that were known to be the most polluted in 1996-1997. In regions where mining took place or still continues, i.e. in the Alaverdi, Zangsur and Ararat regions, rivers have high concentrations of heavy metals (Cu, Pb, Zn, As, Mo and Cd - see Table 10.1). Downstream of big cities or agricultural zones, the content in ammonium and nitrate ions was in general high in 1997 (in particular in the Hrazdan and Getar rivers). Today, monitoring of surface water quality is very limited, and little is known about current surface water pollution.

Box 8.1: Lake Sevan

Lake Sevan is a major environmental issue. It is amongst the most ancient lakes on earth (100 000 years old - 99.9 per cent of the earth's lakes are less than 10 000 years old). The total area of the Lake's basin is 4 900 km^2, of which 1 256 km^2 water surface and the rest catchment area. It is divided into two parts, the Small Sevan, which is deeper (about 79 metres deep), and the Big Sevan (less than 50 metres). Twenty-eight small rivers flow into the Lake. The Hrazdan River is the only outlet. Despite its altitude (1 900 m), evaporation is high due to the semi-arid climate. Today, evaporation is equivalent to precipitation (i.e. 350 mm). However, the surface of the Lake has shrunk by 11 per cent, as it has been overused during the past 60 years. Since 1981, water has been deviated to the Lake via a tunnel from the Arpa River, in another watershed, to compensate for the loss of water.

The quality of the Lake's water is largely influenced by evaporation, resulting in water-soluble salt concentrations slightly above average for freshwater lakes (700 mg/l total soluble salts with more magnesium than calcium). The concentration of original soluble phosphorus is exceptionally high, and the water is alkaline (pH=9.2). Because it is so ancient, the Lake shelters an important endemic flora and fauna. Before its unsustainable management, the Lake was oligotrophic, well oxygenated down to the bottom, and was rarely frozen in winter because of its high salt concentration.

The Lake's water has traditionally been used for irrigating crops on the Ararat plain, and the overflow rate was regulated naturally according to the seasons. In 1933, the Hradzan riverbed was dug to increase the water abstraction for agriculture, but also for boosting hydroelectricity production. Around 1949, a tunnel 40 metres below the Lake's surface was built to increase water withdrawal. The ultimate aim was to lower the level of the Lake by 50 metres, which would have dried part of the Lake, reducing evaporation from a smaller water surface. The net balance precipitation-evaporation would have been positive. From then until the mid-60s, much more water was used than was flowing in, resulting in a 19-metre drop in the water level. This had detrimental consequences for the ecology of the Lake, fish populations decreased and the aquatic habitat deteriorated. Fishing, tourism, irrigation, hydropower production and drinking-water supply were all badly hit. Moreover, the increase in agriculture and other activities resulted in more point and diffuse pollution discharged into the Lake. Animal breeding (20 per cent of Armenia's goats and sheep, and 16 per cent of its cattle) is still taking place in the basin area. All this degraded the Lake's trophic status to mesotrophic, almost eutrophic.

In the 70s, the Government attempted to raise the Lake's level by reducing water uptake, constructing pumping stations and water reservoirs, and diverting water from other water basins. Water was transferred from the Arpa and Vorotan rivers, through the building of an Arpa-Sevan tunnel and a canal, and a Vorotan-Arpa connection (still under construction). A Debet River connection was also planned. These measures gave some results, which were offset by the economic crisis and the consequent need to increase the production of hydropower from Lake Sevan. On the other hand, the economic crisis also resulted in alleviating pollution pressure, for instance through a 20 per cent reduction in livestock, a 40 per cent decrease in fertilizer use, and an industrial activity currently at 5 per cent of its potential. But agricultural activities still contribute to eutrophication, as they are responsible for about 33 per cent of the phosphorus and 70 per cent of the nitrogen loads. Households contribute about 18 per cent to the phosphorus and about 10 per cent to the nitrogen load. 85 per cent of waste water from a population of 210 000 drains into the Lake, with only 30 per cent connected to sewers and waste-water treatment units that often do not work properly.

The Government initiated, in 1995, the development of the Lake Sevan Environmental Action Programme, to solve or mitigate the problems (for more details see Box 8.3).

Lakes and reservoirs. There are at least 57 reservoirs in Armenia which have been built to store water from autumn till mid-May. The stored water is used for irrigation during the dry season. It is also used to produce energy at the same time. The biggest reservoir, the Achurjan reservoir (capacity of 525 million m^3) is half Armenian, half Turkish. Others, like Azat (70 million m^3), Arpilitch (105 million m^3), Aparan (91 million m^3), Spandaryan (277 million m^3), Toloris (97 million m^3), Djoghaz (45 million m^3), Kechut (25 million m^3), Shamb (13.6 million m^3), Mantash (8.2 million m^3), Hradzan (5.6 million m^3), add up to a total capacity of 1.1 billion m^3. Dam safety is of concern, as Armenia lies in a seismic zone. The dams have lacked maintenance over the past decade. The World Bank is currently carrying out a survey of their status.

Armenia's lakes are mountainous and rather small, except Lake Sevan. Arpi, Akna, Aighr, Kuri and Sevlich are the other main lakes. Lake Sevan is the largest alpine lake in the Caucasus (1 246 km^2). Its resources are particularly important for the country: hydropower production, irrigation of Ararat Valley croplands, habitat for fish and shellfish, nursery zone for various aquatic species, resting place for migratory birds, and also tourism and cultural activities. The Lake has been overexploited in recent decades and its level has dropped drastically (see details in Box 8.1).

Floods. Flash floods occur in all regions of Armenia, in some parts every 2 to 3 years. They are due to heavy rains or quickly melting snow in a generally mountainous topography, with steep and deforested slopes. Maximum flooding usually occurs in April. There are no data on flood damage, but floods have disastrous effects on urban and industrial areas. There is no inventory of the flood protection infrastructure. Flood canals and embankments are in a poor state, as are a few dams. Under the Irrigation Rehabilitation Project, 4 dams have been rehabilitated, and another 10 are in high need of rehabilitation.

8.2 Water use and pollution pressure

Water use structure and trends

Enough water is available in Armenia to cover its average water needs. In 1985, about 4 billion m^3 were abstracted and 3.5 billion m^3 were used. In 1995, only 2.5 billion m^3 were extracted and 1.5 billion m^3 used, i.e. considerably less than the available resources. Data for 1998 are almost comparable to 1995 (Table 8.3). However, locally some regions lack water resources or suffer from shortages during the dry season – like the northern Agstev river and the southern Vochci and Megri rivers, as well as the north-western and western sides of Mount Aragats (see Figure 8.1). In response, water is redistributed geographically by pumps, canals and pipelines on a large scale.

Table 8.3: Water abstraction and use in Armenia, 1985-1998

Million m^3/year

	1985	1990	1995	1998
Water abstraction - Total	**4 072**	**3 786**	**2 530**	**2 765**
*losses in distribution***	*14%*	*14%*	*42%*	*40%*
Water use - Total	**3 489**	**3 258**	**1 477**	**1 665**
of which				
Irrigation	2 337	1 956	641	800
Domestic*	616	771	627	550
Industry	518	408	209	165
Others	18	123	0	150

Source: NEAP for data 1985-1995, and State Committee of Nature Protection data in IEDS database for 1998.

* Excluding private water supply in rural areas.

** Compared to total abstracted volume.

In 1985, irrigation was by far the main water user (67 per cent of the total), followed by domestic use (18 per cent) and industry (17 per cent). The 1995 drop in overall use is mainly due to reduced irrigation. Irrigation remained the main water user in 1998.

Water use by agriculture

Agriculture is the main water consumer, mostly through irrigation activities. A year 2.3 billion m^3 of surface water, i.e. 1.4 billion from run-off water during the vegetation period and 0.9 billion stored in reservoirs, are available for agriculture. Another 300 million m^3 of groundwater are also available. A regulation worked out by the Water Issues and Hydrotechnology Research Institute defines the quality requirements for irrigation water.

Irrigation is a long-standing practice in Armenia as agriculture in the Ararat valley in particular would not be possible without it. Out of the total arable land, 80 per cent need to be irrigated. In 1999, the area equipped for full or partial control irrigation is about 284 000 ha, of which currently 217 000 ha are actually irrigated. This area has decreased in the 90s due to the earthquake and economic hardship (311 000 ha were irrigated in 1985). Almost 70 per cent of the equipped areas need some kind of rehabilitation (See Chapter 11).

The use of water for irrigation has decreased by 65 per cent since 1985. In 1998, 800 million m^3 of water were used for irrigation (Table 8.3). The efficiency of the irrigation infrastructure is deteriorating, with leakage reaching 30 per cent. Another 15 per cent is probably lost in distribution within the farms. The overall loss is at least 45 per cent (other sources mention 70 per cent). It reflects the poor condition of the pumps, canals, pipes and sprinklers, which have not been maintained since 1991. In addition, the pumping system is highly energy-intensive. The cost of electricity represents 65 per cent of the total maintenance cost and is hardly affordable.

The impact of agriculture on the quality of water stems from the use of pesticides, commercial fertilizers and manure. The contribution of agriculture to water pollution depends on the intensity and nature of the activities. Although difficult to quantify compared with other sources of pollution, and although the consumption of agricultural inputs has dropped drastically these past few years, it is likely that pollution from agriculture still remains the major contributor to water pollution. For instance, agricultural activities around Lake Sevan (crops and animal husbandry) bring much more nitrogen pollution to the Lake than households. Farmers are not sufficiently aware of this. Also, as protection zones around water uptake points are rare, grazing occurs in their vicinity, polluting water at the source of abstraction.

Fish farming is practised in 20 farms located mostly in the Ararat valley and Lake Sevan. Production has declined because the fish could not be sold at prices covering production costs. No information is available on the water used in fish farming. It seems that, when reservoir levels are low, the quality of the water is poor and causes diseases among fish populations. Fish farms are being privatized.

Domestic use of water

Table 8.4: Trends in estimated water supplies, 1980-1997

Litre/capita/day

	Armenia		AWSE*		YWSE**	
	Households	Total	Households	Total	Households	Total
1980	390	664	312	522	477	823
1985	428	720	354	575	511	881
1990	521	697	371	560	675	839
1994	453	522	370	470	544	582
1995	462	544	337	451	604	651
1996	532	641	313	468	730	797
1997	342	558	285	414	401	708

*Armenian Water Supply Enterprise; ** Yerevan Water Supply Enterprise

Source: NEAP, 1998.

Drinking water quality and quantity. Domestic water use has decreased by 30 per cent since 1990 (Table 8.3). In 1998 average daily consumption per person was calculated to be about 550 litres per person per day, in Yerevan 800, a figure that includes much water leakage. Outside Yerevan, the figures show a decrease in water quantities supplied to households to about 350 l/person/day, which also includes leakage (Table 8.4). The difference between water supply to "households" and total water supply in Table 8.4 is supplied to industry. Except for some areas in Yerevan, water is supplied only 2 to 6 hours a day, sometimes less. The reason is the general deterioration of the distributing facilities and in particular of the pumping stations, while at source water is available.

In general, water used for drinking is extracted from deep underground layers. A few residential areas use water from upper river stretches. At source, the quality is good and does not require treatment, except a simple disinfecting treatment before entering a public supply system. Investigations made in 1995-1996 into the quality of tap water showed that 10 to 20 per cent of the samples did not meet the applicable bacteriological or physico-chemical standards. An analysis of tap water in Yerevan in 1995 provided evidence of faecal pollution and an insufficient residual chlorine level in about 40 per cent of the samples. For details on health effects, see Chapter 13.

Water supply infrastructure. Chlorination facilities exist in most large water supply systems. 123 stations are operating. In many places, the operating conditions of the facilities are not satisfactory, as equipment is obsolete, repairs are insufficient and chlorination too short as chlorine is expensive. The poor condition of the distribution network means that contamination (in particular microbial) is frequent along the distribution network - a phenomenon aggravated by interruptions in pumping (see Chapter 13).

Individual water consumption is not metered. The payment for service is based on consumption norms. They are 300 litres/person/day in towns, 250 in rural areas and 400 in Yerevan.

In 1996, 55.7 per cent of drinking water was supplied through pumping stations, although the topography would allow for a bigger supply by gravity. 80 per cent of the pipes are more than ten years old and 55 per cent more than 20 years old. Their maintenance has been neglected. The number of breakdowns is increasing regularly. As no water supply is metered, it is difficult to estimate the losses in distribution. Estimates range from 40 per cent to 65 per cent (37 per cent in Yerevan). This high leakage may cause pressure in the pipes to drop below the minimum allowed, thus creating favourable conditions for contamination from outside the pipes. Other consequences are the waste of expensive electricity and of water in the dry season.

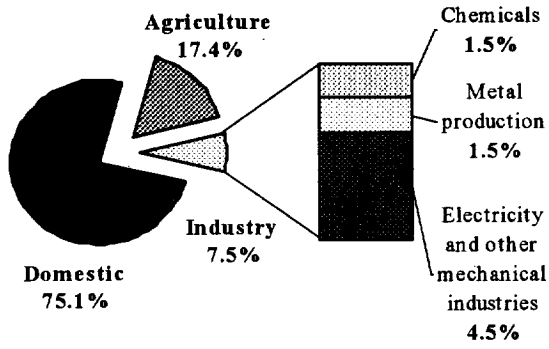
The conditions of the pumping stations and drinking water supply systems in rural areas that are operated by local communities are worse that in the urban areas. In general, there are few professional staff to operate and maintain them, and little repair work is carried out. In 60 per cent of these rural areas, water is not disinfected because of a lack of chlorine or the bad state of the equipment. The villages supplied by gravity also face critical situations: pipes need maintenance and the supply does not meet the basic demand.

Box 8.2: Vanadzor water supply facility

Vanadzor counts 172 000 inhabitants. The city is supplied with surface water from the rivers Novoseltovo, Spitak Chai, Verin Vank, Maimekh, Lernajur and Khaji Dzor. The capacity of the drinking water treatment plant is 50 000 m^3/day. About 250 litres/person/day are distributed by the Armenian Water Supply Enterprise (AWSE), which is in charge of the plant. Although its technology is old and not automated, the facility is well managed by 42 competent staff. A small laboratory with wet chemistry apparatus verifies physico-chemical parameters and residual chlorine of water leaving the plant. On top of the 10-15 per cent water lost in the station, 40 per cent are lost in distribution. The system is obsolete and suffered during the 1988 earthquake. The water is delivered by pumping or gravity, depending on what the mountainous topography requires. The water complies with drinking quality standards when leaving the plant, but, according to data from the Vanadzor Sanitary and Epidemiological Centre, 40 per cent of the samples break the standards when they reach the taps, causing stomach diseases, gastro-enteritis, hepatitis and other water-borne diseases. The Centre informs the population through public information campaigns of the care that should be taken when using tap water.

The price of water is between 280 and 370 drams/month/person, which few can afford in this region strongly hit by the economic crisis. The collection rate is 15 to 20 per cent. The money, collected by a regional bureau, is sent to the Ministry of Urban Development to feed the State budget. The Ministry returns some money to the treatment plant to pay for salaries and chlorine. It does not attribute any funds for repairing pipes. A request for 140 million drams to this end was frozen in 1999. There is a municipal water supply development programme for Vanadzor, but so far it has not been attributed any funds for repairing water supply infrastructure.

Figure 8.2: Waste-water discharge, 1998



Total waste water discharged: 692 million m^3

Source: IEDS database, 1999.

Note:
Waste water generated by industry comes from chemicals (1/5), metal production (1/5) , electricity and other mechanical industries.

Treatment of domestic waste water. In 1998, 692 million m^3 of waste water were discharged, of which 520 million from households (Figure 8.2). The sewerage infrastructure was well developed in the past, whereas its present status is critical. There are sewerage systems in all towns (60 to 80 per cent of waste waters are collected) and in the capital (collection rate about 75 per cent). There are about 4 000 km of sewers, of which 250 in rural areas. About 30 per cent of waste waters are discharged without treatment, the rest flows into waste-water treatment facilities.

The sewers are old, 90 per cent of the pipes are more than 10 years old, and 60 per cent more than 20 years old. When they burst, they are rarely repaired. In 1996, it was estimated that a one-km pipe was on average ruptured in six points. Leakage of untreated waste water may contaminate the piped water supply. Though treatment plants still exist, few sewer systems are connected to waste-water treatment plants that actually work. Moreover, since 1994 these plants have operated only the mechanical step of the treatment, biological treatment being cut off because of high electricity costs. Consequently, pollution removal rates are low, in particular of dissolved pollution. No collective infrastructure for waste-water treatment exists in rural areas. Table 8.5 shows the characteristics of the waste-water treatment infrastructure, but does not reflect the performance of operating facilities.

Table 8.5: Sewerage network characteristics

Facilities		Total	Sharing		
			AWSE	YWSE	Villages
Waste-water treatment plants	*Number*	18	17	1	0
	Capacity (thousand m^3/day)	900	350	550	0
Waste-water pumping stations	*Number*	8	8	0	0
Main waste-water collectors	*(km)*	1 080	860	220	0
Secondary collectors	*(km)*	3 080	1 930	900	250
Waste-water monitoring laboratories	*Number*	18	17	1	-

Source: NEAP, 1998.

There are 18 major treatment plants in Armenia. They have a total designed capacity of about 930 000 m^3 per day. An assessment of the state of the waste-water treatment infrastructure in 1997-1998 concluded that none of the 18 plants is in good condition. The state of the Yerevan plant is poor, that of 5 plants is average, that of another 4 is also poor and 9 are beyond repair. Annual demand for treatment in Yerevan is 350 million m^3 but the installed capacity is only 200 million m^3, and the Yerevan Water Supply Enterprise (YWSE) can treat only 150 million m^3. Outside Yerevan, the situation is worse, with only 15-25 per cent of waste water actually treated. In the Lori Marz (capital city Vanadzor), which was badly affected by the 1988 earthquake, only one of the five waste-water treatment plants is working and operates the mechanical step only, although it is also equipped for biological treatment.

Two huge treatment plants (Vanadzor and Yerevan) were under construction before independence. They have not been completed (the buildings are there but the mechanical equipment is incomplete). Their Soviet technology of the 80s is outdated. Its concept was to transport sewage from far away into a huge central plant - a technology that is showing its limitations today, as the pipe network is becoming obsolete and starts leaking, and the main plant no longer operates. Such a situation results in huge discharges of untreated waste water into the environment. Therefore, small, flexible, responsibly managed facilities are preferable, even though their performance may be theoretically lower.

There is no incentive for operators of waste-water treatment installations to meet the legal requirements for discharge, as violations are not punished. Consequently, water is discharged virtually untreated into the rivers. As most of the drinking water comes from underground, the pollution of rivers does not jeopardize human health, but it is likely to have consequences for the river ecosystems, and badly affects recreational uses. These effects have never been assessed.

Water use by other activities

Mining industry. Mining and mineral processing are today reduced to low levels, but remain pollution threats. Rains lixiviate accumulated tailings when they are exposed to the atmosphere, resulting in the drainage of acid water with a high concentration of metals. In the still active mining and processing sites of the south, beneficiation and mineral separation processes use inorganic and organic chemicals and ultimately generate waste water loaded with heavy metals. All those effluents are generally discharged into rivers without treatment (see Chapter 10). As only Cu, Zn and Fe are routinely covered by environmental monitoring – if and when it is carried out -- it is difficult to work out the present scale of water pollution by heavy metals. In 1997, copper ions were reported to exceed permitted concentrations in rivers by a factor of 15.

Electricity production. The institutional set-up of the electricity sector was restructured in 1998 (see Chapter 12). Each electricity company is responsible for its own water supply. The water quantity authorized is set each year by contract with the water enterprises or the said Ministry. Most of the water is used for generating hydropower. Regarding Lake Sevan, each year a government resolution sets the quantities authorized for energy production.

Thermal power stations used some 50 million m^3 in 1995. In the 90s, waste water from thermal power plants fuelled with heavy petroleum products was often discharged into surface water - a practice which has stopped, as no petroleum products have been used for electricity production since 1998. Information on thermal pollution from cooling water is not available.

Power plants as all other industries are supposed to pay according to their annual, self-metered water consumption. Very few, if any, of the power plants have water meters. Apparently, the hydropower plants do not pay, except for the water from Lake Sevan (See Table 2.2).

Manufacturing industries. Water for industry is often supplied through the drinking water supply system managed under the Ministry of Urban Development, or directly taken from irrigation channels subject to the authorization of the Irrigation Operation and Maintenance (O&M) enterprises of the Ministry of Agriculture. The water distributed to industry fell from 300 million m^3 (i.e. 40 per cent of the total water supply) in 1985 to 45 million (9 per cent) in 1995, and has been almost stable since then, while overall industrial water use dropped from 518 million m^3 in 1985 to 165 million in 1998.

Previously, industrial waste waters were usually treated in municipal waste-water treatment plants, possibly after preliminary treatment on the industrial premises. Some large industrial plants had their own treatment facilities. Today, the few existing industrial waste-water treatment plants are no longer operated. Industries are discharging their waste water directly into municipal sewers or surface water bodies.

There are no recent data on industrial water pollution. It is likely that highly polluting and toxic elements are discharged from slaughterhouses (organic matter), as well as from metal processing (heavy metals). Also, toxic micro-pollutants can go through treatment plants. These pollutants are neither monitored nor analysed, as there are no laboratories equipped for micro-pollutant analysis in the country. With shrinking industrial activity, this is not an acute problem, but it could turn into one when economic activity resumes. In 1996, an investigation of reservoir water showed that all reservoirs used as drinking water sources contained chemical/toxic substances, although they did not break drinking-water standards.

It is also likely that groundwater is threatened by soil pollution percolating from industrial premises. At a number of industrial sites, wastes or toxic components have been stored and are threatening groundwater. Illegal landfills and waste dumps pose a similar problem. The risk of contamination has not been assessed.

Tourism. Many resorts that used to be frequented by Soviet tourists are now closed down. Tourist resorts are facing the same difficulties with water quality and shortages, whether they are supplied by water companies or by municipal systems. For instance, several resorts on the north-eastern banks of Lake Sevan are intermittently operated (summer season). They are supplied with water from municipal networks, but their sewage system is no longer operational, so their waste water is discharged directly into the Lake. There are water hygiene requirements on 1 323 different substances for water bodies used for recreational purposes.

8.3 Policy and institutions for managing water

Objectives in water management

The Principles of Legislation on Nature Protection contain directions for different environmental issues, but there is no explicit strategy on water resource use applicable to all users. Similarly, there is no accepted national water protection strategy or master plan. At local level, tasks regarding water issues are in the hands of various local offices that are supervised by different ministries. Actions are not integrated under any local/regional water management plan. In fact, the Water Code is used as a policy.

Table 8.6: NEAP identification of main issues and problems regarding water management in Armenia

Main issues	Policy issues
Pollution of surface water	Inadequate institutional set-up
Pollution of groundwater sources	Insufficient management
Pollution of drinking water	Insufficient monitoring and enforcement
Allocation of water across sectors	Outdated legal and regulatory framework
Regional lack of water	
Flash flooding	
Waterlogging	
Over exploitation of Lake Sevan	

Source: NEAP, State Committee of Nature Protection.

A big part of the NEAP has been dedicated to water management, covering water supply and use, as well as water protection. While the responsibility for NEAP implementation rests with the Ministry of Nature Protection, its drawing-up has involved the Ministries of Agriculture, Urban Development, Energy and Economy, monitoring and scientific institutions, and other sectors of activity. The NEAP has identified the

main issues and problems regarding water management in Armenia (Table 8.6). Related projects have been identified with an evaluation of their cost and a priority ranking. The priority projects are:

- The preparation of a national water master plan
- The creation of a national water management board
- Improved protection of groundwater springs and wells
- A national awareness campaign on domestic water use practices
- A leak detection and repair pilot project in Yerevan
- The development of appropriate treatment technology through pilot plants in rural areas

The NEAP was adopted in late 1998. In June 1999, the Ministry of Nature Protection started to work out an "integrated water resources management plan", but it is narrower and more technical than the expected water master plan. An Action Plan for the management of Lake Sevan was also adopted (see Box 8.3), and an integrated water resources master plan for Lake Sevan is planned. The Ministry intends to involve stakeholders from the beginning and has requested the support of the World Bank to inform and consult sectors of activity, local administrations and NGOs, and develop public information campaigns. An information programme has been worked out

Box 8.3: Management policy for Lake Sevan

In 1995, an Action Programme for Lake Sevan was initiated. An integrated management approach was adopted. This kind of approach was deemed necessary in view of the multiple uses of the Lake. The preparation of the action plan was financed with a grant from the World Bank and grants from Finland, the Netherlands, Sweden and Switzerland. The Action Programme does not aim at restoring the initial level of the Lake, which would be unrealistic. Nevertheless, one of its major objectives is to raise the level gradually to the extent possible. Following an analysis of the situation, it seeks a sustainable management of the Lake for (1) tourism and recreation, (2) protecting and enhancing biodiversity, (3) improving fisheries, (4) controlling and minimizing pollution discharges, (5) improving institutional arrangements for integrated resource use, and (6) restoring the strategic value of the Lake.

The Action Programme seeks to involve all sectors and establish a management structure with broad responsibilities. It also advocates self-financing mechanisms based on user and polluter fees, argues for an integrated watershed management structure and for the consolidation of all legal instruments dealing with Lake Sevan into one single law, avoiding overlaps, gaps and inconsistencies.

The integrated water master plan for Lake Sevan will be part of a national integrated water master plan. The Action Programme is to be implemented in phases, which have been identified together with their costs, priorities and implementation schedule. Implementation in 1999 was hampered by a serious shortage of finance.

Legal framework

A large number of laws and decrees have been merged into a Water Code (1992). It regulates the State's management and control of water use, water consumer rights and duties, water protection and prevention of water impact. The Code provides for permits to abstract water and discharge pollution. Water user fees are charged to water utilities, industry, agriculture and irrigation water users. Pollution fees are required from industries and waste-water facilities. The Code specifies principles for solving water use problems.

Particular provisions apply to Lake Sevan National Park, where permits and implementing rules are more severe than elsewhere. A zoning system defines permitted activities within each zone. Fishing in Lake Sevan is controlled through a licensing system established in 1996, which specifies catch quotas and gear restrictions. Each year the Government Council decides on the quantity of water that can be abstracted from Lake Sevan for irrigation, in the framework of the Annual Programme on the Social and Economic Development of Armenia.

33 government resolutions on water protection existed in early 1999. Legal instruments of a more general character, such as the Law on Environmental Protection and Nature Use Charges (1998) and the Governmental Resolution on Environmental Protection Tax Rates (1998) also influence water policy. A US$ 1.5 million project on drinking-water supply and waste-water treatment is being developed by UNDP. It will focus on improving legislation and the regulatory framework. The legislation does not, however, introduce concepts such as integrated water management, management by hydrographic basin, decentralization of responsibilities and decision-making, or extended financial autonomy at local level.

Institutional responsibilities

Since 1998, the Ministry of Nature Protection has been fully responsible for the allocation, use and protection of waters, including the management of Lake Sevan waters. Its Water Resources Protection Department counts 6 staff. The Department manages water use (issuing licences) and water pollution (granting permits regulating discharged substances). It reports on water management, drafts water strategies and participates in project preparations.

Allocation of water resources. The main responsibility for limiting water abstraction lies with the Ministry of Nature Protection. The Ministry decides on the sharing of water resources on the basis of requests from the various users, i.e. ministries which have their own interests. Decisions are made through intergovernmental resolutions. This system is not easy to implement. The Water Resources Protection Department receives information (i) on the state of water resources from Armhydromet, (ii) on the needs for irrigation from the Ministry of Agriculture and its 16 regional branches, (iii) on hydropower production plants from the Ministry of Energy, and (iv) on drinking-water needs from the Yerevan Water Supply Enterprise and the Armenian Water Supply Enterprise under the Ministry of Urban Development. The Water Resources Protection Department maintains a register on water resource use, works out plans for the use and protection of water, and projects for balancing the water economy It is responsible for the annual planning of water allocation.).

Drinking water is given priority over other uses and is not normally from the same sources as water abstracted for other uses (in general deep aquifers). Conflicts occur rather between water use for irrigation and for energy production. In case of severe drought, if it is difficult to supply both energy production and irrigation, Lake Sevan can be used as a buffer, upon the express consent of the Ministry of Nature Protection. Other environmental considerations (recreation and protection) also receive due attention.

Management of the irrigation infrastructure. The practical management of irrigation has been modified with the land privatization. Since then, only the main pumping stations and pipes remain under direct State responsibility, i.e. the Ministry of Agriculture. The Ministry is also responsible for the maintenance and building of reservoirs, the Vorotan tunnel and drainage systems. The provincial infrastructure is maintained by the 14 provincial branches of the Ministry's Irrigation Operation and Maintenance (O&M) enterprise. They sell water to farms, villages for public supply, energy and industrial plants. Since 1997, farmers have been encouraged to create water user associations at village level. There are about 550 such associations, managed by elected villagers, at least one per village. They are in charge of investment, operation and maintenance of the irrigation infrastructure, but that work suffers from the very low charge collection rate.

Management of the public water supply and waste-water treatment infrastructure. Yerevan has its own water enterprise, the Yerevan Water Supply Enterprise (YWSE), dealing with water supply and waste-water treatment. The Ministry of Urban Development, through its Armenian Water Supply Enterprise (AWSE), plays a major role in supplying drinking water to and treating the waste water of the other main towns. The AWSE is in charge of operation, maintenance, investments, financing of current expenditures and also of monitoring both water supply and waste-water treatment systems, all related assets being owned by the Ministry of Urban Development. AWSE operates in 47 towns and 231 villages. It is also responsible for the main supply network of 220 rural settlements, where the secondary supply network is under the rural municipalities. YWSE does the same for Yerevan under the control of its municipality, and maintains the water-supply network of 52 villages located in the capital's vicinity. In Armenia's other 449 villages, water supply services are the responsibility of local authorities. Both the Yerevan and the Armenian Water Supply Enterprises strongly depend on the Ministry of Finance for all financing and investments. The quality of drinking water is monitored by the Ministry of Health, the Ministry of Nature Protection setting technical regulations.

The country's water enterprises have inherited sufficient staff and equipment from the previous regime. But for 10 years, this equipment has not been maintained, nor has staff been trained. Experienced managers may have left, their responsibilities are too wide and too centralized, and they have to operate their plants with insufficient budgets.

Water resource protection. The Ministry of Nature Protection is responsible for the protection of water resources. It issues water abstraction permits and waste-water discharge permits. The Ministry has 11 regional inspectorates that verify compliance with the discharge limits.

Flood forecasts are one of Armhydromet's tasks – together with substantial tasks in monitoring - and are made for 23 rivers and 9 reservoirs. Constructing and maintaining flood protection structures and dams are the responsibility of the Irrigation O&M State Enterprise.

Coordination of local and State institutions. Coordination regarding water protection and management is complicated, because territorial responsibilities correspond to the limits of regional administrative units (Marz) and not to hydrographic basins. The responsibilities for managing water resources or protecting them are scattered at local level between different local administrations of the different State ministries involved. Very few responsibilities are left to the Marz Water Department and to municipalities. The Marz is responsible for providing infrastructure services such as water supply and irrigation. It should be noted that there are no revenues managed at the local or regional level. All regional activities are controlled by the central Government and financed through the State budget.

Monitoring and water information

The Department of Hydrometeorology, Armhydromet, monitors the water regime of surface waters. Of its total staff of 120, 35 deal with hydrology and water resources. The network of stations is operated by 10 regional offices. Armhydromet takes measurements, keeps the water register and provides related information to the public. One of its tasks is to issue a regular special bulletin on the status of the water balance of Lake Sevan.Armhydromet currently operates 110 hydrological stations (down from 215 in 1988). Since 1992, Armhydromet has taken samples of water and measured the basic variables such as pH, temperature, dissolved oxygen, etc., as well as the global chemical measurements (anions and cations).

The other parameters are analysed by the Environmental Monitoring Centre. The results are used for establishing the water cadastre. The data are transmitted and treated manually. A decision of 1998 by the Ministry of Nature Protection requires water quality to be monitored in 131 sampling points by the Environmental Monitoring Centre. This decision has not been fully implemented because of a lack of finance. The Centre publishes a monthly bulletin on the quality and pollution of water in different locations. For the time being, there is no intercalibration between laboratories, casting doubt on the reliability of the analytical results.

Both monitoring institutions face extreme difficulties because of drastic financial shortages and are no longer able to fulfil most of their tasks. It is estimated that, in 1998, only 20 per cent of Armhydromet's minimum budgetary needs were met. Even in the traditionally well monitored Lake Sevan, very few monitoring activities are currently carried out, resulting in a disruption of data sets for a range of parameters.

The Ministry of Nature Protection's Department of Geology monitors groundwater in 40 aquifers. The number of observation points is around 200, compared to about 1 000 in the late 1980s. There is also a network for the monitoring of groundwater regimes. The Department produces hydrogeological maps. Data are processed manually.

The Inspectorate of Nature Protection has its owns laboratories in Yerevan and other regions to analyse and control waste-water discharges. This monitoring is not systematic, again because of financial shortages and because laboratories hardly function. Information collected by enterprises and organizations about their water pollution (self-monitoring is compulsory) are directly transmitted to the Inspectorate.

Various annual reports, such as that on water use by the Ministry of Agriculture, that on water pollution by the Ministry of Nature Protection and reports from enterprises and organizations on their use of groundwater, are forwarded to the Ministry of State Register and Statistics.

Standards, norms and permits

The water quality norms of the former Soviet Union still apply in Armenia, i.e. maximum permissible concentrations (MPCs) for about 420 substances. Two main norms apply to (a) the quality of raw water at the source, by type of use, and (b) the control of tap water. Some are stricter than the WHO standards, others less so (see chapter on Health). Their enforcement is questionable.

The permits for water abstraction and for the discharge of waste water into surface water bodies are issued by the Inspectorate of Nature Protection. There are no threshold values for permits. The ecological passport defines the discharge limits for a range of pollutants. The law does not specify the period of validity of the permits, which is defined in decisions and instructions. The frequency of inspections depends on the company's production volume. If emission levels are below the maximum permissible concentration (MPC), no compensation charge is due. Charge levels in case of exceedances are set by type of pollutant. Two scales of compensation apply - one for violations up to 50 times the MPC, and a more punitive scale for violations of more than 50 times the MPC.

Water prices

The description of the system of charges for water abstraction (i.e. resource use) and pollution is included in Chapter 2. These charges add to the cost of the supply service. There is a total lack of water metering in Armenia (water meters are only used in about 9 per cent of industry). In almost all cases, the charges are based on self-assessment by the economic operators, be they the irrigation enterprises, the water supply enterprises, or industrial facilities.

The price of irrigation water is composed of a nationally common part decided by the Ministry of Agriculture (2.3 drams per m^3), and a price for distribution inside villages, which varies between water user associations. The common part theoretically includes the abstraction charge and the cost of supply, but falls short of the real cost of providing water (6.3 drams per m^3). The difference between the price charged and the real cost of water is compensated by the State. The energy cost component in the cost is about 65 per cent, as most of the water is pumped. There are large losses in distribution (about 30 per cent). The 2.3 drams per m^3 are collected by local O&M enterprises. The water user associations receive an additional 0.9 to 2 drams per m^3 for maintaining the distribution systems in the villages. The collection rate is low (about 15 per cent according to the associations). Revenues are insufficient for maintaining the irrigation systems and hardly cover 25 per cent of the operation and maintenance expenses.

Domestic drinking water is paid according to the resource use charge described in Chapter 2, plus a charge for water pollution and the supply service itself. As there is no individual flow measuring, prices are charged according to an assumed consumption of 250 l/person/day in Yerevan and 200 l elsewhere. Different prices apply depending on whether the water is distributed by the Yerevan Water Supply Enterprise, the Armenian Water Supply Enterprise or independent villages (Table 8.7). Since early 1997, the prices have been increased by 86 per cent for Yerevan, 20 per cent for other urban supplies and 43 per cent for village supplies. However, the assumed consumption volume per person was reduced.

Table 8.7: Prices for drinking water, 1998

Location	Assumed consumption	Water price		Monthly charge		
		Supplied water	Sewage	Total	Supplied water	Sewage
	Litre/capita/day	*Dram/m³*			*Dram/capita*	
Yerevan district	250	46	10	420	345	75
Other places	200	30	7.46	225	180	45

Source: State Committee of Nature Protection.

The majority of water used for industrial purposes is taken directly from the municipal system and is supplied by Armenian/Yerevan Water Supply Enterprises. Public supplies to industry are charged like public supplies to households.

Public supply prices are decided by the Ministry of Finance. In general, the prices and collection rates are not sufficient to cover the operation and maintenance of the water supply, as electricity, in particular, is very expensive. For instance, in 1997, revenues covered 40 per cent of the operation and maintenance costs in Yerevan and 50 per cent outside the capital. The new 1998 tariffs would be sufficient to cover operation and maintenance costs, if they were fully collected, but would not allow any investment into modernization. The funds for new projects generally come from general budgets (municipal in Yerevan, Ministry of Urban Development for other towns).

Water protection expenditures and projects

Current expenditures for the rational use of water resources and water protection represent the bulk of environmental expenditures (i.e. 74 per cent in 1997 or about US$ 1 million and 84 per cent in 1998 or US$ 1.9 million). About 10 per cent go to subcontractors, who distribute and treat water and waste water. Expenditures by industry for water protection are steadily decreasing. In 1996, they amounted to 1 260 million drams, in 1997 to 525 million.

Investments in water supply for drinking and irrigation purposes and in waste-water treatment have not been reported for several years. It is likely that in the future available funds will have to be spent on the most urgent rehabilitation work and the least costly maintenance of the existing infrastructure (see NEAP priorities). Nevertheless, the obsolete water infrastructure badly needs investment. Two important projects are currently developed under the World Bank:

- The Municipal Development Project
- The Irrigation Development Project

The Municipal Development Project was approved in September 1998. It chiefly aims to (i) ake emergency short-term improvements in the water supply system to improve drinking water supply to Yerevan, in particular to the poorer and most affected parts of the population; (ii) improve the efficiency, management, operation and delivery of water and waste-water services to the Yerevan area; (iii) lay the groundwork for the involvement of the private sector in the overall management of water companies. Progress should be made on reducing water that is unaccounted for (install water meters, decrease the loss of water), increasing the continuity of the water supply to customers, increasing revenue collection (actual 6 per cent, target 85 per cent) and reducing energy consumption.

The project costs US$ 35.5 million: US$ 5.5 million from Armenia's own budget and a US$ 30 million loan from the World Bank. In spring 2000, a private operator was chosen for a four-year contract. The operator will train Yerevan Water Management Enterprise so that it can resume management at the end of the contract. US$ 9.5 million will be invested in restructuring and rehabilitating the network. As a first implementing step, work is being carried out to rehabilitate the Arzakan water source uptake, which feeds Yerevan City.

In parallel, an Armenian Water and Sanitation Project is being prepared as another part of the Municipal Development Project. It aims at rehabilitating of the water infrastructure managed under the AWSE. As a first step consultants have drafted a Water and Sanitation Sector Strategy for Armenia. A project management unit will be created under the Ministry of Urban Development for the implementation. The project will benefit from foreign funding, in particular from Germany (Armavir Marz) and the Netherlands.

Already since 1995, an Irrigation Rehabilitation Project (continued as the current second step in the Irrigation Development Project) has been carried out with the help of the World Bank. At the same time, the institutional capacity of the O&M enterprises has been improved and water user associations created. These associations now cover 15 per cent of the irrigated area. The programme has the following components: (i) the rehabilitation of 56 000 ha of irrigated land by 2005; (ii) the extension of the total irrigated area to 400 000 ha before 2010; (iii) an increase in the storage capacity to 2 billion m^3 (i.e. twice what it is today); (iv) the conversion of

pumped irrigation systems into gravity systems; (v) the improvement of technically deficient dams; (vi) the institutional strengthening of O&M enterprises of irrigation networks; and (vii) the reinforcement of the project implementation unit established under the previous project. Its costs are estimated at US$ 85 million, of which US$ 20 million will be covered by Armenia's own resources. It is not clear how much has been spent so far. At present, the project is slackening its pace as certain sites in the Ararat Valley where irrigation infrastructure was going to be restored would be eligible as Ramsar sites, a point that should be considered in the EIE procedure.

Other projects regarding the Lake Sevan Action Plan, the drawing-up of an integrated water resources management plan and a dam safety project are also worked out by the World Bank. Some smaller projects are carried out by the European Union's TACIS and the United States Agency for International Development (USAID). It is likely that some TACIS funds will be spent on implementing the Lake Sevan Action Plan and monitoring the Kura River.

Box 8.4: The Vorotan tunnel and Yehvards reservoir projects and Lake Sevan

The Vorotan tunnel will divert water from the Vorotan River to Lake Sevan, in order to reverse some of the environmental damage that has been caused by the drop in its water level, and will provide additional irrigation water and a strategic water reserve for use during a drought or need for hydropower production. This combination of agricultural, energy and environmental interests justified the classification of the Vorotan tunnel as a "Project of National Importance". The tunnel is included in the Lake Sevan Environmental Action Plan. It has received considerable resources form the State budget (250 million drams per year from 1994 to 1997, 1.2 billion in 1998).

The tunnel was started and almost completed in the 1980s (with only 2 km of the total 21 km still to be excavated). Construction was stopped in the early 1990s due to a lack of funds. There are no reliable cost estimates for the remaining part; calculations from the 1980s produced an estimate of 7.5 billion drams (US$ 15 million). The project is seen to be of such high national importance that it is likely to be completed using Armenian resources, if international support is not forthcoming. A cost-benefit analysis was made in 1997 to investigate whether diverting the water from the Vorotan watershed to Lake Sevan was economically viable. The outcome was negative. Another project, the construction of the Yehvards reservoir, would bring water to Lake Sevan. Construction started in 1984 and was interrupted in 1989. The overall cost of the project is about US$ 100 million, with 15 million still to be spent to complete the last phase.

8.4 Conclusions and recommendations

The management of water resources and pollution is a complex problem in Armenia. The water sector being capital-intensive, its development is particularly impeded by the economic recession. Undoubtedly, this situation has slowed down the development of a realistic legal framework for water management, with clear policy goals, a modern kit of management instruments, new standards and powerful enforcement mechanisms. It has also impeded investments in all water infrastructures (water abstraction, drinking water supply, waste-water sewage and treatment and irrigation) which are in dire need of rehabilitation.

In spite of this tight financial situation, Armenia is striving to tackle water problems in a constructive and efficient way, and is preparing the future with modern views and concepts. A first step was the institutional restructuring which regrouped under one single body, the Ministry of Nature Protection, the responsibility for water resources allocation and water protection. However, although concertation takes place, the process of decision-making on allocating water resources to the different sectors and in the different regions through intergovernmental resolutions is not easy to manage. Therefore, the NEAP recommended the creation of a permanent national water management board. It was pointed out as a top priority given the strong need to reconcile conflicting interests and harmonize sectoral policies regarding water management and protection. The board has not yet been set up. It seems essential for the application of a water policy plan and a sustainable and coordinated use of water resources. The board should also include other relevant partners. In particular, NGOs could play a more prominent role if they are given a chance.

Recommendation 8.1:
The setting-up of a national water management board should be accelerated. NGOs should be encouraged to take part in all actions aiming at improving water management, in particular the protection and conservation of water resources.

Another positive aspect is the work started under the impulse of the NEAP to draw up integrated water policies at national level. Building a national water resources management plan and creating a new, decentralized

decision-making structure for water management have been included as first priority projects of the NEAP. A team constituted mostly of Armenian experts started work in June 1999 to try to modernize the water management concept and practices in Armenia. In early 2000, an interim report on Integrated Water Resource Management was prepared by an inter-ministerial Committee. The content of this report has not yet been disclosed. However, this common work shows the willingness of several ministries to solve the water problem together, which is a first step toward an integrated approach. A similar approach is being followed in the Lake Sevan Environmental Action Plan. Unfortunately, further progress in the implementation of the NEAP and the Lake Sevan Environmental Action Plan have been hampered by the lack of finances.

The legal framework for water needs to be modernized, as the 1992 Water Code does not contain the necessary elements for a modern water management. It would be useful to revise it and adapt it to modern approaches, in particular regarding intersectoral cooperation, water management by river catchment basin, financing and concessions, and decentralization of administrative responsibilities. The revised Water Code should also be the basis for the upcoming water resources management plan. Other laws are also needed. In particular, the water supply has to comply with hygiene standards. To this end, clear legislation is needed on drinking-water supply. This does not exist in Armenia. WHO has emphasized *inter alia* the necessity to better address drinking-water legislation. A proposal was drawn up recently, but not yet forwarded to Parliament. See Chapter 13, proposing a list of requirements for the revision of drinking-water legislation.

Recommendation 8.2:
A law on drinking water should be drawn up and the Water Code revised.

Water management affects every citizen, producer and user of water. The public should be informed of the water situation and problems in the country, and should be aware of their own individual role and duties. Only then will they modify their behaviour and use water more rationally. Today, it seems that both the water user associations for irrigation water and water enterprises or local offices collecting water payments from households face difficulties, because the service is poor, and users are not sufficiently aware of the larger water economy. The existing legal sanctions for non-payment are not enforced. On the other hand, it seems that some users in Yerevan are requesting flow meters. Pilot projects in the suburbs should be encouraged, and the public should be widely informed of the results.

Recommendation 8.3:
A national awareness campaign should be launched on domestic water use practices and a policy on sustainable and healthy water use practices should be developed. NGOs should play an active role in the campaign.

All water infrastructures need to be rehabilitated. This implies considerable financing that the country cannot afford all at once. A chief priority should be put on delivering safe water to the citizens. The poor state of the distribution infrastructure undermines the quality and quantity of the tap water available. The infrastructure should therefore be improved urgently. Investments are the cornerstone, but they are not available at present. To overcome this problem, Armenia is currently turning to international financing, mainly through the World Bank. Armenia should pay special attention to the longer-term benefits of this international cooperation. Foreign concessionaires could help decentralize financing, encourage clients to pay their bills by improving water services, save water by introducing flow meters, and assist in the training of local water enterprises in water service management.

Recommendation 8.4:
Armenia should require management practices and training components for managing concessions and financing methods to be included in any cooperation projects, in particular when such projects concern the public water supply.

Waste-water treatment is also a serious problem in Armenia. At present, industry is not discharging large amounts of effluent into rivers. Industrial facilities have never been equipped individually, as they were all connected to the public sewer network and thus enjoyed municipal waste-water treatment. Attention should therefore be paid to those plants that will resume production, but are no longer connected to an efficient waste-water treatment plant. For instance, in Vanadzor, three industrial plants without proper treatment

facilities are to be reopened soon. The waste water that they will generate will go to the municipal waste-water treatment plant, where only the mechanical step is operated. Action should be taken to prevent chemical or industrial effluents being discharged untreated into rivers.

At this time, the waste-water problem is more acute for domestic effluents. Biological treatment has ceased. At most mechanical treatment is done, but can be maintained only in few cases. Sludges are not treated, they are spread onto soil without stabilization treatment - jeopardizing the quality of drinking and irrigation water and, ultimately, food. An assessment made for the NEAP indicates that many waste-water treatment facilities need be entirely rebuilt.

In the past, the approach was to collect waste water from distant villages and cities in huge municipal waste-water treatment units, with the help of extensive networks of sewers. For instance, Yerevan's unit treat the sewage of all villages upstream of the Hrazdan valley to the city of Carancavan (about 40 km from Yerevan). This concept is costly, as the infrastructure is difficult to operate and maintain. As all existing sewage collecting pipes and waste-water treatment infrastructure are obsolete and should be rebuilt, it is time to move towards a more flexible concept. Smaller units that require smaller investment and are cheaper to operate should be envisaged in rural areas, where space is available. They should be put under the direct responsibility of local administrations. They need to be simple to operate. Different types of extensive treatment exist (extensive ponds, macrophytic ponds, reed beds, infiltration systems, etc.). The choice should depend on the prevailing climatic and natural conditions (landscape and soils) of each site. The NEAP recommends that pilot projects should be launched as models to test two or more of possible treatment options. This proposal should be strongly encouraged and assistance from donor countries sought.

Recommendation 8.5:
The future waste-water treatment system should favour small units. Options for waste-water treatment in rural areas should be adapted to the site's conditions. A balanced level of treatment should be sought for the country as a whole.

The irrigation infrastructure is also in bad need of rehabilitation. A more efficient use of water (saving electricity and preventing losses) would also mean smaller bills for users. The irrigation rehabilitation project and the irrigation development project of the World Bank aim at improving the infrastructure. In parallel, efforts should be pursued to involve the farmers in the management of the local distribution pipes and canals. This will eventually make them more willing to pay water charges. The collection rates of water payments should be improved, if necessary also through the enforcement of sanctions. It is not fully clear what percentage of the rural territory is managed by water user associations (15 per cent of irrigated territory at end of 1998 according to the World Bank, 550 associations according to the Ministry of Agriculture). Water use associations are a good way of involving users in maintaining the distribution infrastructure and using water in a more sustainable way. They should therefore be further extended. The International Fund for Agricultural Development (IFAD) was the initiator of the associations under the Irrigation Rehabilitation Project and should be encouraged to pursue this task.

Recommendation 8.6:
The extension of water user associations to all rural areas should be encouraged, with the general introduction of flow meters becoming one of their aims.

Finally, monitoring is a key element in decision-making and a necessary tool to assess the efficiency of any water policy. Water monitoring has been poor for several years and is getting worse. The monitoring institutions (Armhydromet, the Environmental Monitoring Centre and the State Inspectorate), despite having joined forces, are no longer able to provide a reliable picture of water quality and water pollution. There is no integrated water monitoring system. The sampling procedures are not integrated in space and time, and the quality of sampling, conservation and transport of samples does not correspond to good laboratory practice. For instance, in 1999, the Monitoring Centre was able to check only 35 out of the 131 sampling points twice a year, instead of the usual seven times. In addition, inspectors did not coordinate their sampling procedures with the Monitoring Centre or Armhydromet. Inspectors rarely take samples any more, as they know that analysis is too expensive and any violation would not be penalized anyway. The results of industry self-monitoring are kept by the Inspectorate for internal use.

Such a situation has persisted for the past ten years, with no investment in equipment (sampling equipment, sample preservation and transport, modern flow-measuring and analytical devices, on-line monitoring, etc). Therefore, it is likely that the previously high professional expertise and background of the staff are now lagging behind current technological practices. This problem cannot be solved without large investments, which the State cannot afford at present. Thus, international financing has to be sought.. Bilateral cooperation could be an efficient way of helping the monitoring institutes and introducing modern analytical equipment. As laboratory analysis is increasingly based on spectrometric methods, it is important to train Armenian staff in these new techniques simultaneously.

Recommendation 8.7:
Water monitoring should be considered a key element of water policy and decision-making. Armenia should improve the monitoring of water and modernize the management and techniques of the existing monitoring bodies. The possibility of allowing the above bodies to work partly on a contractual basis should be considered. Also Armenia should strive to attract all possible help from abroad regarding monitoring, be it laboratory equipment or training of laboratory staff in modern analytical and computing techniques, data management and processing, etc.

Chapter 9

AIR MANAGEMENT

9.1 State and determinants of air pollution

Air emissions

In general, air emission trends in Armenia since 1987 have been influenced, directly or indirectly, by the following events:

- The earthquake in 1988, which affected 40 per cent of the country's area
- The economic decline
- The armed conflict over Nagorno-Karabach
- The transport blockade imposed by Turkey and Azerbaijan, and the internal conflict in Georgia

Table 9.1: Trends in anthropogenic emissions of selected pollutants, 1987-1998

1 000 tonnes, except Pb (tonnes)

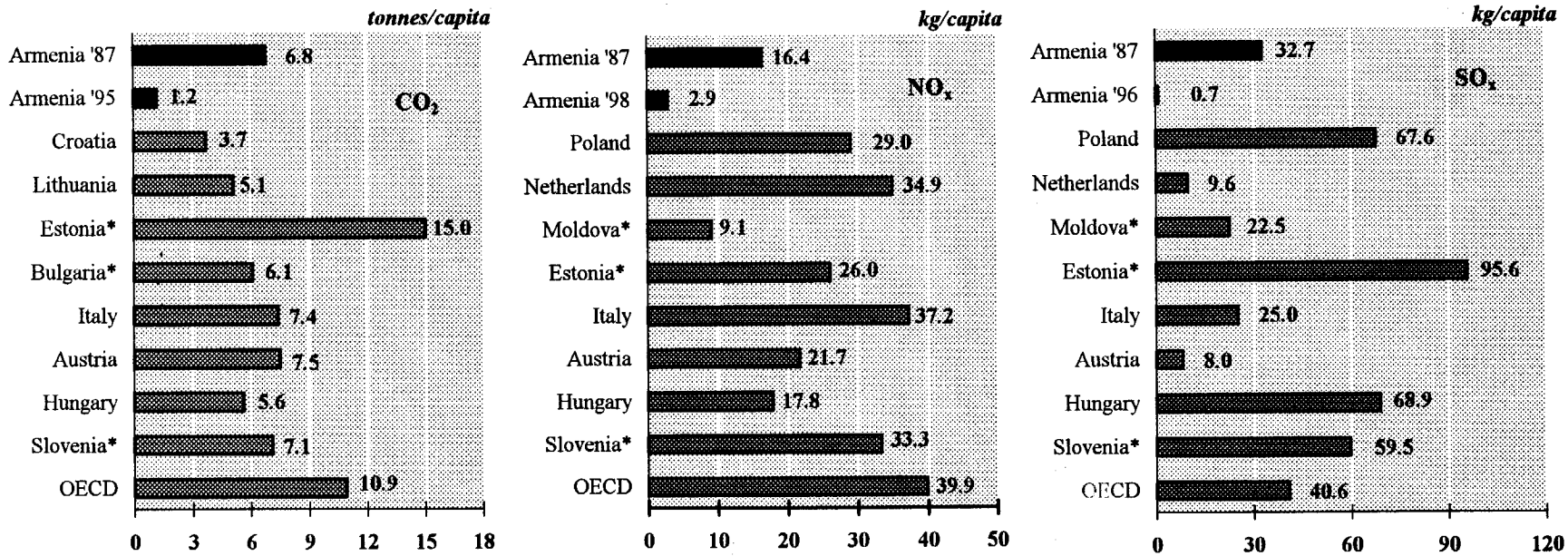
		1987	1990	1992	1994	1995	1998
SO_x	**Total**	**112.5**	**75.8**	...	**4.5**	...	**3.7**
	Stationary sources	110.6	73.0	44.1	4.2	2.5	3.3
	Mobile sources**	1.9	2.8	...	0.3	...	0.4
NO_x	**Total**	**56.5**	**46.2**	**21.9**	**11.8**	...	**11.0**
	Stationary sources	28.2	22.7	10.2	3.9	5.4	4.1
	Mobile sources	23.3	23.5	11.7	7.9	...	6.9
NMVOC*	**Total**	**104.0**	**81.2**	**30.9**	**17.1**	...	**17.0**
	Stationary sources	27.4	8.8	1.3	0.3	0.3	0.1
	Mobile sources	76.6	72.4	29.6	16.8	...	16.9
CO	**Total**	**416.5**	**304.2**	**195.1**	**128.0**	...	**124.3**
	Stationary sources	27.2	16.7	7.3	1.6	1.7	7.4
	Mobile sources	389.3	287.5	187.8	126.4	171.9	116.9
NH_3*	**Total**	...	**24 900.1**	...	...	...	...
	Industry	1.7	0.1	0.1	0.0	0.0	0.0
	Agriculture	...	24 900.0	...	...	...	...
Pb	**Total (tonnes)**	**159.0**	**123.5**	...	**17.2**	...	**35.31**
	Stationary sources	46.00	11.00	0.60	0.30	0.30	0.01
	Mobile sources**	113.0	112.5	...	16.9	...	35.3
Particles	Stationary sources	54 389.0	30 582.0	8 292.0	3 336.0	3 679.0	1 485.0
CH_4*	Total	...	152.7	...	...	79.0	...
CO_2	Total	...	22 013.0	...	...	4 458.0	...

Source: Ministry of Nature Protection and author estimations.

* NMVOC - Non-methane volatile organic compounds
CH_4 - Methane.
NH_3 - Ammonia.

** Estimation of the author- using fuel consumption, amount of lead in petrol (leaded 0.226 kg/tonne; unleaded 0.017 kg/tonne; emission factor of 75%) and sulphur in diesel (0.5 %).

Figure 9.1: Air emissions, 1996



Sources: Ministry of Nature Protection, 1999; OECD, Environmental data, Compendium 1997.

Note:

* Data refer to 1995.

The main economic consequences of these events were a decline in production (its volume index declined by 67 per cent between 1988 and 1993), energy crises and acute hyperinflation. They were accompanied by a sharp decrease in air pollution. Since 1987, air emissions of the main pollutants in Armenia have decreased by 93 per cent from stationary and by 73 per cent from mobile sources. SO_2 emissions have decreased by 96.7 per cent, NO_x by 80.5 per cent, NMVOC by 83.7 per cent, CO by 70 per cent and solid particles by 97.3 per cent (Table 9.1).

Apart from the lower energy demand due to the overall production decrease, the emissions of sulphur dioxide (SO_2) and solid particles decreased also due to structural changes in the energy conversion sector (27 per cent of energy demand is currently supplied by nuclear power) and the switch from the use of heavy fuel oil to natural gas (95 per cent of total fuel consumption in 1996). The power plants also took primary measures to reduce emissions of nitrogen oxide (NO_x).

Agricultural restructuring led to a significant decrease in livestock (82 per cent of pigs, 70 per cent of poultry and 50 per cent of sheep in 1996 as compared to 1990). In addition, as a consequence of the 1988 earthquake, almost all of the chemical plants producing or using ammonia, including the Kirovakan chemical factory producing mineral fertilizers, ceased operations. As a result ammonia emissions in Armenia dropped sharply after 1990.

Also the emissions of heavy metals such as Pb, Cr, As, Cu and Hg have decreased by more than 98 per cent since 1987. This is mainly due to a drop in production in the metal industries. Lead emissions from traffic decreased by 69 per cent compared to 1987, due to a decrease in traffic density and the step-by-step introduction of unleaded petrol (accounting for 30 per cent of total sales in 1998).

Armenia is a party to the Vienna Convention since January, 2000. The country programme on ODS phase-out has not yet been formulated.

In the period of fully functioning industry (1987), Armenia's per capita emissions were more or less comparable with those of other European countries (Figure 9.1). Its SO_x per capita emissions were 19.4 per cent below the OECD average, and more than 45 per cent below those of Slovenia, Poland or Hungary. Its NO_x and CO_2 per capita emissions were clearly below the OECD average.

The emission inventory system in Armenia uses a bottom-up approach, being based on yearly emission reports, which the operators of air pollution sources are obliged to provide. This reporting system was functioning already in the Soviet era. At present, due to the unstable economic situation, the forthcoming privatization and the break-up of larger units, the system suffers from some inconsistencies, and is worsened also by the financial problems of the State Environmental Inspectorate (see Chapter 2). The assessment of road transport emissions is based on the State motor licensing and inspection department, providing information on the number of cars used, their mileage and fuel consumption.

Sectoral pressures and underlying factors

Armenia has a multi-sectoral economy and was one of the most developed countries in the former USSR. Armenia's productive capacity and resources contributed 1.2 per cent of total national output, although the country covered only 0.13 per cent of total USSR territory and represented 0.8 per cent of its productive resources. Industrial development was predominantly in mechanical engineering and metalworking, the chemical industry and in the textile, knitwear and food industries. The mining, extractive and chemical industries, being the heaviest drain on natural resources, accounted for up to 14 per cent of all output.

In 1987, the energy sector contributed 38 per cent to stationary source emissions, non-ferrous metallurgy 14 per cent and the cement industry 11 per cent. In 1998, the energy sector contributed 23 per cent, non-ferrous metallurgy 19 per cent and the cement industry 50 per cent.

In 1987, 66.7 per cent of total emissions were traffic-related, while traffic contributed 89.6 per cent to the total in 1998. However, the decrease in total emissions during this period was 78.6 per cent (71 per cent from traffic and 89.6 per cent from stationary sources), as shown in Table 9.2. This indicates that the main environmental

pressure came from traffic emissions before as well as during the recession. A similar trend may be expected also in the future, as the number of vehicles and traffic density may increase with renewed economic growth.

Table 9.2: Annual total emissions by sector, 1987 and 1998

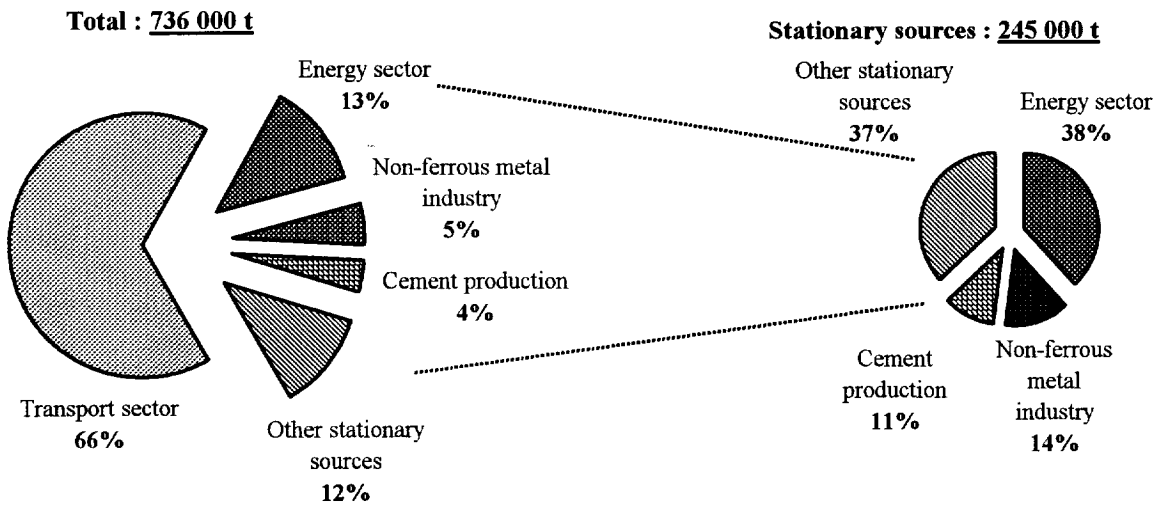
	1987			1998			1987/98
	tonnes	as % of Total emissions	as % of Stationary sources	tonnes	as % of Total emissions	as % of Stationary sources	% change
Total	**736 100**	***100.0***		**157 540**	***100.0***		**-78.6**
Mobile sources	491 100	*66.7*		141 100	*89.6*		-71.3
Stationary sources	245 000	*33.3*	***100.0***	16 440	*10.4*	***100.0***	-93.3
-energy sector	*93 100*	*12.6*	*38.0*	*3 781*	*2.4*	*23.0*	*-95.9*
-non-ferrous metal industry	*34 300*	*4.7*	*14.0*	*3 123*	*2.0*	*19.0*	*-90.9*
-cement production	*26 950*	*3.7*	*11.0*	*8 220*	*5.2*	*50.0*	*-69.5*
-others	*90 650*	*12.3*	*37.0*	*1 315*	*0.8*	*8.0*	*-98.6*

Source: Ministry of Nature Protection.

In Armenia only minibuses are produced, all other vehicles are imported. At present there are no import restrictions that relate to the age or technical properties of vehicles. The average age of the vehicle fleet is thought to be about 12 years. Despite yearly inspections, the technical conditions of vehicles are mostly unsatisfactory. A positive trend is the increasing use of natural gas and LPG (see Table 9.7). Also the share of unleaded petrol is expected to grow in the future. The control of emissions from mobile sources is stated as the first objective in the NEAP for air quality and air protection management, beginning with the phasing-out of leaded petrol.

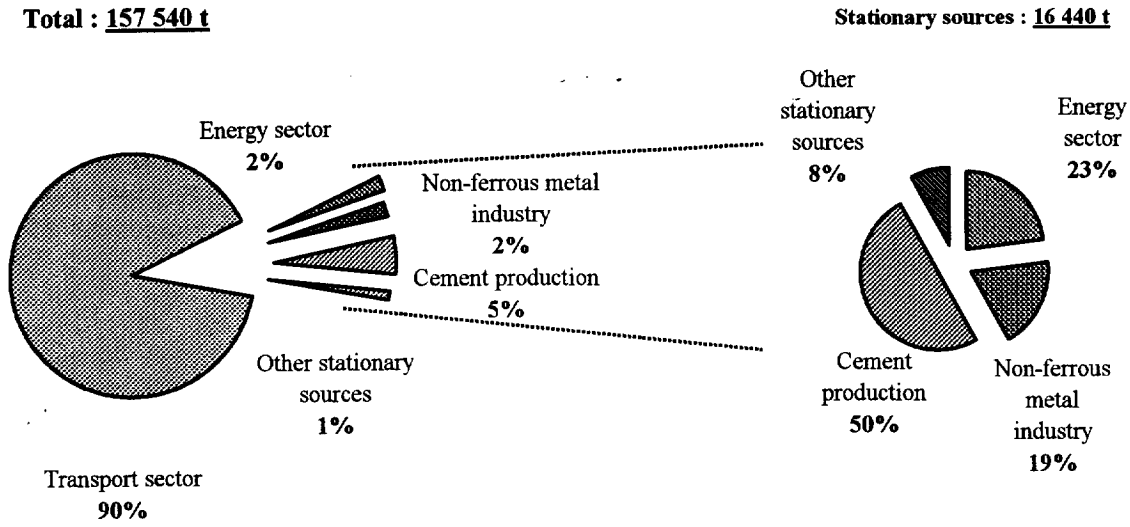
From an air pollution point of view, the energy sector is no longer a problem, as the three thermal power plants (in Yerevan, Vanadzor and Hrazdan) switched from the use of heavy fuel oil to natural gas and introduced primary measures to abate NO_x emission. Nuclear energy (27 per cent) and hydropower (8.6 per cent) supply the rest of the electricity.

Figure 9.2: Emissions by sector, 1987



Source: Ministry of Nature Protection.

Figure 9.3: Emissions by sector, 1998



Source: Ministry of Nature Protection.

The main polluting industrial branch is cement production, because its recession was not so bad as in the other branches. The three cement plants, two in Ararat and one in Hrazdan, are already privatized. Although the plants are equipped with electrostatic precipitators, pollution by solid particles remains a problem, as the efficiency of these filters is only 80-90 per cent. This is also one of the reasons why no co-incineration of selected high-calorific waste is carried out in the cement kilns, although no waste incineration capacity is available in Armenia and energy prices are relatively high.

Significant environmental pressure originates in the non-ferrous metallurgy sector, the copper industry being the most traditional one in Armenia. There are two copper-molybdenum-mining plants in Kajaran and Agarjak as well as a copper-molybdenum ore processing plant in Kapan. The copper metallurgy plant in Alaverdi ceased production after 1989 due to complaints from the population about its heavy environmental pollution. After privatization in 1998 (sale to a Luxembourg company), production was restarted in 1998 but at a substantially lower level. As a consequence, the environmental impact is even worse, as the unit producing sulphuric acid from SO_2 that was removed from the exhaust gas cannot operate at such a low production level. Thus, while 5 000 tonnes of SO_2 used to be emitted per year for a production of 30 000 tonnes of copper, now 9 000 tonnes of SO_2 are emitted a year for a production of 7 000 tonnes of copper.

Also other heavily polluting plants were closed down after 1989, such as the leading chemical factory NAIRIT in Yerevan. Among other products, rubber was produced here for the large USSR market. Today it works again at about 10 per cent of its capacity.

The polyvinylacetate factory in Yerevan ceased production in 1992. In 1998, a test production of petroleum products began here, the first in Armenia. The capacity of the refinery is 0.5 million tonnes of crude oil/year, but only 100 000 tonnes/year are currently processed.

In addition to these two, the Doghagorts chemical factory is also located in Yerevan, as are an aluminium factory, the car manufacturer Yeraz, some machine-building factories (LUIS, emitting cadmium and mercury) and the crystal glass factory Bureghaven. Crystal glass containing 24 per cent Pb was produced here, which, together with the lead from traffic, produced a high ambient air concentration of lead and an increased lead content in children's blood (up to 216 µg/l). Therefore only lead-free glass is produced here at present.

Armenian industry is currently working at 10-20 per cent of its capacity. As a consequence, the country is facing enormous economic problems. A production increase is considered a general top priority, preceding environmental concerns. Due to the lack of resources in the State sector, privatization is facilitated, even by exemption from environmental legislation. For example, according to an agreement with the Government, the Vanadzor factory complex PROMETEUS (thermal power plant, synthetic korund and viscose silk production) is exempted from the licensing procedure as well as environmental inspection during the first seven years after privatization in 1998.

In addition to industry, Armenia also had an important agricultural sector, fruit and vegetables being its most characteristic products. In the Soviet era, large amounts of fertilizers, pesticides and herbicides were used. Their residues (in both soils and stockpiles) constitute an environmental problem today. Building and insulation materials used in the past contained asbestos. Neither indoor nor outdoor measurements of asbestos concentrations are available (see also Chapter 13).

Ambient air quality

In general, the ambient air quality in Armenia has improved in recent years as a consequence of the sharp decrease in air emissions. The main air polluting sectors, traffic and industry, are concentrated in the four largest cities (Yerevan, Ararat, Vanadzor and Hrazdan), Yerevan being the most polluted (Table 9.3). The situation is worsened by their physical location: in valleys between mountain ranges, where calm weather and temperature inversion tend to trap emissions. Therefore, more than half the Armenian population is occasionally exposed to high concentrations of air pollutants.

Table 9.3: Spatial distribution of emissions, 1996

	SO_2		NO_x		CO		VOC	
	kg/capita	*t/km²*	*kg/capita*	*t/km²*	*kg/capita*	*t/km²*	*kg/capita*	*t/km²*
Armenia (nationwide)	**0.68**	**0.09**	**4.03**	**0.50**	**46.92**	**5.86**	**6.30**	**0.79**
Yerevan	14.88	84.55	13.63	77.47	110.90	630.20	22.17	125.00
Ararat	17.36	42.64	20.14	49.20	237.10	579.60	40.18	98.21
Vanadzor	10.62	60.00	8.25	46.73	87.60	496.40	44.20	250.40
Alaverdi	7.54	13.15	8.10	14.20	111.90	56.75	17.30	30.16

Source: Ministry of Nature Protection.

Table 9.4: Ambient air quality in selected towns, 1987-1996

	Yerevan				Vanadzor				Hrazdan				Alaverdi			
Pollutant	SP	CO	NO_x	SO_2	SP	CO	NO_x	SO_2	SP	CO	NO_x	SO_2	SP	CO	NO_x	SO_2
*MPC mg/m³**	0.15	3	0.04	0.05	0.15	3	0.04	0.05	0.15	3	0.04	0.05	0.15	3	0.04	0.05
1987	0.5	7	0.12	0.14	0.5	5	0.29	0.24	0.6	3	0.08	0.22	0.1	2	0.02	0.23
1988	0.6	7	0.11	0.11	0.5	6	0.13	0.21	0.4	2	0.07	0.21	0.1	1	0.03	0.36
1989	0.6	6	0.10	0.17	-	-	-	-	0.4	2	0.06	0.23	0.1	1	0.03	0.19
1990	0.5	6	0.14	0.17	0.5	9	0.1	0.16	0.4	2	0.07	0.26	0.1	1	0.02	0.05
1991	0.4	5	0.16	0.04	0.3	5	0.1	0.05	0.4	2	0.07	0.24	0.1	1	0.03	0.02
1992	0.4	5	0.12	0.50	0.2	3	0.06	0,4	0.3	-	0.06	0.24	0.1	1	0.03	0.02
1993	0.5	4	0.11	0.20	0.2	2	0.04	0.02	0.3	-	0.05	0.18	0.1	1	0.04	0.02
1994	0.4	4	0.10	0.16	0.1	2	0.02	0.05	0.3	-	0.05	0.19	0.1	1	0.04	0.02
1995	0.4	4	0.08	0.09	0.2	2	0.02	0.04	-	-	-	-	0.1	1	0.03	0.02
1996	0.4	4	0.12	0.14	0.2	2	0.02	0.03	-	-	-	-	0.1	1	0.03	0.02

Source: Ministry of Nature Protection.

* Daily average.

SP: solid particles.

Trends in air pollution (according to monitoring results) are shown in Table 9.4. In 1987, maximum permitted concentrations (MPCs) were exceeded for almost all the monitored pollutants in the most polluted cities. Air quality improved along with decreasing production volume, but exceedances still occur in Yerevan.

SO_2 pollution was mostly critical in Alaverdi, where a copper smelter is located. In the 1987-1989 period, concentrations of SO_2 peaked at up to 17 times the MPC. When the smelter was closed down in 1989, air quality improved, but with the recent restarting of production (1998) without proper SO_2 abatement (as described above), it can be expected to become critical again.

MPC for particulate matter is exceeded in the biggest cities. This is alarming because of the possibility that other hazardous substances, such as heavy metals or persistent organic pollutants, may be adsorbed on the surface of the particles.

The NO_2 and CO concentrations are not so alarming, even if the MPCs are not always met, since Armenia's standards are more stringent than the WHO guiding values.

According to both older and recent measurements, air pollution by lead is a serious health risk. During the 1988-1991 period, MPC exceedances were measured in Yerevan and Alaverdi 10 to 16 times. According to recent measurements (1997), the MPC value in Yerevan was still exceeded 3 to 6 times the normal value.

9.2 Policy objectives and management practices

Objectives and legislation

The general objective of Armenia's air protection policy is to sustain or to obtain a healthy living environment. At present, no consistent overall environmental policy is in place, nor is one being prepared. However, the National Environmental Action Plan (NEAP) has been drawn up recently, supported by the World Bank. Based on a detailed assessment of the present situation, the main issues and problems in air quality and air protection management were identified, and a prioritized action plan established.

At present, the following legal documents directly or indirectly govern air protection:

- The Law on Atmospheric Air Protection (1994)
- General Council Resolution on the Implementation of the Law on Atmospheric Air Protection. 08.12.1994.
- The Law on Environmental Impact Expertise (1995).
- Government Resolution No. 465 concerning the implementation of real estate joint monitoring and real estate State register holding order. 22.10.1997.
- Government Resolution on Environmental Protection Tax Rates (1998)
- The Law on Environmental Protection and Nature Use Charges (1998).
- National Council Resolution on ratifying the Vienna Convention for the Protection of the Ozone Layer. 28.04.1999.
- National Council Resolution on ratifying the Montreal Protocol on Substances that Deplete the Ozone Layer. 28.04.1999.
- Government Resolution No. 29 concerning active works on impact on atmospheric processes. 20.01.1999.
- Government Resolution No. 192 concerning emission licences, norms of maximum permitted hazardous physical impact and maximum atmospheric air polluting emissions. 30.03.1999.
- Government Resolution No. 419 concerning arrangements for the implementation of the Law on Environmental Protection and Nature Use Charges. 10.06.1999.
- Government Resolution No. 221 concerning tax rates for natural resources consumption and hazardous substance emissions and confirmation of the payments order. 25.06.1997. (amended 30.12.1998 by Government Resolution No. 864)
- The Law on the State Register of Enterprises.02.09.1993.
- The Law on local self-administration. 22.07.1996. Amended 24.06.1997.
- The Law on Standardization and Certification. 27.05.1997.

- The Law on Energy.27.05.1997.
- The Law on the unification of measuring. 27.05.1997.
- Government Resolution No. 92 concerning the measures to implement the 1996 social-industrial development programme. 02.04.1996.

The Law on Atmospheric Air Protection prescribes maximum permitted levels for anthropogenic emissions. There is no special legislation for monitoring. Armenia is also a party to international agreements on air protection (see Chapter 4).

Armenia has recently ratified the Convention for the Protection of the Ozone Layer, together with the Montreal Protocol, but no national strategy to reduce emissions of substances that deplete the ozone layer has been drawn up yet.

As a first step to fulfilling international commitments, the following studies are needed:

- Implications of the Convention for the Protection of the Ozone Layer and of the Montreal Protocol and Armenia's possibilities for meeting the related commitments
- Implications of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to the Convention on Long-range Transboundary Air Pollution and Armenia's possibilities for meeting the related commitments
- Implications of the Protocols on Heavy Metals and Persistent Organic Pollutants and Armenia's possibilities for meeting the resulting commitments

To prepare these studies, as well as to incorporate BAT-based technology emission limits into the prepared legislation, about US$ 100 000 are required.

Institutional framework

At present, the following institutions have air quality management tasks and responsibilities:

- The Ministry of Nature Protection - Air Protection Department (6 staff): development of air protection strategy, policy and legal instruments; definition of MPCs; setting of emission standards and limits; administrative supervision of the implementing institutions; responsibility for monitoring and reporting on national level; organization of ecological training and education; responsibility for the international treaties and their implementation into the national policy and legal system
- The Ministry of Nature Protection - Nature Protection State Inspectorate: inspection of polluters' compliance with the air protection legislation; supervision of the implementation of protective measures and emission limits as specified in the MPC projects and yearly reporting on air emissions
- The Ministry of Nature Protection - Environmental Monitoring Centre: monitoring of air quality, atmospheric precipitation, surface water quality and soil quality and maintaining appropriate monitoring databases
- The Ministry of Nature Protection - Hydrometeorological Department: monitoring of hydrological and meteorological data, total ozone concentration and radiation monitoring as well as scientific support in particular regarding dispersion modelling
- The Regional ('Marzpetaran') and Yerevan City Nature Protection Offices: cooperation with the Ministry of Nature Protection and its Nature Protection State Inspectorate; supervision of compliance with environmental protection legislation in the region and reporting on violations to the responsible bodies; cooperation with citizens and social organizations taking an interest in environmental activities
- Ministry of Health: defining MPCs on the basis of health effects; assessing emission sources and their physically hazardous effects; supervising the application of sanitary rules

Armenia has a strongly centralized air protection management system, with the main responsibility lying in the different departments of the Ministry of Nature Protection, especially the Air Protection Department and the State Inspectorate. On the regional level the regional inspectorates play the key role. The collaboration between these two bodies seems to be well organized. Until now the local self-government bodies have had no real

responsibility within the air protection management system. According to present legislation, their task is to help the central State administration to implement the legislation at the local level, without an exact description of the content of this task. There are plans to put the management of air pollution sources with yearly emissions below a certain threshold under the responsibility of the Marzpetaran offices. The Ministry of Nature Protection should systematically train the staff of the regional offices, but due to the overall lack of financial resources this is not yet possible.

The Ministry of Nature Protection is financed fully from the State budget, however resources are insufficient and allow neither the proper functioning of the individual departments, nor their effective collaboration. The insufficient financing of the respective implementing institutions seems to be the main implementation constraint. Also cooperation with specialized expert institutions such as the Centre for Ecological-Neosphere Studies ('Ecocenter') of the National Academy of Science, founded as the principal research organization for fundamental and applied studies in ecology and environmental protection, suffers from a lack of funds.

Air quality management and monitoring

Air quality management is based on air quality standards, the so-called maximum permitted concentrations (MPCs) inherited from the Soviet era. Although the law requires that these standards should reflect both environmental protection and public health criteria, present MPCs are based solely on health criteria. If necessary, stricter standards can be set for separate regions, but in general MPCs are the same throughout Armenia. MPCs are determined for about 420 substances (instantaneous, 20-minute and daily averages). MPCs are in general more stringent than WHO or EU standards (Table 9.5). The comparison is complicated, because MPCs are not set on an annual basis. Considering the fact that even in the days of fully functioning monitoring in the eighties only a small part of the substances was monitored, the effect of this instrument is questionable.

An important role in air management in Armenia is still played by the system of national GOST standards inherited from the Soviet era. GOST standards regulate, for example, fuel quality, the concentration of pollutants in motor vehicle exhaust gases, methods for determining the MPC of different pollutants, dispersion modelling and also parts of the EIE procedure. GOST standards are usually associated with a network of laboratories equipped to supervise compliance with the standards. At present, the conversion of Soviet GOST standards into Armenian ones is being prepared, but the process is complicated by the very bad economic situation of the country.

Until 1992, Armhydromet (through the Environmental Monitoring Centre) was responsible for air quality monitoring, using the same GOST standards as the rest of USSR. After 1992 the Environmental Monitoring Centre became independently responsible for air quality, atmospheric precipitation, surface water quality and soil quality monitoring and maintaining an appropriate monitoring database. Monitoring is done with old-fashioned, physically deteriorated technical equipment. Observation ports (produced in 1978) collect air samples at the monitoring stations by means of electro-aspirators. The pollutant concentrations are analysed in the chemical laboratories using the following analytical methods: sulphur dioxide, chlorine, formalin and the nitrogen oxides (spectrophotometry); carbon monoxide (gas analyser); chloropren and aromatic hydrocarbons (gas-chromatography); dust (gravimetry). All this equipment has a measurement error of approximately 25-30 per cent.

Air quality monitoring is carried out following guidelines compiled by the State Committee of Hydrometereology and by the Ministry of Health, and confirmed by the Department of Standards (Guidelines for air pollution control 52.04.186-89).

The number of sites for air quality control was decided on the basis of several criteria, mostly according to the population in the city. They are located to characterize air pollution from different sources, such as industry, traffic and domestic heating. Usually, four samples a day are taken. The sites are placed at a 0.5-5.0 km distance from each other; the samples are taken 1.5-3.5 m from ground level during 20-30 minutes and taken to the laboratories. Until 1990, ambient air quality in small cities was also monitored, though irregularly. Samples were taken once every 3-5 years and analysed in a mobile laboratory.

The monitoring programme has seriously suffered from a lack of resources to maintain and run the laboratories. Air quality monitoring in Hrazdan was stopped in 1994. Four of the Yerevan sites have no electricity because they do not have the money required for connection to the new power-supply system. In Gumri, monitoring has not restarted after the laboratories were destroyed by the earthquake. The total number of samples, 67 186 in 1987, had decreased 63 per cent by 1996, and since then the situation has even worsened. The number of sampling sites, 24 in 1985, was reduced to 8 in 1998 and even the operating and maintenance of these sites is an enormous problem due to the lack of resources even for essential inputs such as electricity and chemicals.

Table 9.5: Comparison of selected Armenian air quality standards with recommended WHO guiding values and EU present and future standards

Substance	Armenia MPC mg/m^3		WHO guiding value / averaging time	EU standards / averaging time	
	20 min	*24h*		Present	According to IPPC Directive a/
Carbon monoxide	5.00	3.00	60 mg/m^3, 30min 10 mg/m^3, 8h		
Sulphur dioxide	0.50	0.05	0.5 mg/m^3, 10 min	0.08 mg/m^3, annual, median value if BS>40 and b/	0.125 mg/m^3, 24 h, c/ exceeded not more than 3 times annually to protect human health;
			0.125 mg/m^3, 24 h	0.12 mg/m^3, annual, median value if BS £ 40	0.020 mg/m^3, annual and d/ in winter to protect ecosystems
			0.05 mg/m^3, annual		
Nitrogen dioxide	0.085	0.04	0.2 mg/m^3, 1 h	0.2 mg/m^3, annual, exceeded not more than 2% time	0.2 mg/m^3, 1 h, e/ exceeded not more than 8 times annually (50% margin of tolerance)
			0.04 mg/m^3, annual		0.04 mg/m^3, annual, (50% of tolerance) both to protect human health; 0.03 mg/m^3, annual, as $NO + NO_2$ to protect vegetation
Particulate matter		0.05	0.06-0.09 mg/m^2	0.08 mg/m^3, annual median value	0.05 mg/m^3, 24 h, (50% margin of tolerance to protect human health)
				0.13 mg/m^3, winter median value	0.03 mg/m^3, annual, (50% margin of tolerance to protect human health)
				0.25 mg/m^3, maximum value not to be exceeded more than 3 times annually	
Lead		0.0003	0.0005 mg/m^3, annual	0.0002 mg/m^3, annual	0.0005 mg/m^3, annual (100% margin of tolerance)

Sources: SDEP; WHO Air Quality Guidelines for Europe and EU Directive 96/61 on IPPC.

Notes:

a/ **IPPC**: Integrated Prevention Pollution Control.
b/ **BS**: Black smoke.
c/ Attainment date: 01-01-2005.
d/ Attainment date: 2 years after entry into force of the IPPC Directive.
e/ Attainment date: 01-01-2010.

Management of emission sources

Standards for stationary air pollution sources are also based on MPCs. According to present legislation, all enterprises whose activities generate air pollution have to get emission permission from the Ministry of Nature Protection. The emission permit is based on the confirmed MPE project. MPE projects are prepared by the companies (usually in collaboration with an expert institution) and presented to the Ministry for State examination and confirmation. For each source the mass flow (g/s) of each pollutant is limited. It is defined as the maximum emission which (under the least favourable dispersion conditions) together with the background concentration will cause no exceedance of the MPC in the layer close to the ground (1.5 m above ground). Also the maximal yearly emission is limited, based on the permitted mass flow and average operating hours. MPE projects contain much technical information about production technology as well as the abatement techniques used, and are to be updated at intervals not exceeding 5 years. All MPE projects are available at the Air Protection Department.

The methodical documents used for MPE projects are based on dispersion modelling. This method also allows the calculation of emission limits for a group of neighbouring sources in a kind of "bubble model". However, GOST standards are used for dispersion models that do not take account of the complex terrain topography. These models, sufficient for the flatlands of Russia, are less suitable for a mountainous country like Armenia. Moreover, they need a comprehensive set of meteorological input data as well as data on ambient air concentrations (for calibration purposes), both lacking currently due to the insufficient financing of the monitoring networks.

All enterprises are responsible for providing annual emission estimates to the Ministry of Nature Protection. Emission estimates are mainly based on fuel consumption data and emission factors. Occasionally, measurements are also used to determine the actual emission levels and emission factors.

The State Inspectorate is responsible for control of the air pollution sources and their compliance with the legislation and permits. However, because of an overall lack of finances, from which inspection laboratories and their mobility are suffering, this control is not very effective.

In the case of violation, sanctions may be applied (see Chapter 2 for the description of enforcement tools). In extreme cases, the facilities concerned may be closed down. This happened in the early nineties, when green parties dominated the Commission on Social Issues, Public Health and Nature Protection of the National Assembly – which alone has the power to do so. Some of the most polluting sources, such as Alaverdi metallurgy plant, Nairit chemical plant and even the nuclear power plant, were closed down. At present, they are partly operating again.

Economic instruments and cleaner technologies

The *polluter pays principle* was introduced after the political changes. Yearly charges have to be paid by the operators of air pollution sources (mobile as well as stationary) depending on the amount and kind of pollutants. A system of penalties for violation of the legislation and non-compliance with applicable emission limit values has been introduced as well. These payments are paid into a separate account. It was intended to use those resources as a basis for an environmental fund, which would be used to finance different environment conservation activities. However, at present this account is an integral part of the State budget.

Under existing legislation, expenditure for environmental conservation may be deducted from pre-tax profit. A more extensive description of economic instruments is included in Chapter 2.

The emission limits determined in accordance with the above methodology do not correspond to the technological BAT-based limits used in most European countries. If an enterprise is not able to meet the determined emission limit because of the technology it uses, it may continue to operate, but has to pay triple fees. Currently industry is working at 10-30 per cent of its capacity, but a recovery may be expected in the future. To motivate the use of cleaner technologies and to prevent the importing of outdated technologies, technology-based limits are also being introduced into new legal documents.

The very poor economic conditions also hamper the introduction of cleaner technologies. There are no incentives in present legislation to encourage the introduction of cleaner technologies into new or reconstructed enterprises. Nor are there tools for stimulating or enforcing primary or secondary measures for air pollution abatement in industry.

9.3 Policy objectives and management practices in the transport sector

The transport sector is regulated mainly by the following legal documents:

- The National Council - Law on Automobile Roads (27.05.1996). Additions and alterations – 24.09.1997
- Government Resolution No. 648 concerning the establishment of the order of State control of atmosphere polluting automobile transport emissions (12.12.1991)
- Government Resolution No. 32 concerning the improvement of activity of the State automobile inspection under the Ministry of Internal Affairs (21.05.1995)

The Law on Automobile Roads regulates the economic, legal and organizational aspects of the management of roads, including their construction, structure and maintenance.

State control of air polluting vehicle emissions is based on national standards (GOST), limiting the maximum content of CO and VOC in the exhaust gases of petrol-driven passenger cars, and the soot content in diesel. At the same time, the standard defines the estimation method, which is continuous infrared radiation spectroscopy for the CO and VOC measurement. At present, only CO concentration is measured at approximately 120 control points. These control points, some of which are privatized, have to be licensed according to the *Instruction of the Ministry of Transport on automobile exhaust inspection (1988)*. Exhaust gas control is obligatory once a year and shown by a sticker on the windscreen. It is relatively expensive (5 000 drams or US$ 10). If a car does not display the sticker, the State automobile inspectorate may impose a penalty of up to 50 per cent of the minimum salary.

The most important strategic document for the transport sector in Armenia is the *Government decision on the privatization of the transport sector*. By the year 2001, most of Armenia's transport sector should be privatized with the exception of:

- The metro in Yerevan
- Trolleybuses in Yerevan
- Trams in Yerevan
- Three main railway sections

No State subsidy will be given to the private sector. At present, approximately 30 per cent of the transport sector is in private hands (including part of the aviation and trolleybuses in Gjumri), and it is expected that the privatization target will be met according to plan.

Hand in hand with privatization, institutional arrangements have to be made to establish a body for the enforcement of transport-related legislation and to supervise the private transport sector. A legal document on the creation of the national transport inspectorate is in the interministerial adoption procedure. It will also contain penalties for non-compliance with the rules. It was expected to be adopted by the end of 1999.

In the international context, Armenia's transport situation is complicated by a transport blockade. Both traditional railroad connections to the Russian Federation, its most important trading partner, are blocked: one because of the conflict in Nagorno-Karabach, the other due to problems in the Abchasian region in Georgia. Therefore, bilateral contracts with Bulgaria and Georgia, concerning sea transport in the Black Sea, are of great importance. Armenia has only one seagoing ship, and relies on cooperation for sea transport. Armenia has signed up to the Transports Internationaux Routiers (TIR) and is an observer in the European Conference of Ministers of Transport.

Back in the 1960s, the railways were the main mode of transport for both passengers and freight. In the ensuing years there were sharp increases in the volume of freight carried by road and air. In 1987, the railways handled 49.8 per cent of freight traffic, road transport 49.8 per cent and aviation 0.4 per cent. The figures for passenger traffic were 51 per cent by rail, 44 per cent by road and 5 per cent by air. Due to the blockade, the share of passengers and freight transported by road and air increased further.

A cargo terminal for both aviation and rail/road/ship transport was built recently with financial support from the World Bank. It should serve for the whole Trans-Caucasus region and should also be privatized by the year 2001. There are also other privatized cargo terminals.

The transport infrastructure (Table 9.6) is characterized by almost fully (97 per cent) electrified railways and the very bad state of the roads.

Table 9.6 : Transport infrastructure, 1998

	Km
Road transport infrastructure	
Total length of roads	7 567
of which: Motorways	430
Railway transport infrastructure	
Total length of railway links	806
of which, electrified (%)	*99.0*

Source: Ministry of State Register and Statistics.

National standards regulate the composition and properties of petrol and diesel. From the air protection point of view, the sulphur content regulation in diesel fuel is important (0.2-0.5 per cent). There is both leaded (0.17 g Pb/l) and unleaded (0.013 g Pb/l) petrol available on the market. The share of unleaded petrol sales is 30 per cent.

After the dramatic energy crises in 1992-1994, the situation in the fuel distribution network improved remarkably. Still, mainly in the rural areas, sellers equipped with a few cans are selling fuel of dubious quality. At the customs offices samples are taken from imported fuel, to be analysed at the laboratories of the national standard system (GOST). However, due to the current economic problems the well-established system of GOST laboratories also suffers. None of the fuel distribution stations has a vapour recovery installation, nor are the VOC emissions from petrol stations considered a problem.

Table 9.7: Fuel consumption in the transport sector, 1985-98

	1985	1990	1994*	1998	1985/98
	tonnes	*tonnes*	*tonnes*	*tonnes*	*%*
Petrol	667 000	664 000	100 050	288 924 **	-56.7
Diesel	380 000	558 000	57 000	87 840	-76.9
Compressed natural gas	0	148	2 960	8 479	

Source: Ministry of Nature Protection.

*Assessment of the author.

**Share of lead-free petrol is 30%.

As Armenia does not have any car fuel producing capacity, it relies wholly on imports. Before the transport blockade, fuel was imported by railroad, mainly from the Russian Federation. Today, imports come via the Black Sea by tankers, and then by railroad through Georgia. However, in the former polyvinylacetate chemical

plant in Yerevan, the test production of an oil refinery with a capacity of 0.5 million tonnes of crude oil/year began recently, and it is intended to establish further capacities in other chemical plants. In accordance with NEAP, the Ministry of Nature Protection prepared a regulation on the limitation of lead in petrol (max. content of lead only 0.013 g/l), which is in the process of approval. It is intended also to restrict the import of leaded petrol. Trends in fuel consumption by transport are shown in Table 9.7. The present consumption of fuel by transport is still 56 per cent lower for petrol and 76 per cent lower for diesel than in 1985. On the other hand, the use of pressurized natural gas as well as propane-butane was introduced in 1990 and has increased approximately by 60 times since. Pressurized natural gas is available at five distribution points, four of them in Yerevan and one in Vanadzor. Propane-butane is available all over the country, as it is used also by households.

A large part of public transport is already in private hands. The minibuses produced in the Yeraz car factory in Yerevan determine the typical picture of public transport. The number and frequency of the bus connections are considered to be satisfactory, as is the price (100 drams per journey). In addition, metro, trolleybus and tram connections are available in Yerevan. A private trolleybus network was also established in Gjumri (former Leninakan).

9.4 Conclusions and recommendations

The emissions of all air pollutants have decreased and Armenia's ambient air quality has improved in recent years. The main reasons were the decline in output, the energy crises and acute hyperinflation, resulting from the 1988 earthquake, the disintegration of the Soviet Union, the armed conflict over Nagorno-Karabach and the transport blockade. Structural changes in the energy conversion sector together with a fuel switch to natural gas and the use of primary measures to combat air emissions from power stations have also contributed to improving air quality. Armenia does not at present have consistent development strategies for individual economic sectors. The centrally set strategy, inherited from the Soviet era, is still in place. It can be expected that new strategies will be developed in the near future. If and when this occurs, the need for sustainability should be recognized by favouring the introduction of cleaner technologies so as to prevent the resumption of old pollution patterns.

The *polluter pays principle* was introduced after the political changes. Environmental taxes/penalties/fees are paid into a separate account. It was intended to use those resources as a basis for an environmental fund. The development of the legal basis for this fund should be accompanied by a clear definition of its sources of revenue. See Recommendation 1.1.

Armenia recently adopted its National Environmental Action Plan. The main issues and problems in air protection management were identified and a prioritized action plan established. The envisaged priorities point in the right direction. They should therefore be maintained and implemented. See also Recommendation 1.5.

The present legal system in air protection is still based on that inherited from the Soviet era. MPCs for about 420 substances are set; there are 20-minute and daily average values, but no yearly averages. Compared with WHO guiding values or EU standards, Armenian MPCs are more stringent, but action only rarely follows even in the case of substantial and permanent exceedances. Moreover, only 10 of the 420 pollutants are actually monitored, against 26 in the past. Emission limits for stationary air pollution sources are also based on MPCs, set with the help of dispersion modelling for each particular source. Only limited emission measurement capacity is available.

The air protection management system is strongly centralized and the local authorities play no significant role. The emphasis is put on inspection, rather than on using efficient air quality management tools. No legal instruments secure the implementation of BAT or even BATNEEC in new or reconstructed sources. Furthermore, no tool is available to enforce the use of primary and secondary measures to abate air emissions.

This system differs in its main features from that of most European countries. As a first step towards harmonization and modernization, emphasis should be put on adopting realistic MPCs (calculated also on an annual basis) for a limited number of pollutants, and at the same time on ensuring the proper monitoring of these pollutants. Furthermore, technology-based emission limits should be set for new and reconstructed sources, to prevent air quality deterioration accompanying economic growth. The main sectoral pressure will

continue for some time to come from traffic. However, along with economic growth, significant pressure may be expected also from the metallurgic and chemical industries. The air pollution problems are concentrated in the four largest cities, Yerevan being the most polluted.

Recommendation 9.1:
Maximum permitted concentrations for a limited number of pollutants (short term and annual) should be adopted, and be harmonized with World Health Organization guiding values and/or European Union standards. Technology-based emission limits for new and reconstructed sources should be incorporated into the air protection legislation. Existing sources should be given enough time to comply with those emission limits.

National standards (GOST continues to be applied) in theory support the enforcement of the air protection legislation, setting technical parameters together with their control methods and the laboratories equipped to use them. However, these laboratories currently suffer from the overall lack of financial resources, and at the same time their methods are increasingly obsolete.

Specialized departments of the Ministry of Nature Protection are responsible for air quality monitoring and the monitoring of meteorological data, both essentials for the MPC-based air protection legislation, since they are needed for dispersion modelling and model calibrations as well as the assessment of air quality. The monitoring programmes have a relatively long tradition, but in recent years have seriously suffered from a lack of resources to maintain and run the sites and laboratories. Moreover, both methods and equipment have become obsolete. The monitoring programmes have already reached the critical minimum and any further reduction would in fact mean no usable monitoring data at all.

Since 1990, there has been neither a State body, nor any other organization with the necessary resources to carry out a comprehensive monitoring programme (in fact, the networks that are currently operated are driven by the enthusiasm of their staff), and evaluating the current air pollution situation in Armenia is problematic. Moreover, there is no ambient air quality monitoring in rural and suburban areas, which makes the assessment of air pollution effects on sensitive ecological receptors such as natural vegetation or agricultural crops impossible. The reduction of related activities has now reached a level that must create concern over the maintenance of any meaningful air management system. The development of a truly satisfactory monitoring programme can wait for the return of more favourable economic conditions, but a minimum programme has to be defined and maintained.

Recommendation 9.2:
The air quality and meteorological monitoring programmes should be maintained at least at their 1996 level. A new monitoring strategy should be developed along with the adoption of harmonized ambient air quality standards in the future.

Armenia has at present no waste incineration plant. As it suffers from a lack of primary energy sources and relies on fossil fuel imports, the possibility of co-incineration of high-calorific waste, such as used tires, plastic or solvent residues, for example in the three cement plants, should be studied.

Recommendation 9.3:
The possibility of incinerating high-calorific waste in the cement plants should be assessed.

Substantial air-pollution-related health risks are generally known to be associated with traffic. All these risks can be expected to appear or grow as transport activities resume along with economic recovery. One such major health problem can be expected to result from growing lead concentrations in ambient air. As lead emissions from industry have decreased in recent years, leaded petrol is its main source. While measures will have to be prepared and eventually taken that anticipate several air-pollution-related health risks, the phase-out of leaded petrol – to which Armenia is committed since the Aarhus Conference – should be started rapidly with concrete measures, as the full implementation will be time-consuming and costly.

Recommendation 9.4:
Both legislative measures and economic incentives should promote a gradual phase-out of leaded petrol.

More than 89 per cent of air emissions in Armenia are traffic-related. An improvement could be achieved by gradually replacing the current vehicle fleet by cars equipped with three-way catalysers. As Armenia has no passenger car production, import regulations could support this process.

Recommendation 9.5:
The technical parameters of imported cars should be regulated, and imported cars equipped with three-way catalysers should benefit from a lower import tax than other cars.

Chapter 10

MANAGEMENT OF MINERAL RESOURCES

10.1 Mineral resources: potential and use

General aspects

Before independence, notably from 1960 to 1980, Armenia's industry experienced innovations and technological growth supported by highly specialized educational institutions and a well-trained labour force. The gross industrial output of 1987 was 8.3 times higher than that of 1960. Armenia's economy was integrated into Soviet central planning, and therefore highly dependent on the markets of the former USSR.

However, its situation has drastically changed in the past decade. The earthquake in 1988 and the shutdown of its nuclear power plant, which accounted for 35 per cent of its energy supply, caused extensive damage to its infrastructure and industrial capacities. The break-up of the Soviet Union in 1991 and the political conflict over Nagorno-Karabakh aggravated the situation. As a result, all sectors of the economy declined sharply. The mining and metallurgical sectors were severely affected by huge cuts in the energy supply, shrinking trade with Armenia's traditional markets and disrupted transport routes. Reduced mining and mineral processing resulted in a temporary decline of environmental pollution in mining regions. In 1994, economic degradation started to slow down due to strong governmental measures. With economic growth, the mineral output is expected to increase, and this, in turn, may generate serious environmental pollution.

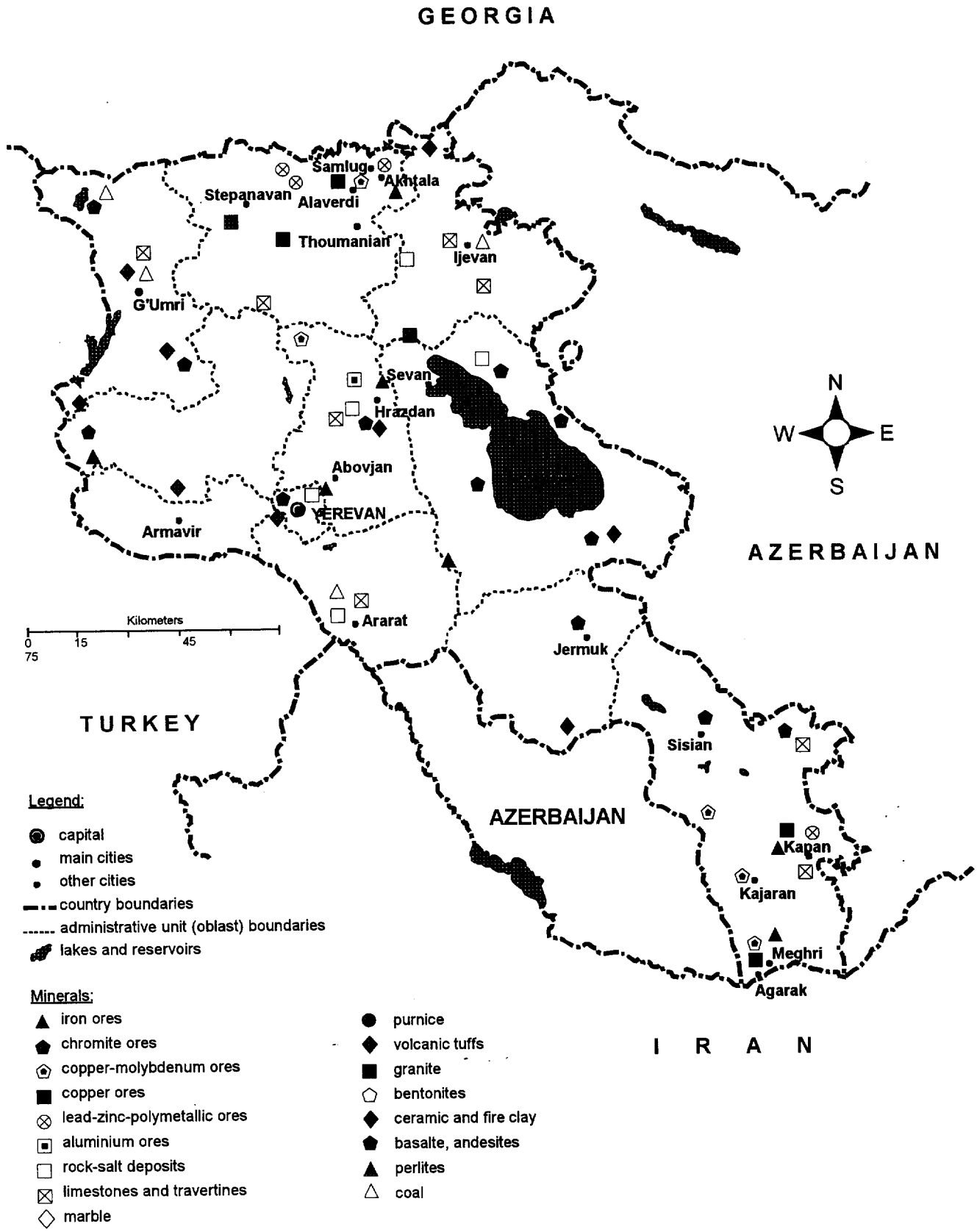
Mineral reserves

Armenia has a great mineral potential, although it is the smallest of the newly independent States. There are approximately 480 deposits of different types of mineral resources, of which 33 per cent are metals. Important reserves of iron, copper, molybdenum and polymetallic ores containing gold, silver, lead, zinc and rare earth elements are located in the country's territory (Figure 10.1). There are also deposits of raw materials used for construction and facing stones, mineral sorbents, salts, nepheline, mineral waters, semi-precious and ornamental stones. Reserves of coal, oil-shale and gas have been found locally.

Some deposits of ferrous metals are of industrial importance, including the Abovian and Hrazdan iron ore deposits. These deposits also contain valuable rare and trace elements like germanium, gallium, thallium, niobium and tantalum in association with the iron ore. The reserves of the Abovian and Hrazdan deposits are estimated at 400 million tonnes and 150 million tonnes, respectively, with an iron content of 28 to 32 per cent.

Copper deposits are the most important among the non-ferrous metals, with significant amounts of associated molybdenum and polymetallic ores. These deposits are mainly located in the south (Kajaran, Kapan, Agarak and Shahumian) and in the north (Alaverdi, Shamlug, Akhtala, Thoumanian, Teghut and Armanis). Gold, silver, zinc, lead, rhenium, selenium, tellurium, bismuth and germanium can also be present in the copper ore. 35 per cent of the molybdenum reserves of the former URSS were located in Armenia. The molybdenum content in the ore varies from 0.001 to 0.1 per cent. Although the reserves and the production of copper and associated metals are still a State secret, it is well known that the Kajaran and Alaverdi areas alone constitute potential sources for the next 100 and 300 years, respectively. The copper reserves of the Alaverdi region are estimated to be worth US$ 2 billion, with a copper content in the ore veins of up to 20 per cent. The Kajaran copper deposit also contains the world's largest reserves of rhenium.

Figure 10.1: Location of principal mineral deposits



Source: Environmental Research and Management Centre

Deposits of lead-zinc, copper-zinc and gold-polymetallic ores with subordinate valuable rare elements like cadmium, bismuth, indium and selenium, are the second most common in Armenia. The average content of zinc is 2 to 6 per cent, lead 1.5 to 3 per cent and copper 0.5 to 1 per cent.

Precious metals, specially gold and silver, are obtained from copper deposits or can be exploited in their own deposits. In recent years, Armenia's gold-bearing deposits, such as Zod, Meghradzor and Terterasar, have attracted foreign interest.

Coal, oil-shale and natural gas deposits are spread throughout the country. The main coal and oil-shale fields are located in Idjevan, Shamut and Germaniess, with proven reserves of 17-18 million tonnes. The Dilijan oil-shale field has proven reserves of 6 million tonnes, with possible reserves of 128 million tonnes. There are coal deposits in the Idjevan region, with proven reserves of 100 million tonnes. In addition, there are oil and gas prospects in the Armanis and Ararat regions. In order to implement modern and more effective coal exploration, a programme funded by USAID was developed in the framework of the Energy Programme, with the assistance of the United States Geological Survey.

Armenia has a great potential for construction materials, with large reserves of basalt used for gravel production, different varieties of high-quality tuff and many deposits of facing stones, such as marble, granite, travertine and limestone. Armenia's estimated reserves of tufa are 3 billion cubic metres. There are small deposits of clay gypsum, the raw material for gypsum production, of which the Parakar deposit is the most important.

Many deposits of natural mineral sorbents of industrial value are found in Armenia. There are five deposits of diatomite, with a total balance reserve of 16 126 cubic metres, which is used for the production of filtration material in the chemical, paper and food industries. High-quality perlite is found in three deposits, of which two are currently exploited (Aragats and Jzaber). Total balanced reserves of perlite are 155 799 cubic metres. The extracted perlite is used as filtration material in the refining of oil and oil products and as a component in the glass and ceramic industries. It can also be used as a light additive for concrete. Bentonite, used as a component in the production of food and fertilizers, is found in the Sarigyugh deposit. A deposit of zeolite was found in Noyemberian and reserves were estimated at 150 to 170 million tonnes. Zeolite presents high selective absorption qualities, used in technological processes to drain, separate and clean liquids and gases. It is also a catalyst bearer used for environmental protection to capture or clean gas and to extract valuable components from industrial sewage waters.

Armenia has a variety of semi-precious and ornamental stones which are highly valued for jewellery and decorative art works, including agates, jasper, obsidian, amethyst, turquoise and onyx. Obsidian, which is a volcanic glass, is found in northern Armenia, especially in the Hrazdan region. Despite the country's great potential to develop these resources, little exploration has been undertaken to increase the mining of precious stones.

There are salt deposits near the capital Yerevan, with reserves estimated at 159 to 200 billion tonnes.

Armenia is rich in mineral water reserves, which differ in physical and chemical composition, temperature and medical properties. The main deposits are found in Jermuk, Arzni, Dilijan, Bzhnj, Hankavan and Sevan.

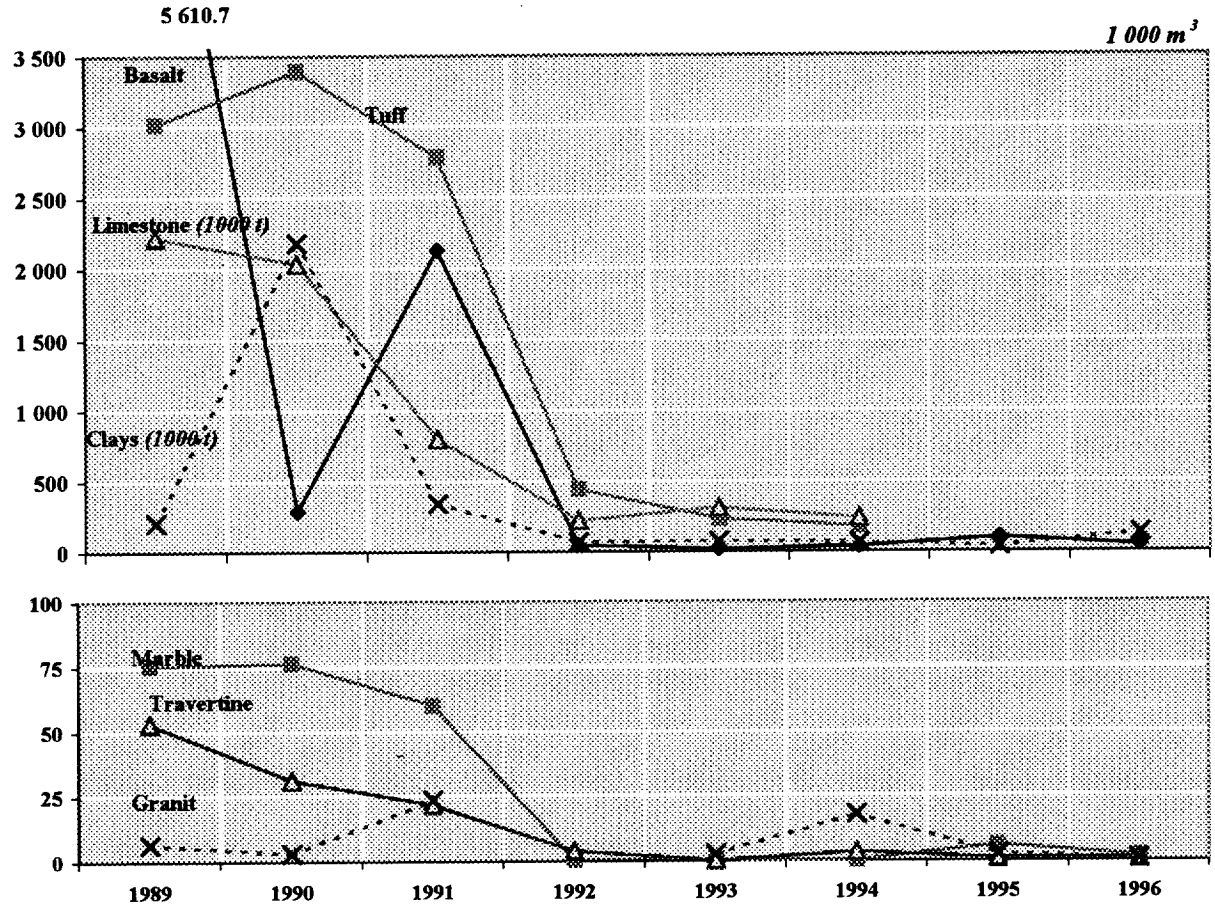
Mining and metal industries

Metallurgical production, notably of molybdenum and copper concentrate, has sharply declined during recent years. Despite the availability of mineral resources, especially of non-ferrous metals, and a well developed infrastructure, the mining and metallurgical sectors have suffered badly from the economic crisis. There are two major mining regions in Armenia, one in the north (Alaverdi region) and the second in the south (Zangzur region). Copper and molybdenum are extracted and refined near the mining towns of Kapan, Kadjaran and Agarak, which belong to the Zangzur Mining Company. According to the Ministry of State Register and Statistics, 2 494 000 tonnes of copper and molybdenum ores were extracted in 1997, but only 372 000 tonnes in 1998. In comparison with 1987, the Kajaran and Agarak mines worked at 47 per cent of their capacity in 1998 and the Kapan copper concentration plant at 20 per cent. A metallurgical plant of the Manes and Valeks

Company is located in Alaverdi. It produces blister copper, blue vitriol sulphur pyrite, as well as sulphuric acid, brass and bronze powder. At present, it is working at less than 10 per cent of its capacity. The reconstruction of the Alaverdi metallurgical plant and the upgrading of metallurgical production in Kapan are projected by the Government for the coming years. A gold-reprocessing plant, located in Ararat, refines gold from mining wastes and belongs to the First Dynasty Mining Company joint venture. The gold mines of Zod, Meghradzor and Ararat were not active in 1998.

Armenia's natural richness in raw material for construction, notably facing stones, clays and limestone, is the basis for 330 mines throughout the country. Limestone reserves used to produce 3 million tonnes of cement and 1 400 000 cubic metres of reinforced concrete structures a year. However, the construction material sector has drastically decreased its output (Figure 10.2). Before the earthquake, the sector was growing at an average annual rate of 5 per cent. By 1998, compared to 1987, cement raw material production had decreased 10-fold, perlite 6-fold, facing stones 11-fold, marble 300-fold, sand and gravel 24-fold and tuff 46-fold.

Figure 10.2: Extracted reserves of raw materials for construction



Source: Ministry of State Register and Statistics.

Precious metals and stone processing was not heavily affected by the adverse transport conditions after independence. It accounts for a large share of export revenues (US$ 59 million in 1993, US$ 78 million in 1994 and US$ 90 million in 1995). The sector consists mainly of diamond polishing plants, located in Stepanakert, Vayk and Yerevan, using raw diamonds from the Russian Federation and European Union countries. Jewellery is produced from diamonds, gold, silver and semi-precious stones for domestic use and exports by both State-owned and private enterprises. According to the Ministry of Industry and Trade, the development of the diamond-processing industry will create 2 000-2 500 new jobs in the next two years.

10.2 Environmental concerns in mining and mineral processing

Tailings and effluents

The main environmental issues in mining regions involve the large volume of accumulated tailings and effluent discharges from mining and mineral-processing industries. Tailings disfigure the landscape and are sources of dust, water and soil pollution. Acid mine drainage, which occurs as a result of the natural oxidation of sulphide minerals contained in mining wastes, is a common problem when tailings are exposed to the atmosphere. It may adversely impact surface and groundwater quality, as well as land use, due to its typically low pH and high concentration of metals and sulphate. Waste-water discharges from beneficiation and mineral separation processes that use dangerous chemicals (e.g. cyanide for gold) or organic reagents (e.g. flotation for copper) are also important sources of environmental pollution in Armenia. Most polluted areas due to mining activities are located in the Alaverdi, Zangzur and Ararat regions. According to the Ministry of Nature Protection, mines account for 15 100 hectares (3 per cent) of total built-up areas in Armenia. The total volume of accumulated tailings from mineral processing, especially of metals, is estimated at 220 million cubic metres.

Alaverdi region. The volume of mining tailings from open pits in the Alaverdi region is estimated at 46 761 million cubic metres. Some small areas were recultivated during the 60s, but little has been done since then.. The metals present in these tailings used to be recovered in the past, but now they are just abandoned. Since there is no efficient drainage system in place for tailings, the contamination of soils, surface and groundwaters with heavy metals, such as Cu, Pb and Zn, is relatively high. Environmental monitoring is not performed in these areas, which makes it difficult to evaluate the environmental and health impacts of heavy metal pollution.

The Shamlough copper mine (with associated zinc and lead) and the Akhtala concentration plant have been active for many years, producing large amounts of solid wastes and effluents, which were discharged without any treatment into the local environment. The copper reserves of the Shamlough deposit are estimated at 250 000 tonnes. Today both mine and plant are completely abandoned, but a rehabilitation project is expected to start in 1999. The volume of wastes from mineral processing in Akhtala is 3.1 million cubic metres. They are degrading the landscape and constitute potential sources of soil and water pollution with heavy metals. As tailings contain on average 0.4 per cent of copper, they can potentially be used in copper powder production or in the construction material industry, but this rarely happens. In the Chochkan storage site, located near Akhtala, the volume of accumulated wastes is estimated at 6 million cubic metres. These sites have not been rehabilitated. Moreover, acid drainage seems to be a great problem, as there is no tailing management in place. Preventing acid drainage, which is common in deposits of sulphide minerals, is less costly than repairing the damage. Acid drainage exacerbates heavy metal contamination, which has severe effects on local ecosystems, and metals can enter the food chain. Drinking water contaminated with metal and inhaling dust can cause a wide range of adverse health affects, such as dermatitis, cardiovascular diseases, central nervous system disorders, lung, kidney and liver damage, and cancer.

Zangzur region. In the Zangzur copper mining region, notably in the Kajaran, Kapan and Agarak areas, large amounts of mining wastes have accumulated. 26 and 24 million cubic metres of mining tailings have been deposited in the Darazami and Saghkarsu sites, respectively. Tailings from mineral processing amount to 10.6 million cubic metres in Kajaran, 3.2 million cubic metres in Kapan and 3.6 million cubic metres in Agarak.. Since there is a lack of appropriate tailing management, the environment has been severely damaged. Land reclamation in mining sites is not a common practice, except in Kajaran, where a small area has been recultivated.

Effluents from mining and processing containing many harmful substances, such as organic reagents and heavy metals, are directly discharged into the nearest river. The Kavart and Khaladg rivers, which pass through the Kapan copper-processing plant and the Shahumian gold-polymetallic deposit, are highly contaminated. Soil, surface waters and vegetation contain heavy metal (Cu, Zn, Pb, As, Mo and Cd) concentrations tens and even thousand times greater than the area's background concentration (Table 10.1). Acid waters are responsible for heavy metal mobilization and migration, with maximum concentrations observed up to 500 metres from these mining sites. Soils are the ultimate sink for metals, which tend to accumulate in the surface layers. The build-up of metals in the topsoil makes them readily available to crops.

Table 10.1: Heavy metal concentration in areas adjacent to the Kapan copper deposit and its tailings

	Soil		Surface waters		Vegetation	
	Deposit area	Regional background	Deposit area	Regional background	Deposit area	Regional background
	mg/kg		*mg/l*		*mg/kg*	
Cu	200 - 1 100	10 - 200	5 - 75	0.002 - 0.02	100 - 200	5 - 50
Pb	5 - 50	0.5 - 5	...	...	1 - 100	...
Zn	50 - 300	3 - 50	20 - 500	0.005 - 0.01	50 - 150	1 - 30
As	10 - 100	1	0.06	...	...	...
Cd	0.1 - 0.5	0.1	...	...	0.5 - 2	0.01
Mo	7.5 - 20	0.2 - 7.5	0.01 - 0.05	0.001 - 0.005	2 - 20	0.1 - 3.5
SO_4	...	...	50 - 4 500	10 - 25	...	...
pH	...	...	2.8 - 5.3	6.5 - 7.4	...	...

Source: Geochemical estimates of environmental pollution resulting from prospecting and exploration of Kapan and Shahumian deposits. Aslanyan, M. (1994).

Although the amounts of metal discharges have decreased over the past 10 years as a result of the economic crisis, metals persist and cycle in the environment. Furthermore, as the economy improves, there is potential for a marked increase in the release of metal contaminants.

Box 10.1: Construction material exploitation

Mining of construction materials for industrial use is widespread in Armenia, but is most intensive in the Artik region. In general, there is a lack of adequate exploitation techniques, leaving important reserves below ground and producing excessive wastes. As mining and environmental control are not effective, illegal mining without any planning is increasing, aggravating environmental damage. At present, Armenia is facing serious environmental problems as a result of soil and landscape degradation and the lack of recultivation in abandoned pits. Lands degraded due to the exploitation of construction materials exceed 3 196.1 hectares, of which 45 per cent are exhausted mines and 13 per cent are not considered subject to rehabilitation, since the upper fertile soil layer is depleted. It is estimated that in a few years the open pits craters will increase ten-fold or more, if no mitigation plan is implemented.

The Saral basalt mine, in the Lori region, reflects the current situation of this mining sector. Saral has 11 million cubic metres of reserves, with a production capacity of 100 000 cubic metres per year. The mine is currently working at 5 per cent of its capacity. The equipment is old and the exploitation technique outdated, creating a serious safety risk. In the Pambak open pit, also in the Lori region, only 4 per cent of the high-quality monzonite reserves have been extracted, leaving 6 million cubic metres of this resource in the ground. Both Saral and Pambak were severely affected by the disruption of the transport system, impeding the export to traditional markets, like the Russian Federation and the Islamic Republic of Iran.

Ararat region. Gold mining in Armenia, particularly in the Ararat region, has been inefficient, i.e. with a very low recovery of metals, which remained in the tailings of cyanidation. The total volume of these tailings is 7.5 million cubic metres. Today, 1g/tonne of gold is recovered using a conventional carbon in leach (C.I.L.) process, involving the dissolution of gold into a gold/cyanide solution by the addition of cyanide and oxygen. As the cyanide is very toxic, strong safety measures are required at all stages of its use. During the first stages, lime is also added to prevent the evolution of the highly toxic hydrogen cyanide (HCN) gas, which is given off when cyanide contacts water. HCN is fatal even in small doses and should thus be monitored on every shift to ensure safe working conditions. This stage is followed by the adsorption of gold from the solution into activated carbon, changing gold to a solid form. The slurry from which gold has been extracted is treated to destroy the residual cyanide and is pumped back out to the tailings dam. The neutralization of the free cyanide present in these tailings is done by a classical method, which is not effective. A description of the process used is included in Box 7.1.

The cyanidation process to recover gold, which is currently used in the Ararat reprocessing plant, has huge environmental impacts. Although environmental data assessment is very difficult in Armenia, cyanide concentrations in the river systems near the Ararat gold-processing plant are expected to exceed the MPC, which is 0.2 mg/l. Cyanide is a highly toxic substance that can affect the body via the respiratory system, by ingestion or by absorption through the skin, with serious health consequences.

Air pollution

The smelting of sulphide minerals, which are the main source of several common metals, notably copper, produces large amounts of sulphur dioxide. In the metallurgical smelting of copper, the sulphur dioxide released into the atmosphere undergoes reactions resulting in the formation of sulphuric acid. This returns to earth in the form of acid rain, which damages the tissues of susceptible plants and trees and lowers the pH of lakes and groundwaters.

For many years, especially in the 80s, the metallurgical sector was highly developed and active in Armenia. At that time, the Ministry of Nature Protection reported that 730 000 tonnes of air pollutants were emitted annually. Copper smelting was done in the Alaverdi metallurgical plant, using conventional smelting and, thus, producing large amounts of sulphur dioxide and trace metals leading to exceedances of maximum permitted concentrations. After independence, harmful emissions decreased drastically, as metal production was low.

Mining and mineral production are also sources of dust, which is generated at almost all stages of operation, contributing to air pollution. Dust is produced by open pits and by crushing and grinding operations, or can be given off by tailing dams. Air pollution from dust is an important environmental problem in the Ararat region, where concentrations exceed MPCs more than 7 times. This problem is mainly attributed to cement production from raw materials.

Box 10.2: The Alaverdi metallurgical plant

Mining activities in Alaverdi, northern Armenia, date back more than 200 years. The region has a great mineral potential, with large deposits of copper, molybdenum, zinc and lead. The Alaverdi metallurgical plant started processing copper in the early 30s. It was privatized in 1995, and now belongs to the Manes and Valeks Company. At present, mining and mineral processing are at a very low level, producing blister copper with 98 per cent of copper. In the past, notably during the 80s, the Alaverdi region was a hub of copper mining and metallurgy, attracting labour force and investments. Local mines as well as copper mines from southern Armenia used to send their output to the Alaverdi plant to produce copper. At that time, copper production reached high levels, processing 45 000 tonnes of copper sulphides per year. Manes and Valeks produced 5 000 tonnes in 1990, which represents a decrease of 89 per cent in the production level of the 80s. In the same year, the plant exported 2 700 tonnes of copper to Germany.

Copper smelting was considered the main source of air pollution in Alaverdi. The plant was forced to close several times due to major environmental risks. A system to capture harmful gases was in place though, indicating that the facilities were not efficient. At present, gas treatment facilities are not operating and the plant equipment is old and outdated. As a result, sulphur dioxide and other gases are directly released into the atmosphere.

A rehabilitation plan for the Alaverdi metallurgical plant has been prepared, aiming at a production of 25 000 tonnes of copper using cleaner technologies. The estimated total cost of rehabilitation is US$ 150 million. There are problems in implementing this plan. Recently, the Alaverdi Metallurgical Plant has restarted operations with an initial investment of US$ 3million and an annual production of 10 000 tonnes of copper to supply internal markets. the plant currently employs 700 workers. The problem now is the lack of new and more environmentally friendly technologies in mineral processing. A month after starting operations, the plant had already exceeded air pollution limits on four occasions. This is due to the lack of air treatment facilities. In this respect, the installation of new filters is foreseen by the end of the current year, but sulphuric acid production will start only from 2002.

10.3 Instruments for the management of mineral resources

Legal framework and policies

Since independence, 6 laws, 4 codes and 150 governmental resolutions on environmental issues, including the Principles of Legislation on Nature Protection, the Underground Resources Code and Government Decree No. 864, defining charges for the use of mineral resources (30 December 1998), have been adopted. 21 of the adopted government resolutions are related to underground resources use and protection. The Underground Resources Code (23 March 1992) is the main legal instrument for the management of mineral resources in

Armenia. It provides guidelines for the protection and effective use of these resources in order to meet economic and other demands. It also regulates the exploitation and processing of useful minerals by mining companies, foresees environmental protection and occupational safety during the use of the mineral resources and ensures the protection of the rights and economic interests of the State and users of underground resources. The participation of the public and NGOs in the discussions of environmental issues related to the use and protection of mineral resources is ensured by current law.

The current legal framework lacks adequate enforcement instruments for an efficient and sustainable management of mineral resources. Most legal instruments for the management of mineral resources are still highly influenced by the consumption principles inherited from the Soviet period, leaving environmental issues low on the list of priorities.

General policies in the mineral sector preserve the major directions and principles from the former Soviet administration. At present, the main policy objective in the mineral sector is to create favourable conditions for the sustainable management of mineral resources through regulatory, legal and economic instruments. Environmental strategies in the mineral sector are still neglected.

Regulatory and economic instruments

Permits for the exploitation of mineral resources are provided through specially authorized bodies responsible for the use and protection of underground resources (Ministry of Industry and Trade and Ministry of Nature Protection), after expertise and approval by the local authorities. The use of underground resources, as a rule, is granted for a certain period. Its duration is mentioned in the contract made on the basis of the licence. The contract should include the obligations of the parties, the conditions and duration of use, the payment system and the procedure for compensation for damage in the form of socio-ecological or other negative consequences during the use of the underground resources. Economic instruments, including the charges for the extraction of mineral resources, are described in Chapter 2. Data on actual payments made are included in Table 10.2, together with the 1997/1998 volumes of extraction.

Table 10.2: Volumes of extracted minerals and related charges, 1997-1998

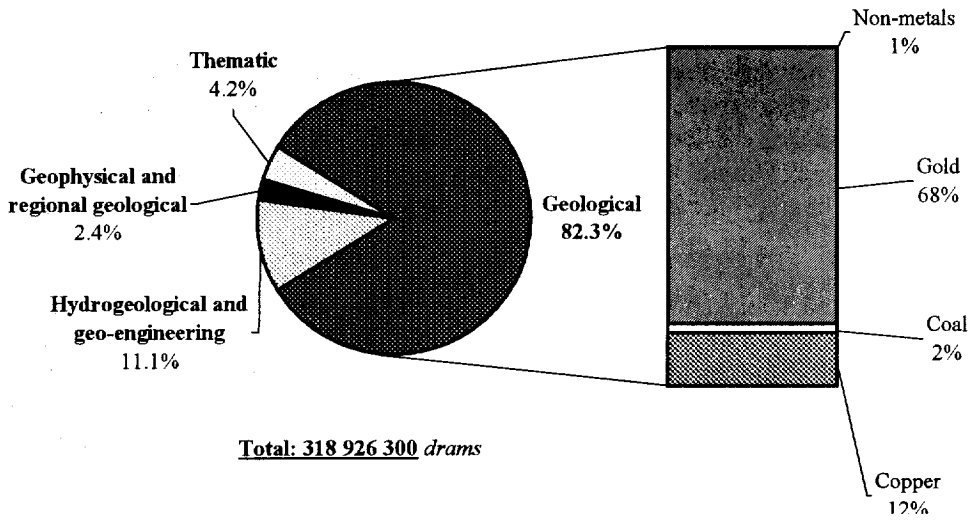
	Volume		Payment *Thousand drams*	
	1997	1998	1997	1998
Tuff *(1000 m^3)*	50.1	46.6	1 519.2	1 310.7
Cobble/Pebble/Sand *(1000 m^3)*	111.3	66.9	2 536.6	985.7
Basalt *(1000 m^3)*	103.7	48.7	317.0	1 707.2
Clay-gypsum *(1000 tonnes)*	11.5	9.9	453.6	124.0
Salt *(1000 tonnes)*	67.4	43.1	12 391.6	17 417.7
Copper-molybdenum ore *(1000 tonnes)*	2 493.8	372.2	81 915.1	9 303.9
Limestone *(1000 m^3)*	0.0	284.5	1.6	4 266.9
Marble *(1000 m^3)*	0.8	1.0	120.4	184.8
Granite *(m^3)*	313.1	153.9	41.3	24.0
Clay *(1000 m^3)*	...	172.0	...	2 666.1
Perlite *(1000 m^3)*	...	6.2	...	465.0
Travertine *(m^3)*	...	95.0	...	21.9

Source: Ministry of State Register and Statistics.

The users of underground resources are responsible for the environmental as well as economic rehabilitation of territories damaged as a result of mining and mineral processing. Environmental requirements for the construction and operation of mining and mineral-processing facilities include the reasonable use of accumulated ore tailings and of empty spaces created by mining activities. Obligations concerning safety and health measures to ensure the protection of workers, the population in general, the underground and the environment are also provided in the legal basis for the management of the underground.

Issues related to land, water and air pollution from the use of mineral resources are regulated by the corresponding laws. Mining companies that break environmental requirements have to pay pollution fees. The payments go to the State budget, and 10 per cent of the total amount should be used for geological exploration. At present, only a small percentage of total payments is actually transferred to the body responsible for geological exploration. See also Chapter 2.

Figure 10.3: Mineral prospecting activities by category and type of resource



Source: Ministry of State Register and Statistics.

Exploration for mineral resources is obviously a government objective. In 1998, 318 926 300 drams were spent on mineral prospecting, of which 68 per cent was used for gold, 12 per cent for copper, 1 per cent for non-metal minerals and 2 per cent for coal exploration works (Figure 10.3).

Institutions

The Ministry of Nature Protection defines State policy for the protection and rational use of mineral resources. Four of its departments are involved in mineral resources management. The Department of Geology undertakes the budgetary geological exploration works. The Department of Mineral Resources draws up strategies, programmes and laws on the issue. Permits for mineral resource exploitation are awarded by the Department of Underground Protection, which is also responsible for environmental requirements in mining. The National Geological Fund manages the State Register, a geological database of reserves, deposits and occurrences of useful minerals, according to periodical reports submitted by users.

These institutions work in cooperation with the State Inspectorate of Nature Protection and the State Environmental Expertise. The State Inspectorate is in charge of environmental control during the development of mining works. It has 125 inspectors, of whom 27 are exclusively devoted to the supervision of mineral resources. The State Environmental Expertise conducts the expertise of mining companies, in the process of permitting the allocation of land to mineral exploitation. Areas of recultivation are subject to environmental expertise as well.

The Ministry of Industry and Trade issues licences and permits for mineral exploitation. Two of its main departments, the Department of Mining and Metallurgy and the Department of Non-Metal Resources and Construction Materials, are involved in mineral resources management.

The Commission on Subsoil Minerals is responsible for the development of methodologies and standards for the sustainable management of mineral resources, including procedures for feasibility studies and the evaluation of reserves. It also developed and implemented a new classification of mineral reserves based on the United

Nations International Framework Classification for Reserves/Resources, which differs from the methodology in force in the former Soviet Union.

Environmental monitoring and information systems

Environmental monitoring has drastically decreased during the past ten years for lack of economic resources. The Environmental Monitoring Centre is the main institution in charge of air, water and soil monitoring in Armenia (see also Chapters 1, 8 and 9). The monitoring network for surface waters in the Kapan and Kajaran mining regions consists of 8 observation sites and in the Agarak area of 4 observation sites. Since 1997, no effective monitoring of surface and groundwaters has been undertaken.

The Department of Geology's network monitors exogenous geological processes and also controls the regime of groundwaters in about 26 observation sites. 60 per cent of the Armenian territory is prone to natural geological processes like landslides, erosion and mud flows. Some 59 800 hectares are affected by landslides, mainly in the Idjievan, Tavush and Dilijan regions. Given the natural geological conditions of the country, more effective monitoring seems to be necessary to prevent dangerous trends in the development of these processes. See also Chapter 6.

The Environmental Research and Management Centre of the American University of Armenia has developed an information database using a geographic information system (GIS). Although it is still in its infancy, the introduction and use of a GIS represent an advance towards the generation and dissemination of reliable environmental data in Armenia. Current projects being developed at the Centre include the mapping of metal contamination in the air, water and soil in the main industrial and mining regions and assessing its environmental and health risks.

Box 10.3: Projects relevant for the management of mineral resources

An ambitious project for the development of the environmental monitoring system in Armenia was proposed in 1996 by UNDP, and expected to be funded by the State budget and financing organizations. The project, with a total cost of US$ 500 000, has not been implemented so far due to the lack of funding. Its main goal is the drawing-up of a national programme for the development of comprehensive monitoring of natural resources, including mineral resources, and its legal basis. It also foresees the creation of an ecological database and the introduction of GIS software for its management. The Monitoring Centre also prepared a programme to improve its network, which was not implemented for lack of finance (for details see Chapter 1).

A project in the energy sector, funded by USAID and other foreign donors, including Japan, the European Union and the World Bank, aims at developing a more economically sound and environmentally sustainable energy system. It focuses on the improvement of energy efficiency and institutional instruments to promote market reform. Within the framework of the project, the United States Geological Survey is providing assistance to the Ministry of Nature Protection to implement a modern and more effective coal exploration programme in order to enlarge the country's reserves. The total project cost is estimated at US$ 8 million.

10.4 Conclusions and recommendations

Armenia has undertaken efforts to modernize its legal system in many areas. Regarding mineral resource management, many of the legal instruments of the former Soviet Union still prevail. Given the economic importance of its underground resources, an update of the current environmental legal basis for the use of mineral resources, including environmental expertise procedures, as well as stronger institutional and economic instruments, are important requirements for improving the management of mineral resources, which should be given top priority. The finalization of the regulatory framework for environmental impact assessments in the mining sector is paramount in this respect.

A review of existing legislation with regard to the methods used in calculating some charges and fees is also urgent. Payments for mineral extraction are currently based on the type, volume extracted and price of the resource. They do not take into account the geological particularities of deposits, the scarcity of the mineral resource or exploitation conditions. Special attention should be paid to the introduction of more differentiated charges, which are adapted to the type of both mineral resource and deposit.

Recommendation 10.1:
The current legal and regulatory basis for the management of mineral resources should be updated. The revision should include the preparation of detailed guidelines for environmental impact assessment in mining, and the introduction of more differentiated payment schemes for the use of mineral resources.

Given the importance of an efficient and environmentally sound management of mineral resources, special attention should be paid to their rational use and protection. However, environmental issues in the mining and metallurgical sectors are not covered in the NEAP, leaving an important gap in the improvement of the national environmental policy. Putting an end to the neglect of these sectors will permit the country to increase its economic potential in the near future. This is also feasible if the recommended early revision of the NEAP is implemented (see Chapter 1).

Recommendation 10.2:
Realistic medium- and long-term policy objectives and environmental strategies should be developed for the mineral sector as a top priority. These policies and strategies should be included in the NEAP as soon as possible. See Recommendation 1.5.

Although Armenia has a great mineral potential, its mineral basis is not well documented and reserves are sometimes underestimated. To expand the country's mineral base and increase the efficiency of geological exploration, an autonomous body should be created to reinforce the institutional framework for the management of mineral resources. Its main functions should be mineral exploration and the monitoring of natural geological processes. The restructuring of some institutions directly involved in the management of mineral resources should be critically considered. Their main responsibilities and tasks need to be reviewed so as to improve their work performance. In addition, the installation of modern computing equipment is vital to provide the reliable information that can ensure sustainable management practices in the mineral sector.

Recommendation 10.3:
The creation of a geological survey is a prerequisite for the introduction of modern management of mineral resources in Armenia. Technical assistance, modern computing equipment and staff training will be essential to achieve its important tasks.

As environmental monitoring is reduced and analytical techniques, laboratory equipment and standards are inadequate or outdated, there is a general lack of accurate environmental information in Armenia today. The introduction of specific methodologies and geographic information systems seems necessary to develop and manage an efficient database. Harmonization in data collection and analysis will permit environmental information assessment at both national and international levels, promoting a more sustainable management of mineral resources. To reach these objectives, the responsibilities of the environmental monitoring agencies should be clarified to avoid overlapping and some restructuring may be necessary to increase efficiency. See also Chapter 1.

In general, Armenia's information network is currently in a poor state and legal instruments for its management are non-existent. Environmental monitoring is the main source of data collection and analysis for further use in decision-making. However, most of the environmental data in Armenia are based on official inventory statistics rather than on sample analyses. In mining regions, the monitoring of heavy metals and other hazardous substances is limited. Consequently, air, soil and water qualities have not been well assessed there. An accurate assessment of the extent of metal contamination due to mining and mineral processing is hampered by the lack of reliable data. The current data collection and processing methodology, as well as the instrumentation, are often inadequate. There is also a need to quantify the release of individual metals, and to determine their sources and spatial distributions. These are the first steps in assessing metal contamination and its environmental and health impacts.

Recommendation 10.4:
All existing possibilities should be used to allocate the necessary funds to modernize and enlarge the monitoring network, increase its concentration in mining regions and modernize laboratory equipment, analytical techniques and standards. See Recommendation 1.7.

Armenia has to handle serious environmental problems associated with the exploitation of mineral resources. The present situation can be considered the result of many years of inadequate environmental strategies and management practices in the mining and metallurgical sectors. Soil, water and air pollution and its health, social and safety consequences represent major environmental issues in Armenia's mining areas. Large volumes of tailings from past mining activities, notably in the Alaverdi copper district, have been accumulated and abandoned. At the same time, the active mines in the south, for instance in the Kapan and Kadjaran regions, produce large amounts of mining tailings and effluents that do not receive any kind of treatment before discharge into local ecosystems. An accurate inventory is required of the hazardous environmental impacts of mining, as a precondition for the development of sectoral strategies to promote environmental protection and public health.

Recommendation 10.5:
An inventory should be established of environmental problems in mining regions, in particular of the volume and quality of tailings and waste-water discharges, and of areas damaged by mining activities. It should be used to guide feasibility studies for old and recent tailing reclamation, as well as to evaluate the extent of soil, water and air contamination in these regions. *See Recommendation 7.3.*

International environmental restrictions are becoming increasingly severe and emission discharge limits have decreased, making the introduction of cleaner, environmentally friendlier metal-production processes necessary. For example, the implementation of a cleaner copper production will be essential to get environmental certification, which may in the future be demanded by copper markets. In this context, a gas capture system could play an important role in copper smelting due to the need to control not only sulphur dioxide emissions, but also the highly toxic arsenic trioxide. A cleaner metallurgical production of copper should envisage an increase in gas capture levels, a reduction in the sulphur content in the concentrates and associated acid production by smelter decontamination plants.

Therefore, pollution control technology, environmental policy implementation and the enforcement of environmental standards need to be more rigorous to protect the environment and human health. Mining and mineral processing constitute potential sources of environmental pollution, unless operations are carefully designed and managed. Every step of mining and processing operations should be controlled to promote an efficient use and protection of the related mineral resource. An environmental management system (EMS) should help to identify the methods and procedures that a company should use to reach policy objectives and environmental targets, such as tailing management practices, water and air treatment facilities, mining techniques and land rehabilitation plan.

Recommendation 10.6:
An environmental management system according to international mining standards and practices should be adopted as a requirement for licences and permits for mineral exploitation. A gradual introduction of cleaner technologies in mining and metallurgy, and the training of staff at all levels of mineral resources management should be envisaged as well.

PART III: ECONOMIC AND SECTORAL INTEGRATION

Chapter 11

ENVIRONMENTAL CONCERNS IN AGRICULTURE

11.1 The situation of agriculture

Natural resources

Armenia is a landlocked country with a great variety of relief, soils and climate. Its altitude ranges from 400 m (in the Araks and Debed valleys) to 4 095 m (Mt Aragat). Its cultivated land is located between 600 and 2 500 m, with 51 per cent of its area on slopes of 3° to 7°, and more than 22 per cent on even steeper slopes. There are thick layers of fertile soil in the valleys and on the plateaux, and coarse shallow soils, subject to erosion, prevail on the mountain slopes. The slopes of the wider valleys form terraces. The climate varies from dry subtropical to mountain tundra climate, and temperatures can range from -41° C to + 42° C. Annual rainfall is about 500 mm, ranging from 114 mm in the semi-desert zone to about 900 mm in the high mountains. Rainfall is the lowest in the hottest months (August and September), when evapo-transpiration is at its highest. Rainfall is inadequate for cultivation in many areas and irrigation is widespread. The combination of topography, altitude, climate and soil conditions determines land use for either cultivation or grazing.

Armenia has a long tradition of agriculture, with records dating back to three or four centuries BC. It is characterized by a rich diversity of crops, which is conditioned above all by the climate and terrain. Armenia is furthermore considered as the primary gene centre for a number of cultivated crops. Cattle breeding also goes back a long way, and Armenia is known for the wild ancestor of sheep, the mouflon, numerous domesticated sheep breeds (Mazekh, Blabas, Karabakh and Bozakh), as well as goat breeding (Kilikian semi fine wool).

Overall, agricultural land does not enjoy high natural fertility, and agricultural activities over thousands of years have also greatly affected the soil. The most suitable zone for crops is the steppe characterized by deep, well structured chernozem soils and the semi-desert with its high proportion of irrigated alluvial brown soils. Half the arable land is served by irrigation systems, and 80 per cent of the crops are grown on irrigated land.

Use of agricultural land

With 1 391 400 ha, the agricultural land covers 46.8 per cent of the total area of the country. Only 16.4 per cent of the land is arable with 483 500 ha for annual crops (35 per cent) and 74 700 ha (5 per cent) for permanent crops. Vineyards (3 per cent of all agricultural land) and orchards (35 per cent of Armenia's orchards are in the Ararat valley) are economically important. Although considered as a minor economic sector, livestock raising is practised all over the territory. Hayfields cover 139 000 ha or 10 per cent of agricultural land and pastures 693 500 ha or 50 per cent.

Armenia's agriculture is traditionally highly specialized. Today the focus is on wheat and barley, cattle and sheep breeding, wine grapes, apricots, peaches, quinces and walnuts. Potatoes and tobacco are also important. Conditions in Armenia are also favourable for the production of technical plants rich in ether-oils (geranium, rose, and peppermint, and speciality teas). Armenia's fruits are considered of superior quality, and its vineyards are famous for their cognac and other liqueurs.

Box 11.1: Small and large farms in the irrigated plain

Small vegetable/fruit growers in the Ararat valley. Ania and Petia, and Giegan and Giulietta operate with their families 0.5 ha of irrigated land each in the district of Artashot. Petia used to be a car mechanic and Giegan a worker in a cement factory. Their wives have no specific training. Both lost their jobs with the crisis and turned to agriculture with the newly distributed land. While Giegan grows vegetables (cucumbers, tomatoes, beans) and wheat, because it is easier to do, Petia specializes in fruit (102 apricot trees on 0.2 ha and grapes on 0.3 ha) and next year will discontinue the vegetable crops he was growing between the young apricot trees. Agricultural work is performed by hand, except for ploughing and preparing the sowing bed, for which machinery is hired from another, equipped villager. Fertilizers (N, P, K) and pesticides are used and applied according to their personal experience and the actual aspect of the crop.

The products are sold on the market of Yerevan, sometimes directly by the farmers themselves, sometimes by a retailer for a commission. Petia tries to avoid delivering to the wine factory, or does so only at the end of the harvest: since it has been privatized, prices are not stable. Giegan could grow vegetables after the wheat harvest, but he does not do so, because the market would not absorb his production.

Future prospects are uncertain. Giegan's son will return to his father's farm after his national service, and Petia thinks that his son (now 15) will take over his land, because there is nothing else he can do. If agricultural land were available for sale, Petia would like to buy it for his son. Both families cannot afford training for their sons, agricultural or otherwise.

An agricultural entrepreneur in the Armavir region. Kamo graduated from the Academy of Agriculture, heads a former kolkhoz, and is the mayor of the village. Lena, his wife, is a maths teacher. The two operate a farm 19 ha (7 ha are rented from a neighbour), irrigated by artesian water. They have 3 employees. Their main product is wheat (12 ha of an American variety) followed by fodder crops (2 ha of lucerne and 3 ha of pasture) for their 20 meat and milking cows (average 5 000 kg milk per lactation). They also grow vegetables (1 ha) and water melons (1 ha). Kamo and Lena stopped growing tomatoes, because the processing factory was closed two years ago. The farm produces trout (5 tonnes/year) in artificial basins, with running water. The wheat is sold to mills, the vegetables, watermelons and cheese are sold on the Yerevan market (they plan to open a small shop), meat to cattle merchants, and milk to neighbours. They also barter, for instance watermelons in exchange for potatoes from the Lake Sevan region. Besides animal manure (liquid manure is not collected), the use of agrochemicals is limited to ammonium nitrate because of costs.

Already an exception in today's Armenia, Kamo wants to be a successful farmer. He is sorry that he cannot use his full production potential. He would like to buy land, build greenhouses to work all year round, produce much more fish, and hire another 12 workers. Agricultural credits are difficult to obtain (only flats in Yerevan are accepted as collateral), and he expects the Farmers' Union to manage agricultural credit. Of course, his son (now 15 with a special gift for animal breeding) will take over, after training at the Veterinary School. If he obtains good marks, his studies will be free of charge.

Kamo expects the Ministry of Agriculture to create the legal framework to control the quality (both nutritional and ecological) of his products as well as of imported products. And both the Ministry of Agriculture and the Farmers' Union are expected to help marketing and creating the necessary links for exports. He does not need agricultural extension services.

Farm structures

Table 11.1: Farm structures and livestock

		Rural households a/	Collective farms a/ b/	State land
Number of farms		319,300	273	...
Total surface	*ha*	434,248	17,852	245,800
Average surface	*ha*	1	66	...

		Private farms and private plots" c/		Cooperative farms c/		Collective / State farms c/	
Cattle	*thousand*	306	*61%*	178	*36%*	15	
Sheep and goats	*thousand*	648	*74%*	203	*23%*	22	
Pigs	*thousand*	22	*26%*	23	*27%*	39	*47%*

a/ *Source*: UNDP Report on rural households. Figures differ from those of the Ministry of Agriculture (oral communication).

b/ Those farms must be considered as new, private cooperatives. Land still owned by the State is not included.

c/ Defined as such in "Biodiversity of Armenia".

The privatization of land started in 1991, even before the break-up of the Soviet Union (Law on Peasant and Peasant Collective Farms, 1991), and 72.2 per cent of Armenia's arable land had been privatized to the rural population by late 1993 (65.2 per cent of arable land, 78.4 per cent of perennial orchards, 57.3 per cent of hayfields). Land that belonged to kolkhozes was distributed to families, with shares allocated in proportion to family size. However, pasture land (half the agricultural land) remains under State ownership and is managed by self-governing communities. About 320 000 individual farms were created in the process, becoming the dominant form of farming, producing 95 per cent of agricultural output. The farms hold an average of 1.2 ha (0.9 ha of arable land and 0.3 ha of orchard). 20 to 35 per cent of agricultural land is still in a "State Fund" and is destined for the creation of larger farm enterprises (15-25 ha). Structural details about farms and livestock are the subject of Table 11.1.

Box 11.2: New farming structures on a former kolkhoz in the northern hills

There are 24 collective farms (from 30 to 400 ha, average 120 ha) and 32 000 private farmers (around 1.5 ha each) in the Lori *marz*. The land was distributed per head and the surface depended on the total surface available in the village. Collective farms usually grow only crops (an exception is one farm of 100 cows). There is little animal farming (2-3 cows/family); only some private farms may have up to 50 cows.

A farmers' association. Ara, an agronomist and former head of a kolkhoz, manages 120 ha of agricultural land (1 750 m altitude, 650-700 mm rain), without irrigation, belonging to 23 families, who are the members of the farmers' association that was created just after the decollectivization of part of the 460 ha former kolkhoz. In addition to the land, the cattle was also redistributed (7 cows per family but only 2-3 could in the end be kept). The association employs its members and villagers for the potato harvest. The main products are wheat (45 ha), potatoes (45 ha) and barley (12 ha), with lucerne (15 ha) and oats (3 ha) on marginal lands. On deep soils wheat alternates with potatoes, while on shallow soils only wheat and barley are cultivated. Plots are scattered but they are large enough for contour farming and to protect the land from erosion. Lucerne and shrubs are planted on the erosion-prone land. Only N-fertilizers are used (only for wheat and potatoes) and no phosphor, potassium or micro-elements because of their cost, but animal dung is recovered. Pesticides are also used to a limited extent.

Wheat is sold to mills and potatoes to the Ministry of Defence. These products are also distributed or used as payment to the members of the association (providing food for their families and their animals, especially pigs) and kept as seeds for the next harvest. Because of the high yield of potatoes (as compared to wheat) and an existing market outlet, Ara would like to develop their cultivation, restore irrigation facilities that cannot be run because of a lack of energy, and try new, more productive Dutch cattle varieties.

A private specialized enterprise. Besides the farmers' association, Ara has also founded with two friends an animal unit for breeding cows (15 cows, 7.5 cattle units of young cattle) and for fattening pigs (40 pigs). The small cows belong to the common Armenian cross-breed between the Caucasian breed and the Brown Swiss, introduced back in 1927. They weigh 400 kg and they produce 2 100 kg milk per lactation. Milk is sold to a milk factory in town and animals for meat to cattle merchants. This unit uses its private hayfields, fodder provided by the farmers' association and graze the common State pastures in the summer.

A large private farm. Ruben, former mayor of the village, established himself with his family (wife, 3 sons and 2 daughters-in-law, 2 grandsons and his mother) and one employee as a private farmer on 8 ha (5 ha are rented). In terms of his farm's size, he belongs to the upper class of the rural households. His wife used to teach in the kindergarten of an enterprise that closed down. He cultivates wheat and potatoes in rotation, but had poor harvests due to the lack of rain in the past two years. Ruben has 2 tractors and some old machinery, but complains about the price of fuel and the lack of spare parts. For his crops, he uses only animal manure (stocked on the field edge). There is no collection of liquid manure. He has a herd of 25 cows (14 milking cows, with 2 300 kg per lactation) and 15 pigs. Commercial links are the same as above, but own consumption (cheese, butter, milk) is important, and his wife produces everything for the household in her garden. In the 6 summer months, cows graze the State pasture; they are fed hay in the winter. Previously, the cattle of the kolkhoz was transported far away to mountainous pastures. Now, there are fewer animals but all of them are on the pastures around the village. Erosion problems on those pastures are not so bad according to Ruben, but «should not get worse».

Rural employment

Armenia's rural population has been stable at around 31 per cent for some 20 years. Agriculture employed 15 per cent of the active population in 1994, 25 per cent in 1996, and became the largest employer in the country with 41 per cent of employment in 1997. Employment declined in all other sectors. The main share (63 per cent) of employment in agriculture remains seasonal, and the number of jobs per ha is higher on small than on large farms.

Economics and production of crops and livestock

As a predominantly mountainous country, Armenia has little arable land and therefore relies heavily on imports from the former Soviet republics for its food, including 65 per cent of its demand for grain and 65 per cent of its demand for dairy products. Armenia remains a large food importer and used to be heavily dependent on humanitarian aid. In 1995, almost half its population received USAID-funded food assistance and, in 1997, food made up the largest share of imports. Slightly more than 30 per cent of the US$ 893.4 million worth of humanitarian assistance was for food. It should be noted that official statistics are generally thought to be unreliable. The figures presented here were collected from different sources and do not always tally.

By the year 1995, agriculture had declined by 30 per cent, other sectors by 75 per cent compared to 1990. Agriculture's overall contribution to GDP grew from 12.6 per cent in 1990 to 27.9 per cent in 1997. The land reform implemented early in the transition boosted agricultural production by 15 per cent. During the most acute period of the economic blockade (1992-1995), there was only a slight decrease in agricultural production. Since that time, agricultural output has fluctuated but overall remained flat. In 1997, agriculture declined by 6 per cent, whereas GDP grew 3.3 per cent. The GDP share of agriculture is expected to stabilize around 30 per cent in the next 15 years. Crop yields have markedly reduced since 1990, as farming suffers from a lack of inputs and support. The crisis has closed the traditional markets for horticultural crops, and food-processing activities have decreased markedly.

Crops account for 56-58 per cent of agricultural GDP. Not all land classified as arable is under cultivation. For example, in 1996, only 69 per cent of the arable land was cropped because of the difficulties the farmers experienced in meeting tilling, planting and irrigation costs, and because the surface of irrigated land had fallen due to the poor maintenance of irrigation systems and the high energy costs of pumping. The sharp reduction in irrigation land (55 per cent between 1990 and 1995) was also aggravated by shrinking exports to the former Soviet market. On the whole, a considerable amount of land (80 000 ha in 1996) was left fallow because it was not profitable or because of a lack of irrigation.

In reaction to the high price of irrigation water, some farmers are said to have started to grow crops that need less water. On the other hand, a shift in land use has taken place from marketable cash crops to subsistence crops. As a result, vineyards and orchards dropped by half, and some local varieties might be lost. Also, tobacco, sugar beet and geranium production stopped, but the surface of cereals increased between 1990 and 1996 by 34 per cent, that of potatoes by 45 per cent and of vegetables by 18 per cent.

The efficiency of agricultural land use has reduced. The decline in crop yields is general and is the sharpest in cereals and vegetables. The maintenance of orchards and vineyards has declined. Even before the transition (1985), wheat yields reached 20 q/ha (1997: 16 q/ha) and potatoes 150 q/ha (1997: 135 q/ha), probably because not all surfaces can be irrigated (bogar).

Armenia was struck by an exceptional drought in the autumn and winter of 1998-99, affecting winter wheat (75 per cent of the fields were more or less affected and 50 per cent needed to be redrilled with summer wheat) and orchards (less than half the normal production).

Historically, the production of cattle and sheep was based on extensive summer grazing and winter foraging, with harvested hay and manufactured feedstuff. Pigs and poultry, which were raised intensively on imported manufactured feed, are now part of the small agricultural household, raised partly on a free range basis (pigs in woodlands), with a much lower output.

Livestock production made up 55 per cent of agricultural output in the 1980s. This share declined rapidly after the land redistribution, especially in the pig, poultry and sheep populations, which were more than halved between 1986 and 1997. By contrast, the horse and donkey populations increased by 500 per cent, suggesting greater dependence on animal traction on small farms. Dairy is the main production and 37 per cent of the meat is produced in the country. While sheep and goats – and bovine cattle to a lesser extent (see Table 11.1) – are mainly raised on family farms, the majority of pigs are raised on larger farms.

Markets

The loss of income, together with the structural problems of the sector, has increased poverty among the farming community. Farmers cannot afford investing. Agricultural production is primarily aimed at sustaining the farmers' families, private farms selling 30-40 per cent of their produce. Thus, agriculture is often more a question of family survival than a profitable economic activity.

Armenian agriculture's main problem is the lack of a market. It suffers as a result of the high unemployment rate (officially 10.8 per cent in 1997) and general poverty. The monthly cost of a basic consumer's basket is more than twice the average salary, and those in the highest 10 per cent income bracket still spend 53.5 per cent of their income on food. Besides, domestic market links are bad. Purchasing organizations play an insignificant role, and farmers try to sell 37.9 per cent of their sales volume directly to consumers, because wholesale market services pay too little. On the other hand, Armenia's agricultural potential in specialities can only be exploited with the help of exports, as the domestic demand of a relatively small population is too small and the population too poor.

11.2 Major environmental issues in agriculture

Agro-biodiversity and habitats

Armenia contains extremely diverse natural landscapes and ecosystems (for details see Chapter 5). Significant bogs and wetlands are situated in the Ararat valley, and in Ashotsk and Gegharkounik districts. Due to the pressure of artesian groundwater and flooding of the Araks river, there used to be more than 1 500 km^2 of wetlands and swamps in the Ararat valley. They were drained (in 1953-1955) and used for irrigation crops, causing fluctuation of the water level, and intensively grazed. In those districts (Ararat, Zangezur, Meghry), only 35 per cent of the area once covered by natural ecosystems is conserved, the remaining 65 per cent are converted to agriculture. Typical wetland vegetation disappeared on a large scale as well as several wildlife species.

Land reclamation for agricultural purposes and grazing pressure are not only destructive for valuable semi-natural habitats, but they also put in jeopardy wild herbivores. The excessive and uncontrolled use of agrochemicals, as non-point sources of pollution especially in the Ararat valley (fertilizers causing eutrophication of water bodies and pesticides having an adverse effect on other species), is an additional threat to biodiversity in agricultural habitats. This problem is less acute in areas of Armenia where village and subsistence agriculture prevail.

The protected area network of Armenia is strongly biased towards the conservation of forests, while other ecosystems, particularly wetlands, are not well represented (see also Chapter 5) and only a small proportion of the State reservations have actually been established. Some of them are converted to agricultural use or subject to overgrazing.

Armenia's agro-biodiversity must be seen against this background. The highly regulated past agricultural policy did not contribute to the conservation of traditional species and crops. However, these plants' genetic resources have long been recognized as having great, global importance for the conservation of agro-biodiversity. Its main components are:

- useful wild plants (60 per cent of Armenia's flora)
- wild relatives of cultivated plants (16 per cent of Armenia's flora)
- local sorts of cultivated plants
- fodder plants of natural hayfields and pastures

The *semi-desert* area is covered mostly by ephemeral plants and is the original habitat of wild relatives of domestic crops, among them wheat *triticum sp.* (13 species, 360 varieties) and rye *secale sp.* These species have played a major role as sources of genetic material for the improvement of crop varieties and still have an important potential value for future genetic selection. Natural semi-deserts of particular floristic composition

Figure 11.1: Rough mapping of the agricultural regions and environmental threats



Sources: Map of the major administration units, Natural soil zones of Armenia, GEF-Project on Climate change.

have been largely converted to agricultural land. *Dry mountain ranges* are also very rich in plant species, with wild relatives of some important fruit trees, among them grapes and pears.

The *meadow steppes* are home to hundreds of wild plants collected and used for traditional dishes or as aromatic plants, as a source of vitamins and medicines, or essential oils, or for dyeing. Some of these plants are on the brink of extinction due to excessive harvesting by local people or by traders. Harvesting was greatly increased due to the sharp rise in food prices during the recent recession and war. Often the extraction technique (uprooting) furthers plant extinction.

On the other hand, it seems that only a restricted number of species are used by the population compared to the number that are potentially of interest. For instance, about 100 species of edible plants are harvested now and 30-40 widely used. Yet, their number was 480 at the beginning of this century. A survey in a Yerevan market in 1995 showed that 14 species of wild fruit berries were harvested of a potential of 50, and the result for aromatic and medicinal plants was similar.

Landslides and erosion

Land erosion affects on average 45 per cent of the total area. Landslide processes affect nearly 60 per cent of the territory. Losses of grain production due to erosion have been assessed at 50 000 to 60 000 tonnes per year. Soil erosion in Armenia is primarily induced by rain and affects both cultivated and pasture land. Noticeable wind erosion seems to take place in steppe zones in some parts of the country. Other sources do not qualify wind erosion as being a large-scale problem. There seems to be no agreement or figures about its scale.

Box 11.3: The grazing problem in Armenia

Natural fodder land in Armenia covers 137 000 ha of hayfields and 682 000 ha of pastures, i.e. about 60 per cent of all agricultural land. The area covered by rangeland exceeds by five times that of haying areas resulting in severe hay shortages during the wintertime. Armenia's pasture land is situated on three altitude levels: (a) the steppes (1 700-2 300 m) with a high vegetation cover and rich flora, (b) the meadow steppes (2 300-2 800), a mixture of both types of vegetation used for summer grazing, and (c) alpine and subalpine meadows (2 800-3 300 m) (28 per cent of Armenia).

The situation of much pasture and hayland is far from satisfactory. Steady overexploitation during the past 50 years has led to a 25 per cent decline in their productivity. Consequently, they cannot feed the calculated potential of 500 000 head of cattle, i.e. the equivalent of Armenia's bovine herd in 1995. Half the pastures (60 per cent) are strongly eroded and their productivity is down by a factor of 1.5-2, compared to 1930. Especially overgrazing in significant areas of the alpine and subalpine meadows has caused the overall decline in productivity and the disappearance of important and desirable plant species. An additional problem of those areas is the disappearance of vitamin plants, which are being replaced by less desirable species that are more resistant to grazing.

In transition, the number of cattle was drastically reduced, and the average density of cattle per pasture area is now considered close to the ideal. The other impacts of changes in livestock management since independence are due to increased transport cost. The grazing pressure in the vicinity of the villages is increased, and that on high and remote summer pastures reduced. In the "winter" pastures near the villages (mainly steppe and subalpine zone), grazing seems to be practised as much as possible all year round, bringing those surfaces close to complete degradation. By contrast, the lack of grazing pressure in abandoned remote pasture land (alpine, and often subalpine and steppe zones) is helping them to recover fast from previous overgrazing and erosion. But in the future, the lack of minimum grazing pressure may bring undesirable changes in the botanical composition and a decrease in their fodder values (growth of bushes).

The overall grazing pressure is expected to double or triple, mainly in the vicinity of human settlements as a result of land privatization, and ought to be regulated. Measures should be taken especially for sheep and goats, because of their specific grazing pattern. Erosion due to the improper use of pastures by sheep is a serious problem in all mountainous countries. Sheep can reach high land, inaccessible for bovine cattle, and quickly destroy the vegetation. Sheep also often compete with wild species, such as the mouflon, the wild ancestor of sheep in Armenia (*see the "Mouflon Programme" by the Animal Kingdom Protection Union, 1999*).

Regulations were issued by the Ministry of Agriculture to define the time of access to summer pastures and the stocking rate for State farms and farming cooperatives on State land, but the implementation of these regulations was not controlled. Regulation 282 of 16 April 1999 contains the necessary legal provisions for the management of remote winter and summer pastures, which are now under the management of local executive committees. Tenants that are legal persons, such as associations, etc. (art. 7), must sign contracts (art. 56) and pay fees (art. 33). The number of head of cattle must be established (art. 4) and respected (art. 33), and the contract has to be reviewed if there is a violation of pasture use or livestock number (art. 33). The government policy of retaining extensive pasture land under State ownership should help the enforcement of better grazing systems.

Of the agricultural land, 60 per cent are affected and 80 per cent are considered at risk of erosion. Soil loss is estimated at 0.3 tonne/ha/year, mainly from pastures (36 per cent), of which 49 per cent is caused by grazing, and from arable land (25 per cent). Brown soil regions are the most severely affected, up to 90 per cent of the land in some regions (Ararat, Aparan, Vayk, Eghegnadzor, Sisian, Kapan, Mehgri). However, current rates of erosion on agricultural land cannot be precisely determined, but a qualitative assessment for arable land is available by type of soil in Table 6.5.

Soil erosion is considered the main problem in the meadows and the steppe zones, where the erosion problem is the most severe. Cultivated areas are affected by moderate erosion with the gradual removal of the most fertile fraction of the soil, which will have a negative and irreversible impact on soil fertility and yields.

On cultivated land, erosion is caused by degradation of the shelterbelts and inadequate agricultural practices on slopes, including the expansion of irrigation to steep slopes like in the mountainous steppe of chernozem soils, or in regions with fragile soils like in dry steppe, or by extensive and inadequate use of irrigation (in the Ararat valley, 5-6 per cent of the agricultural land). Excessive irrigation may initiate the process of solifluction of subsurface layers, causing landslides or soil creep. Agricultural land may be affected and should be protected against soil creep and flash flooding coming from overgrazed and eroded pasture lying above them. See also Chapter 6.

Besides natural erosion (on high summer pastures), erosion on pastures occurs due to excessive stocking densities and grazing during the past 40-50 years in early spring, when vegetation is still fragile. In pastures, water erosion is concentrated in the vicinity of cattle tracks. The compaction of the patches leads to the formation of small water streams with serious eroding effects, especially on brown soils. At present, erosion is considered to be the most severe in non-cultivated areas with intensive livestock grazing, but the slow erosion process on cultivated land with the depletion of the most fertile fine particles should not be overlooked.

Soil fertility and compaction

There was a sharp increase in the use of imported fertilizers in the early 1980s. However, it fell by about 99 per cent between 1985 and 1994, because of a lack of supply of agrochemicals and their limited type and quality. Only ammonium nitrate (see Table 6.6) was used. Fertilizers are used well below recommended levels, due to the farmers' limited knowledge about the fertilizer requirements of their crops and because of their high costs. Depletion of nutrients in the soil leads to reduced yields, to increased mineralization of the soil's organic matter, and to sparse plant cover, generating in its turn erosion. Besides, crop rotation practices have been abandoned (only wheat is sown), and production of pluri-annual fodder legumes such as esparcette and lucerne have dropped considerably.

On cultivated land, compaction (down to 60 cm) is due to the use of heavy machinery on saturated soils, often in combination with irrigation. This problem has diminished considerably since privatization, as heavy machinery is used less. Soils seem to be tilled more with animal traction. On pasture land, soil compaction is reported from early grazing just after the frost has broken, on pastures that are still excessively wet from recent snow, in the mountain and meadow steppe zone.

Drainage, irrigation and salinization

Armenia's rivers are mostly mountain streams, and fed in the spring by melting snow and rains (55-70 per cent of the total flow), and often go dry in the summer or can be drained completely for irrigation (like the Khazak river) during the growing season. 70 per cent of groundwaters are in the Ararat valley and the upper aquifer (<100 m below sea level) is used for agricultural purposes. As a result, the groundwater level fluctuates by 1 to 3 m during the year. Water from drained wetlands seems to be negligible. The northern and southern regions lack water reserves, and the main problem remains water distribution over the year, by contrast to the north-western slopes and western slopes, where groundwater is available throughout the year.

Agriculture can be considered the biggest user of water. On the whole, 2.3 billion m^3 of surface water is available each year for agriculture. The run-off provides 1.4 billion m^3 during the growing season, and 57 water reservoirs (capacity of 1.1 billion m^3) provide water in dry seasons, mainly for irrigation. Another 10 are under construction (396 million m^3), and 8 more are planned (460 million m^3). Armenia has more than a hundred lakes, artificial reservoirs and fish ponds, and Lake Sevan is an important source (about 250 million m^3) and the only strategic stock for irrigation water in Armenia. Another 300 million m^3 of groundwater are available.

The use of water for agricultural purposes peaked in 1985 and has declined since 1989. The surface of irrigated land amounted to 311 000 ha in 1985, but represented only 280 000 ha in 1995, and is now estimated at

217 000 ha. Correspondingly, the use of irrigation water dropped from 1.9 billion m^3 in 1990 to 640 million m^3 in 1995, because of damaged pumps and irrigation systems (Table 8.3). This amount is far less than the water available. Run-off river schemes irrigate only 54 000 ha, mainly in Armavir (30 000 ha). On average, irrigation efficiency is below 45 per cent, and may be as low as 30 per cent in certain regions. Even in 1989 it was only 58 per cent.

Because of the drought in 1998/99, the rivers used for irrigation carried 25-30 per cent less water, and the reservoirs were at only 30-40 per cent of their capacity in normal years. The water deficit was 600 million m^3, and only 127 000 ha could be irrigated.

34 000 ha of irrigated lands are drained, including about 8000 ha with underground clay pipes. Serious drainage problems exist in the Ararat valley. Sometimes the water table comes close to the surface up to 2 metres below ground), with waterlogging in places where the drainage system does not work. Such failure may result from lack of maintenance, causing salinization and alcalinization, through evaporation of the groundwater, of the soils offering at the same time a breeding ground for malarial mosquitoes. These processes are natural in the Ararat valley and could be controlled only by restoring the drainage system.

About 42 000 ha in the Ararat valley have soil salinity problems, of which 9 000 ha are severely affected, with a pH>9. This problem is related to irrigation, and in most cases to the water quality of Lake Sevan. Salinization problems are confined to the paleo-hydromorphic soils of the semi-desert zone, which are very saline (sodium amounts to as much as 62 per cent of all absorbed cations). Their pH values vary from 7.8 to 8.9. These lands are not considered to be reclaimable. The reclamation of saline alkaline soils with a saline content of 1-3 per cent and pH values from 9 to 11 is also difficult (only 17 per cent reclaimed) and must be maintained by continuous drainage with water pumps. Therefore 2 000 ha have already been left for resalinization. 6 000 ha are used for aquaculture. Another 17 000 ha are either partly saline or at risk of salinization if water management does not improve. See also Chapter 6 on drainage, irrigation and salinization.

Water pollution

Surface water and groundwater are of high quality, and pollution of agricultural origin is well below critical levels. The concentration of nitrates (both of sewage and agricultural origin) is not particularly high and meets all international standards. Water pollution peaked in 1985 and has declined since then due to the drop in industrial and agricultural activities, reaching the lowest level in 1995. The surface water and irrigation water that infiltrate the soil are a source of groundwater contamination. If the soil is polluted, leaching of pollutants will continue for decades. However, only a handful of water samples fail to comply with Armenia's applicable standard.

Although difficult to assess, agriculture is the main contributor to water pollution in several areas. The trophic level (N, P) is the main problem in Lake Sevan, and agriculture contributes several times more to nitrogen pollution than do domestic sources (see Box 8.1).

Until now, there is no water quality requirement for irrigation water. For instance, there is no effective quality control of water outflow from Lake Sevan -- the major water stock of the region -- which is used for irrigation. It should be mentioned that river water could well be used for irrigation, although it might be unsuitable for use as drinking water without treatment (See Chapter 8).

Use of agrochemicals

Concentrations of pesticides in soil, water or food are rarely observed. Neither from the point of view of health nor from that of soil protection is pollution with agrochemicals listed as a top priority. The use of agrochemicals has fallen substantially, but there is also much less control over imports and sales of potentially hazardous pesticides. Fertilizers were previously sold through State-controlled corporations, supplying collective farms. Now sales occur through small enterprises directly to the farmers in an unregulated market. There is no legislative basis for the use of agrochemicals. There is no up-to-date certification for agrochemicals, and they are marketed in unidentifiable bottles and containers. The effects of the use of agrochemicals on soil quality are covered in Chapter 6, as is soil pollution.

Contamination of foodstuffs

Excessive contamination with pesticides such as DDT, DDE, dieldrin, aldrin and andrin was found in 2.56 per cent of tested products, mainly in meat, with potentially adverse effects on human health through accumulation in the food chain. Insecticides, in particular, are classified as extremely hazardous substances. In agricultural regions like Ararat and Oktemberian, the most persistent agrochemicals are still found in soil, water and food. In the neighbourhood of industries and when they were all operating, the concentration of heavy metals (lead, cadmium) in agricultural crops exceeded by several times the maximum acceptable levels. They are ingested mainly through soil particles (for grazing animals), through the air, and by the uptake of water by various agricultural products. Molybdenum is toxic for ruminants, but copper and zinc are its antagonists.

Climate change

The energy sector causes 93 per cent of all greenhouse-gas emissions expressed in CO_2 equivalents. At present, research is being conducted in Armenia to determine the coefficients for methane emissions from agriculture. It is currently estimated at one third of total emissions. Half the total emissions of nitrogen dioxide are generated in agriculture by the use of urea as nitric fertilizer.

Deserts and semi-deserts are expected to increase by 33 per cent as lakes and wetlands dry up. Air pollution by current agricultural activities is of little significance and will probably not increase, as it can be expected that better agricultural practices will be adopted. The negative effects of climate change on agricultural yields were estimated for crops and livestock, but these figures are to be interpreted with caution. As for irrigation, it is considered that the application of a stimulating tax and tariff policy for natural resources would increase efficiency in energy use, reduce water losses and favour the introduction of gravitational irrigation.

Box 11.4: Integrated agro-business: a model for the future?

In 1993, after the earthquake, the « Agricultural Productive-Scientific State Stock Company OFMA » was created with a contribution from Sicily's Armenian Community. It belongs to the Ministry of Agriculture and cultivates 270 ha of a former kolkhoz with potatoes, wheat, but also barley, fodder beet, lucerne and esparcette.

It operates as a multiplier of seeds provided by UNDP and supplies 400 farmers of the region. The quality of sold seeds is controlled by the local agricultural authorities. It also produces chicken and chicken feed, and offers veterinary services, milk controls, cheese making, agrochemicals extension services and farm visits, with the collaboration of the Academy of Agriculture. Services are extended to about 100 farmers, members of an association, for the moment free of charge. It does not have links with the local office of Agrogitaspjure (the agricultural extension service), but it is in contact with the head of the regional administration.

The animal potential was planned at almost 500 bovines (200 cows), 1 000 pigs, 80 000 broilers and hens, with milk and meat production units (cheese, butter, meat, salami) and refrigeration facilities. It was conceived as a farm enterprise working in a closed circle, producing all the necessary means and recycling all the wastes. Milk-processing and slaughtering wastes would be introduced into self-produced animal feed (pigs, broilers and bovines in the winter; in summer, cows graze State pasture land), or sold to specialized industries like leather production. Solid and liquid manure are collected in slurry pits and used for fertilization. The enterprise went through the procedure of environmental expertise. It keeps a list of the agrochemicals it has used.

The farm went through a financial inspection and was found profitable in spite of the seed multiplication services. Another 400 ha of a neighbouring State farm are expected to be added to the company, because it has the potential equipment to absorb successfully more land.

11.3 Policy priorities and management

Legal instruments

The Water Code (1992) and the Land Code (1991) are the basic legislative texts to be applied to environmental protection and the use of natural resources in agriculture. The Water Code contains provisions concerning water use in agriculture, rules for discharging waste water into water bodies, and for the protection of water from pollution with fertilizers and hazardous substances. It specifies criminal and administrative sanctions for violation. The Land Code contains instructions for allotting land to agricultural enterprises, provisions for the

protection of land, and the economic principles promoting protection and rational land use. Monitoring of land conditions is foreseen, with provisions for responsibilities for violation of land legislation. The legal basis for enforcing the proper use and protection of agricultural land by its owners and users is laid down in the Principles of Legislation on Nature Protection (1991). It also specifies that persons guilty of wiping out species listed in the Red Data Books are subject to administrative and criminal sanctions.

The status and management of agricultural land is also covered by the Law on Specially Protected Natural Areas (1991). The new laws on flora and fauna will be relevant, too. A number of regulations of the Council of Ministers also apply.

The Law on Environmental Impact Expertise (EIE) of December 1995 is applicable also to agricultural activities. Due to the absence of sufficient implementing tools, EIE has not been undertaken (for details, see Chapter 3).

Institutions responsible for management

The Ministry of Agriculture manages and controls the use of land resources. The Ministry of Nature Protection is responsible for the allocation of water to the different economic sectors (see Chapter 8). It is alsos responsible for water and environmental protection. Environmental monitoring and enforcement of the laws take place at the level of the *marzes* by the State Regional Inspectorates, which can perform checks and decide to limit or prohibit the activities of enterprises or impose remedial action. No organization in Armenia currently has the resources to carry out a comprehensive environmental monitoring programme, so there are no data available to select realistic targets and priorities. For details, see also Chapter 1.

The agricultural extension service "Agrogitaspjur" was founded in 1993, based on the American system, with American specialists, and financed until 1998 by USAID. It employs 200 staff throughout the country in various agricultural specialities and seeks advice from research institute specialists. It provides traditional technical extension, directed at the intensification of agriculture. At present, its focus is on helping farmers to solve their problems under the new market economy conditions that have emerged since land privatization. The service collaborates with the Marketing Assistance Project (which is part of the Agricultural Reform Support Project financed by the World Bank). It also emphasizes teaching basic agriculture in schools in rural areas and rural development in general (home economics, youth clubs, agro-tourism, etc.). Besides field demonstrations and meetings, Agrogitaspjur publishes technical "fact sheets", its own newspaper ("Agrolratu"), articles in provincial newspapers, and it broadcasts a TV programme twice a month. Since 1999, funding has been transferred to the World Bank. The service is undergoing restructuring and will receive less funding. In the future, it seems that the extension service will be privatized and will provide the farmers with services for a fee (veterinary services, sales of agricultural inputs, field treatments and machinery services).

NGOs in Armenia recognize the importance of improving farmers' eco-agronomic knowledge, and a demonstration farm for sustainable agriculture (Gisane) was established in the Ararat valley.

Priorities and measures

The National Environmental Action Plan (NEAP) sets out both actual and potential environmental threats, by region, including the countermeasures to be taken. Tables 11.2 and 11.3 summarize these aspects of the NEAP. It includes suggestions for measures to mitigate actual environmental threats.

The Ministry of Agriculture has no environmental policy or instruments that take into account and integrate environmental concerns into agricultural policies. The objectives for agriculture are:

- To supply food for the population;
- To find export markets for agricultural products;
- To develop quality standards for foodstuff.

Table 11.2: Actual situation of environmental threats and measures in agriculture (by regions)

Planning zone	Semi-desert (5%) /Ararat and Armavir	Steppe (29 %)	Meadows (12%)
Climate	*Altitude : 850-1250 m* Rain : 250-300 mm Soil: irrigated brown soils	*Altitude : 1250-2450 m* Rain : 320-740 mm Soil: chernozems	*Altitude : 2200-4000 m* Rain : 750-1000 mm Soil : meadow soil
Type of agriculture	Orchards and vineyards Horticulture (irrigated) Pastures Animal farms?	Crops (irrigated and non irrigated): potatoes and wheat Hayfields and pastures Family small herds: cattle and sheep Animal farms	Hayfields and pastures Family small herds: cattle and sheep
Actual size of farms	0.6-0.8 ha	1.4 - 1.6 ha	3.0 ha
Actual environmental threats	1. Resalinization due to neglected irrigation and drainage systems 2. Disappearance of traditional orchard productions (grapes)	1. Erosion due to unsuitable plot structure 2. Overgrazing and subsequent erosion of pastures 3. Over-collection of wild species with uprooting	1. Overgrazing and subsequent erosion of pastures near the village 2. Over-collection of wild species with uprooting
Measures	1. Plantation of salt resistant species 2. (a) In situ conservation (mini-reserves) (b) Eco-labelling of agricultural products of Armenian varieties	1. (a) Promotion of tilling associations (larger plots) and land tax relief for anti-erosion measures. (b) Enforcement of legal provisions concerning land use. 2. (a) Enforcement of pasture use rules in contracts. (b) Pasture tax relief if animal are repooled to remote pastures 3. (a) Promotion of cultivation of wild species (b) Eco-labelling of cultivated wild species (c) Licensing for collection of wild species with controls over the collection technique	1. (a) Inscription of pasture use rules in contracts and enforcement. (b) Pasture tax relief if animals are repooled to remote pastures 2. (a) Promotion of cultivation of wild species. (b) Eco-labelling of cultivated wild species (c) Licensing for collection of wild species with controls over the collection technique

Source: NEAP, Land resources (share of agricultural land recalculated), author.

Table 11.3: Potential situation of environmental threats and measures in agriculture (by regions)

Planning zone	Semi-desert (5%) /Ararat and Armavir	Steppe (29 %)	Meadows (12%)
Climate	*Altitude : 850-1250 m* Rain : 250-300 mm Soil: irrigated brown soils	*Altitude : 1250-2450 m* Rain : 320-740 mm Soil: chernozems	*Altitude : 2200-4000 m* Rain : 750-1000 mm Soil : meadow soil
Type of agriculture	Orchards and vineyards Horticulture (irrigated) Pastures Animal farms**	Crops (irrigated and non irrigated): potatoes and wheat Hayfields and pastures Family small herds: cattle and sheep Animal farms**	Hayfields and pastures Family small herds: cattle and sheep
Viable size of	30 ha	60 ha	120 ha
Potential environmental threats	1. Overuse and misuse of agro-chemicals 2. Water pollution due to large animal farms** and misuse of animal dung 3. Extension of agricultural land in natural habitats (wetlands, natural saline lands). Need for more irrigation water. 4. Disappearance of local cultivars	1. Overuse and misuse of agro-chemicals 2. Water pollution due to large animal farms** and misuse of animal dung 3. Disappearance of local cultivars	1. Abandoned summer pastures (too far to be used) 2. Disappearance of local cultivars
Measures	1. Treatment licences. Registration of treatments performed by the holder of the licence and legal liability 2. EIE for land reclamation projects and compensation measures 3. (a) Ecological passport for larger farms. (b) Measures for proper spreading of the slurry or water pollutant agents fees 4. (a) In situ conservation (mini-reserves) (b) Eco-labelling of agricultural products of Armenian varieties	1. Treatment licences. Registration of treatments performed by the holder of the license and legal liability 2. (a) Ecological passport for larger farms. (b) Measures for proper spreading of the slurry or water pollutant agents fees 3. (a) In situ conservation (mini-reserves) (b) Eco-labelling of agricultural products of Armenian varieties	1. Pasture tax relief if animals are repooled to remote pastures to fill up the calculated stocking rate 2. (a) In situ conservation (mini-reserves) (b) Eco-labelling of agricultural products of Armenian varieties

Source: NEAP, Land resources (share of agricultural land recalculated), author.

* According to the estimation of the Ministry of Agriculture: minimum farming area given the locally available technology to meet the basic needs of an average family.

** "Animal farms" are large units of animal production without sufficient agricultural land for proper use of animal dung.

Regulations developed by the Ministry aim at providing for quality standards only, while economic instruments are merely limited to World Bank financing and humanitarian help. In general, environmental requirements do not figure among their conditions. On the other hand, it seems that the main environmental regulations (on water use, land use, etc.) do not clearly spell out the implications for agricultural practices. Protection and use policies for land and water resources are dealt with separately by the Ministries of Agriculture and of Nature Protection, with no effort at coordination or integration. The same is true for their respective inspectorates at the regional level. Local responsibilities are even less clear. For instance, for the time being, municipalities have no significant input regarding pasture regulations on their territory.

The objectives of the Ministry of Agriculture are described in the Programme for National Food Security Policy. The first priority is to secure the food supply of Armenia's population to cover its needs. During the most difficult period, in 1994, the average energy consumed per capita dropped from 2 546 kcal/day (1990) to 1 599 kcal/day. Measures to be taken to increase domestic production include promoting a more efficient agriculture and reducing the dependency on imported food, especially in those sectors where Armenia can be self-sufficient (like fruit and vegetables), and in wheat, although self-sufficiency cannot be fully attained.

Another aspect of the Programme is to protect the domestic agricultural market by a new customs policy. At present, the domestic market is completely unprotected. The promotion of the export of fruits and vegetables, both fresh and canned, is envisaged through the activation of traditional market links (to the Russian Federation), and the establishment of new ones with Europe and the United States. It is recognized that, in order to increase farming efficiency, farmers must have access to credits, agricultural inputs and support services, as well as training.

To improve the productivity of the small farms and the functioning of the market for agricultural land, the creation of farming associations will be promoted in a first stage. Some experts consider that, because of current low yields, an adaptation of land use to more appropriate patterns could generate an increase in production of 50 per cent over a five-year period. The Ministry of Agriculture believes in a slight but steady increase in agricultural yields over the coming years. It sees its main tasks not only in securing domestic and export markets but also in controlling the quality of agricultural products. There is no legislation on eco-labelling.

In response to the drought of 1988/89, the Ministry of Agriculture put up an emergency plan to improve the country's irrigation capacity, based on the development of groundwater wells (936), with the urgent rehabilitation of 223 existing underground wells (a potential of 400), the drilling of 15 new wells (potential 116) and a reduction in water losses in the irrigation system. External (humanitarian) help from donors other than the World Bank is expected for that project.

Armenia relies on external financing for large-scale projects. The World Bank will assist land registration and the creation of cadastral maps. The same project will address marketing problems of agricultural production, by upgrading the extension service to farmers and village credit associations -- to meet small farmers' needs -- provide technical services, and support the food-processing sector. The *North-West Agricultural Services Project*, supported by IFAD, is directed to more disadvantaged provinces and to households and women in particular and intends to strengthen the irrigation infrastructure. It includes the promotion of livestock farming, the development of seed production services, the restoration of irrigation systems on farms, the creation of water-user associations, the obtention of short-term loans and the development of communities.

A GEF project for in-situ conservation and sustainable use of agro-biodiversity was developed in 1999. Its general objective is to preserve Armenia's agro-biodiversity and use the potential of native crops and of collected wild plants for global agriculture and food security. A number of measures are proposed, such as:

Reserves. The Erebuni Crop Reserve was founded in 1981 as a site for the conservation of endemic wild relatives of domestic crops. Other reserves protect half of Armenia's agro-biodiversity, and in most reserves more than 10 per cent of the flora are wild relatives of cultivated crops. See also Chapter 5.

Regulation of the collection of wild species. The Ministry of Nature Protection plans to issue licences for the collection of medicinal plants. The licensing would first apply to commercial organizations, which collect

90 per cent of medicinal plants. Private collection of edible plants (80 per cent of the total) is much more difficult to control.

Cultivation of wild species or local varieties and sales promotion. Education of the public about edible or useful plants, in order to exhaust their economic potential and reduce pressure on the restricted number of species that are actually collected. Experimental cultivation of five edible species by the Ministry of Agriculture and the Institute of Vegetable Crops is under way, and the Ghazaros firm (Idjevan) cultivates 51 medicinal species.

In-situ conservation of local varieties. In particular arid and semi-arid ecosystems host species adapted to a harsh environment. In-situ conservation of local varieties depends on traditional farming techniques, performed by farmers using local varieties in less favoured areas (poor soil, lack of water, high altitude). In-situ conservation should be complemented with taxonomic research into wild relatives of cultivated plants and the creation of ex-situ conservation. Research may be extended to an inventory of wild varieties related to current crops and local sorts, development of their culture and seed production.

Monitoring of agro-biodiversity. A coherent, long-term, cost-effective and systematic monitoring system has to be developed.

Instruments for management

Use of land and of pastures is subject to "land taxes" (15 per cent of the calculated net income of the user) and "pasture taxes" (per head of cattle). Use of water by agriculture for irrigation is subject to tariffs developed by the Head Market Statute Department and the Ministry of Agriculture and adopted by the Government, but the collection rates are low, because it is difficult to determine the amount of irrigation water, given the losses in the distribution system, and because the tax management system is inefficient. The only economic instrument available to control water pollution is the pollution tax mechanism, recently redefined by the Government (see Chapter 2).

There are no economic incentives for the introduction of environmentally friendly technologies in agriculture. For instance, there is no tax relief for those who follow good agricultural practices regarding land use and pasture use, or the sound use of pesticides and fertilizers.

Under current economic conditions, international cooperation is essential for environmental management in many areas. The agricultural sector is affected by the National Biodiversity Strategy, the In-situ Conservation of Agro-biodiversity, the Lake Sevan Action Plan, and environmental training of farmers in the use of forests (UNDP project proposal). In the area of soil conservation, the NEAP recommends cooperation arrangements with European and North American institutions working in that field so as to develop conservation measures, based on thematic maps.

11.4 Conclusions and recommendations

At present there is no clear government policy on land use (including a master plan based on a geographical information system) integrating other policies such as agriculture and environment. Land is poorly protected from misuse and contamination, and economic constraints limit the opportunities for providing technical assistance to farmers and enforcing laws and regulations. Land-use planning should be carried out with the full participation of the farmers, on the village and district levels, in order to adapt it better to the market conditions of agricultural production.

Full and clear property deeds with right of sale will induce farmers to restructure their private farms and invest in irrigation and drainage systems for their land. Landowners have small, often fragmented, plots, making efficient and economic farming difficult. Little trading in agricultural land has occurred. There is still no system for parcel-based registration and the chronological record of property owners and their rights and obligations. Suitable bank credit systems for farmers are not available either. Farmers should be able to get credits or grants to enable them to comply with obligations regarding land maintenance (proper irrigation, drainage, anti-erosion measures).

Recommendation 11.1:
An integrated land-use policy should be developed as a basis for Armenia's sustainable development. Sufficient credit facilities and a land registration system should be created for farmers as a matter of priority, in order to facilitate the purchase of agricultural land as well as investments in land maintenance. An assessment of the potential of agricultural land should help in setting sales prices.

The drawing-up of a land-use policy should give rise to a reconsideration of agricultural production methods. The introduction of new techniques could benefit from a regularly updated inventory of soil and fertility conservation measures, identified land degradation problems, and forest use. It should be performed by the extension service through field trials on pilot areas in each marze, on a voluntary basis. To overcome the problem of fragmented plots, farmers should be encouraged and supported to work together.

The agricultural extension service (Agrogitaspjure) should be responsible for the practical training and the support of young farmers, as this education is not available. Although the conservation and sustainable use of natural resources together with training in extension are part of the Agricultural Academy's programme, there is no specific training in technical schools for agriculture or forestry. Environmental education in Armenia is considered a necessity, and the establishment of a division of ecology at Yerevan State University should be seriously considered.

Recommendation 11.2:
Land degradation, forest use and soil and fertility preservation measures should be monitored. The agricultural extension services should systematically promote the introduction of new agricultural techniques, including through the practical training of farmers. Existing third-level training programmes for agriculture (and forestry) should be strengthened. See Recommendation 6.8.

Nature protection is currently not representative of the multitude of Armenia's ecosystems. Pastures, meadows and hayfields (of all kinds, steppes to alpine) of the most valuable ecosystems must be included in the network of protected areas and precise rules issued for their use. Land-tax relief should be granted in those specific areas. Good agricultural practice, defined in the Land Code, is applicable outside the protected areas. The state of the pasture must be monitored. There is no current operational system for monitoring range conditions. It needs to be developed in parallel with the monitoring of plant cover and agro-biodiversity. Monitoring should cover land degradation, erosion, compaction, fertility decline, salinization and soil contamination. See also Recommendations 5.2 and 5.5.

The richness of Armenia's agro-biodiversity makes its conservation (in situ and ex situ) scientifically and economically advisable. Such conservation is in full harmony with relevant international programmes and supported by international networking (see the FAO world action plan for the conservation and the sustainable use of phytogenetic resources for food and agriculture). The GEF programme could meet this purpose.

Accompanying legal measures are also required. A law on plant protection ought to establish the rules of quarantine for imported plant material (imported food and plant reproduction material), in order to protect cultivated and wild plants in Armenia from new or introduced plant diseases, and natural ecosystems from the intrusion of foreign species. Cultivated wild species and local crop varieties should be labelled "of Armenian origin" (genetics and traditional farming), and international standards for organic farming should be introduced. This label is of great importance for the export of foodstuff.

Recommendation 11.3:
The in-situ conservation and sustainable use of agro-biodiversity should be sought by all possible means, including:
Recommendation 11.3 a : protection of Armenia's endemic species:
- *the legal definition of rules of quarantine for imported plant material*
- *the monitoring of range conditions and botanical surveys of pastures*

Recommendation 11.3.b : protection of the specificity of Armenian cultivars:
- *the monitoring of agro-biodiversity and use of local cultivars*
- *the adoption and implementation of a law on the labelling of agricultural products of Armenian origin*

- *the introduction of standards for organic farming*

Recommendation 11.3.c : protection of Armenia's wild biodiversity:

- *the implementation of the planned GEF project*
- *improving education of the population for the sustainable use and collection of wild plants*
- *the cultivation by farmers of those wild species that are particularly demanded and threatened*

Soil protection is considered a major issue in Armenia. Certain problems arise from natural phenomena in a mountainous country. Steep slopes, torrential rains, high temperature variations may result in a high degree of natural erosion often with soft rocks and unfavourable sedimentation patterns. Floods affect areas of intensive agricultural use, and gravitation and flushing processes are active on all slopes of more than 2°. Arable land is threatened by landslides. There are similar threats to saline salt marshes, due to natural soil and climate conditions. It is estimated that at least 5 per cent of the land is affected by exogenous geological factors. Other problems are of anthropogenic origin or aggravated by human intervention, ploughing uphill, repasturing cattle, or cutting forests. Saline soils may result from errors in irrigation.

The problem of soil fertility is taken seriously in the country and is one of the priorities of the agricultural extension service with its international partners (project "biohumus"). On cultivated land, good or best agricultural practices should include the use of manure as fertilizer instead of as household fuel. It seems that stubble is now often burned because it liberates K-fertilizer for the next crop and alleviates soil tilling. Instead, the grazing of stubble, bringing some dung to the plots, and the incorporation of remains instead of burning them should be encouraged, so as to keep organic matter in the soil. On large animal farms, liquid manure must be collected, not only to protect groundwater and surface water from pollution, but also because properly stored and used, it is a precious fertilizer, which can be distributed to neighbouring farms (bovine liquid manure is rich in K).

Recommendation 11.5:

The promotion of measures to support soil fertility is based not only on sound crop rotation but also on measures like using manure as fertilizer or other organic fertilizers (biohumus), collecting liquid bovine manure from large animal farms for the same purpose, or letting animals graze stubble. The use of sewage sludge produced by waste water treatment plant should also be envisaged. The proper use of those fertilizers should be promoted by the agricultural extension service.

Land degradation problems are more serious on pastures under State ownership than on individual cropland. The erosion problem in Armenia is not new and was addressed during Soviet times. Currently, the lack of financial means, but above all the structure of the small plots (strips in the sense of the slope), and the fact that each farmer needs all his land to feed his family preclude the implementation of simple and well known anti-erosion measures like contour tilling, shelterbelts, strips of fodder crops, crop rotation, etc. (An anti-erosion shelterbelt forestry programme is the second objective of the forest NEAP). Under current circumstances, the application of low-cost measures is advisable. The following should be considered:

- Farmers' tilling associations should be promoted, granting tax relief to those that take measures to protect the soil beyond the legal minimum.
- Local pasture users' associations could be promoted (following the model of water users' associations for the use of irrigation water), responsible for the adequate use of pastures and eventually grazed forests, controlled by inspectors of the Ministries of Agriculture and of Nature Protection regarding the state of the pasture.
- The same measure could be applied to pasture contractors who organize pasture use and repool animals to remote pastures. Repooling should generally be encouraged.
- The use of pastures should generally be reassessed, evaluating stocking capacity and a sensible pasture rotation, the use of mixed bovine and ovine flocks, taking advantage of the complementary grazing habits of different species. Pasture use ought to be planned according to local conditions, and fragile habitats unsuitable for grazing should be clearly marked and removed from pasture.
- Farmers whose animals overgraze pastures or graze in forests are driven by necessity. Research institutes together with the agricultural extension service should demonstrate that with a proper grazing strategy as much or even more milk and meat can be produced on the same surface with fewer animals.

- The Land Code should be revised to include (a) the promotion of agricultural practices like shelterbelts, contour tilling, minimal tilling systems, crop rotations, use of manure, use of appropriate, not too heavy machinery, and (b) provisions for the proper use and conservation of pastures.
- Efficient pasturing schemes integrating all aspects of livestock production and environmental protection with alternate grazing techniques could be promoted.

Recommendation 11.6:
Soil erosion, compaction and decline in fertility should be addressed in an integrated approach. The implementation of a comprehensive system of measures aiming at combating soil erosion should be seen as an urgent, joint task of the Ministry of Agriculture and the Ministry of Nature Protection. The Land Code, which is currently under revision, should include provisions aiming at an integrated approach to agricultural practice (so-called "good agricultural practices"). See Recommendation 6.4.

The restructuring of the Operation and Maintenance Enterprise of the Ministry of Agriculture, leading to its financial autonomy, together with the low degree of cost recovery, has left this organism without the necessary funds for meeting its still important responsibilities in the maintenance of the irrigation schemes. The transfer of responsibilities to farmers' organizations, as foreseen by the NEAP, is not in effect. Due to the sharp increase in the price of electricity, the energy costs for pumping could no longer be covered. This has led to a continuous degradation of the irrigation, drainage and dam infrastructure, and to the discontinuation of irrigation on thousands of hectares. With the Armenia irrigation development project, the World Bank intends to rehabilitate and improve the irrigation systems by converting pumped irrigation to gravity systems. The project, whose objective is to improve profitability and sustainability of Armenian agriculture, will be subject to an EIE, assessing both negative environmental impacts but also improvements in soil and water quality. See Chapter 8.

The rehabilitation of alkaline and saline soils has become a priority in Armenia. The reclamation of saline soils must be examined. From an economic point of view, the reclamation of saline-alkaline soils is not viable. It might be more reasonable to plant resistant crops on moderately saline land and abandon the highly saline land.

Protected areas are under the responsibility of the Ministry of Nature Protection (16 State reservations) and the Ministry of Agriculture (6 State reservations). Their respective roles and lines of responsibility are not yet clear to most of the staff on the ground (see also Chapter 5). Cooperation needs to be developed between the different ministries and research institutes. The lack of a national land-use plan and the current and expected changes resulting from the privatization process have a negative impact on the conservation of biodiversity and natural habitats in agricultural ecosystems. There is certainly a need for enlarging protected areas with valuable dry steppes, marshy and saline ecosystems and eventually rocky surfaces. This should not jeopardize other actions that are envisaged, e.g. the extension of irrigated land, the rehabilitation of saline soils or the reclamation of more saline land.

Recommendation 11.6 a:
Irrigated and desalinized land for agricultural purposes should not be extended at the expense of precious natural ecosystems. Nature reserves for valuable dry steppes or halophytic ecosystems, and eventually rocky surfaces, should be established and compensation measures provided to the owner or land users. See Recommendations 5.4 and 5.5.

Recommendation 11.6 b:
Projects for the extension of irrigated surfaces and for the use of water for irrigation, and for the extension of drained and desalinated surfaces should be subject to (a) environmental impact assessment, and (b) economic assessment.

Soil contamination, for instance with pesticides, is considered a serious problem in Armenia. The protection of water resources is the responsibility of the Ministry of Nature Protection. For economic and institutional constraints, established water and food quality standards are poorly enforced. The effect of pollutants on agricultural production should be monitored. Enforcement of the GOST standards is weak, and legislation is insufficient. Heavily polluted soils could be turned into natural habitats, with a strict ban on grazing or collection of edible wild plants. Reforestation or introducing other plant species that favour soil acidification should be avoided, because acid soils liberate heavy metals in the soil solution (water).

Attention should in the future be paid both to water pollution caused by agricultural activities and to the pollution level of water used for irrigation. Spring waters are especially vulnerable to pollution from livestock, and the storage and handling of chemical substances upstream. A lack of enforcement of the sanitary zones around springs is reported. A list of authorized pesticides (1998) exists, but there is no such instrument as a law on plant protection. Even if pesticides are adjusted to western standards, i.e. become less harmful for the environment, farmers are free to apply any agrochemical on their land without being obliged to acquire the necessary knowledge to handle them properly. More attention should be paid to the use of nitrate fertilizer, since nitrogen is prone to accumulate in the environment and food products. In addition, if soil erosion is not mastered, water quality will suffer from sedimentation and washing-out of agrochemicals. Agricultural pollution can best be addressed by raising farmers' awareness, but also by introducing product fees for harmful substances.

Recommendation 11.7:
Soil pollution should both be recognized and fought with measures mitigating its consequences. The following measures are recommended:

- *the legal provisions concerning the use of waste water for irrigation should contain minimal water-quality requirements*
- *a law on plant protection should be adopted. It should control the trade in agrochemicals and establish a treatment permit for farmers who want to use them*
- *large animal farms should be charged fees for emitting water polluting agents, as long as they do not spread their slurry*
- *fees might also be introduced for the use of some or all pesticides*
- *ecologically safe agricultural products should be promoted, the growing of sensitive crops and grazing on heavily polluted soils should be banned. See recommendation 13.5.*
- *a vegetation cover that can mitigate the scattering of heavy metals in the environment should be chosen for heavily polluted soil.*

Chapter 12

ENVIRONMENTAL CONCERNS IN ENERGY

12.1 Energy resources and technical infrastructure

Indigenous resources

Apart from hydropower and a nuclear power plant, Armenia has almost no developed indigenous energy resources. Known deposits of lignite and hard coal are few, and there has been little exploration of oil deposits. The potential of wind resources is under evaluation and the potential of solar energy, thermal and photovoltaic, has been demonstrated but is still not used on a commercial scale.

Armenia has an estimated hydropower potential of 21.8 billion kWh, with 7 - 8 billion kWh technically available. The commercially available hydropower potential is estimated at 6 TWh, of which 75 per cent are undeveloped. The potential of the two large rivers Hrazdan and Vorotan is well developed, while that of the third biggest system, Pambak-Dzoraget-Debed, is not.

Fossil fuel resources are:

- Proven coal and oil-shale reserves of the Idjevan, Shamut, and Germaniss fields of about 17 - 18 million tonnes
- Proven oil-shale resources of the Dillijan field of about 6 million tonnes, probable reserves about 128 million tonnes
- Proven coal reserves of the Idjevan field of about 100 million tonnes
- Probable oil and gas reserves in the Armavir and Ararat areas are unassessed

The proven reserves of coal and oil-shale equalled 3 per cent of the primary energy supply during 1998. Exploration for fossil fuels is still ongoing and the mapping of the actual resources is not yet satisfactory. The proven resources mapped include peat, bitumen and bitumen sand.

Armenia's reserves of geothermal energy could be used for power production. A geothermal capacity of 175 MW is included in its energy plans.

Insolation amounts to 1 720 kWh/m^2, which is significantly higher than the European average. Options for the use of solar energy are thermal energy and photovoltaic conversion, and the potential for using both technologies is high. As insolation is highest outside the heating season, photovoltaic conversion seems to be the most adequate technology for Armenia. Thermal solar energy systems could be used for hot water supply in areas with individual heating or where electricity is used at present.

Studies of the wind energy potential have been going on for years. Armenian researchers calculated a potential of 1 600 GWh. The current technically and economically feasible capacity of Armenia's network limits use to about 40 - 50 GWh/year. The prospects are that development of large-scale wind energy could justify extending the network and produce electricity at competitive prices.

During the early 90s, the extensive use of fuel wood was necessary, since there was no alternative. Today, fuel wood resources are limited by overexploitation. On the other hand, straw might be available from agriculture. No known studies have investigated this option. Biogas is also an unexplored potential source of energy.

Development of renewable energy sources

Except for hydropower, renewable energy does not contribute significantly to Armenia's energy supply. However, there have been some developments. The Institute of Energy is working on strategies for the large-scale use of renewables. A variety of options are being considered, among them the creation of joint ventures, since technologies for the use of renewables are not widespread in the country.

Wind energy is being considered for electricity generation and the pumping of irrigation water. Small-scale facilities are planned for demonstration, and measurements of wind are being carried out at five sites, with 50 masts provided by the Netherlands Government during August 1999.

The use of solar energy is an obvious option for the hot water supply of both detached houses and apartment blocks. Solar energy would produce most hot water during the summer, and therefore conflicts with the use of district heating (DH) systems. As DH systems based on combined heat and power (CHP) have large amounts available from combined heat and power production, heat would have to be dissipated during the summer, if the hot water were to be provided from solar sources.

Infrastructure of the energy sector

Armenia inherited its energy infrastructure from the former Soviet Union. The Soviet technologies used are not adapted to the conditions prevailing in the present economic system. There are natural gas and electricity connections with Azerbaijan, but they are now unusable. They would require investment before they could be put back into use. The only operating natural gas pipeline links Armenia with Georgia. There is no back-up capacity if supply is cut. Power transmission lines connect Armenia with Georgia, the Islamic Republic of Iran and also Turkey, but the transmission lines with Turkey are not operated. The inland transmission and distribution of electricity cover almost all of Armenia.

The power sector is characterized by a basically energy-efficient combination of heat and power production and hydropower. However, as the technologies in themselves are inefficient and no investment has been made for some time, overall efficiency is low. The gas supply for the power plants was unreliable and smaller than required, so that the electricity supply to consumers often fell short of requirements. The gas supply to households was equally unstable, and major repairs to the distribution network will be necessary for safety reasons before supply can resume.

Thermal and hydro capacities are rather old and all facilities are very inefficient compared to today's best available technologies. The newest thermal power plant is section 2 of Hrazdan, commissioned during 1971 and 1974. The Vanadzor thermal power plant is connected to a chemical plant in the city. The chemical plant was closed during the early 90s and has been idle, but includes a sub-station that has supplied electricity to Vanadzor city continuously. The plant has been under reconstruction since July 1999. It is regarded as having the most efficient boiler of all thermal power plants in Armenia. The district heating system of the plant has not been maintained and is now in very bad shape. The new owners of the chemical plant are prepared to supply heat to the city, but there has been no contact between the city and the plant on this issue.

The hydropower plants are also fairly old, with only 0.075 GW of capacity commissioned in the early 80s and the rest between 1936 and 1977. The small hydropower plants were commissioned from 1913 to 1954.

The Armenian Nuclear Power Plant (NPP) in Mestamor was commissioned in 1976. It interrupted production after the earthquake in 1988, but Unit 2 restarted its operations in 1995, with the approval of the International Energy Agency (IEA). The intention at the time of reopening was to operate the plant until the year 2004, when it was hoped the energy supply would be improved through suitable arrangements with neighbouring countries. The construction of a new nuclear power plant could be envisaged.

The plant at present employs 5 000 workers. The NPP is of the "water-cooled, water-moderated energy reactor" (WWER) type. These reactors were designed before formal nuclear safety standards were issued in the Soviet Union. They lack the basic safety features that are common in pressurized water reactors. The Panel of High-level Advisers on Nuclear Safety in Central and Eastern Europe and in the Newly Independent States

recommended that ongoing EU assistance should continue, focusing on short-term improvements in design safety through on-site projects, remediation of key technical deficiencies and support to the regulatory authority.

District heating is widespread as in other former Soviet Union and east European countries. Some of the systems have not been operated for some years. All systems, whether operated or not, would need refurbishment to create an energy-efficient supply.

The only district heat currently supplied is by the Yerevan TTP. The system in central Yerevan has not been used for lack of fuel, and is not functional. A recent TACIS study has shown a high return on reconstruction capital (IRR of 8 per cent). The study covers heat distribution to the doorstep of buildings and the heat exchangers for building systems, i.e. the heating systems inside buildings are not included.

The Yerevan district heating system consists of 9 plants, including the Yerevan thermal power plant (CHP). The system has 198 natural-gas-fired boiler houses connected to the system. Compared to the power production facilities, the district heating system is fairly new with 1981 as the average year of commissioning. Investments were made up to 1990, when the South Western District was commissioned. Other cities may have DH systems based on boilers and heat from industrial plants. CHP is an efficient approach, provided that the CHP feeding the system can provide the load supported with decentralized peak load boilers - in Yerevan also planned to compensate the very high network losses.

12.2 The national energy economy and environmental issues

Overall supply and demand of energy

During the 90s Armenia experienced a deep recession, together with the conflict with Azerbaijan and the embargo by Azerbaijan and Turkey. Energy prices rose to world market levels and economic activity fell to 30 per cent compared to 1990. As of 1994, the economic structure changed. Annual GDP growth decreased from more than 9 per cent in 1994 to 0.5 per cent in 1997. The agricultural sector grew until 1996, but declined in 1997. Wholesale and retail sales enjoyed very high growth rates during 1994 and 1995, and were at 5.1 per cent in 1997. Other services, including the governmental sector, have grown since 1995, at rates of more than 15 per cent - during 1997 the growth rate was 22.9 per cent.

The development of the energy sector during the 90s reflects the general economic difficulties. Final energy consumption fell from 5.7 million toe in 1990 to 1.2 million toe in 1998. Table 12.1 summarizes the energy balances for the years 1991 to 1998.

Table 12.1: Summary of energy balances, 1991-1998

1 000 toe

	1991	1992	1993	1994	1995	1996	1997	1998
Indigenous production	133	129	369	302	245	763	553	564
Import	8 043	4 054	1 908	1 139	1 424	1 304	1 606	1 703
Export	- 286	0	0	0	0	0	- 11	- 34
Changes of stock	0	0	0	0	0	7	- 26	- 4
Total primary energy supply	**7 890**	**4 183**	**2 277**	**1 441**	**1 669**	**2 074**	**2 122**	**2 229**
Conversion losses etc.	-2 142	-1 285	- 594	- 403	- 457	-1 089	-1 035	-1 043
Total final consumption	**5 748**	**2 898**	**1 683**	**1 038**	**1 212**	**985**	**1 087**	**1 186**
Industry sector	1 632	..	505	259	353	240	295	290
Transport sector	1 279	..	503	122	92	310	350	379
Other sectors	2 525	..	630	622	742	405	397	488
Non-energy use	312	..	45	35	25	30	45	29

Source: 1991-1995: IEA, 1996-98: Energy Strategy Centre of Armenia/Tacis.

The economic crisis and the hostile energy supply situation account for the slump in total primary energy supply (TPES) from 7 890 Ktoe in 1991 to 2 229 Ktoe in 1998. Indigenous production more than quadrupled from 1991 to 1998, while the total primary energy supply decreased to less than 30 per cent in the same period. Final use dropped by about 80 per cent. The fuel breakdown of total energy supply is shown in Table 12.2.

Table 12.2: Final energy consumption, 1991-1998

1 000 toe

	Total	Coal and wood	Petroleum products	Natural gas and LPG	Electricity	Heat
1991	5 748	131	2 687	2 188	742	...
1992	2 898	63	1 278	1 111	447	...
1993	1 683	4	875	401	329	74
1994	1 038	4	237	466	278	53
1995	1 212	1	169	718	262	61
1996	985	22	372	133	390	68
1997	1 087	16	434	166	382	89
1998	1 186	17	478	233	369	89

Source: 1991-1995: IEA, 1996-98: Energy Strategy Centre of Armenia/Tacis.

Consumption of all fuels decreased during the period, that of electricity less than that of other fuels, reflecting the priority of electricity supply during the difficult fuel situation as well as the availability of indigenous hydro- and nuclear power. The consumption of petroleum products decreased like the other fuels, and their consumption towards the end of the period was primarily for transport. Ongoing supply problems are making it difficult for the use of natural gas and LPG to be resumed.

Supply and demand projections

Armenia has been exploring the option of using other gas suppliers, mainly the Islamic Republic of Iran. The project under consideration would involve a US$ 120-150 million pipeline linking the Armenian and Iranian gas grids. Armenia has been seeking funding for the project from the World Bank, and Greek officials have consulted their Armenian counterparts about possible Greek participation in the project.

Table 12.3: Planned supply development

Project	Capacity *MV*
Up to 2005	
Geothermal power station	10.0
Wind turbines	1.2
Small hydropower	35.5
Steam-gas power devices	337.0
Stop of the nuclear power plant	-440.0
2005 to 2010	
Geothermal power stations	165.0
Wind turbines	13.2
Private small hydro power stations	35.5
Hydropower stations	164.0
Steam-gas power device or a new NPP	167.0

Source: Armenia – Country Study on Climate Change, October 1998.

Another project is linked to the supply of Russian gas to Turkey through the existing pipeline network in Georgia and Armenia, with a spur built to link it to the Turkish gas grid. Armenian officials and Gazprom executives met in July 1999 to discuss the issue.

A new nuclear power plant would produce fewer greenhouse-gas emissions, but would make less economic sense. The capacity reduction during the period 2000 to 2005 (by 56 MW) is due to the envisaged closing-down of the nuclear plant in 2004. The increase in capacity planned from 2005 to 2010 is 544.7 MW. If nuclear power capacity is added, the two steam-gas units of 337 MW capacity will not be built.

The new investments would make it possible to supply the amounts of energy shown in Table 12.4. The increase in supply would exceed growth during the period 1995 to 1998.

Table 12.4: Forecast of energy supply, 2000 - 2010

PJ

	2000	2005	2010
Electricity	81	96	151
Heat	32	63	77
Petroleum Products	26	34	42
Primary Energy Resources	122	173	216

Source: Armenia – Country Study on Climate Change, October 1998.

The energy demand forecast is the subject of Table 12.5. The demand predicted for 2000 exceeds the final energy consumption of 1998 by 50 PJ. Economic development during the period is expected to bring Armenia to the level of its 1990 GDP, while the forecast energy demand in 2010 is 350 PJ lower than its 1990 level. It should be satisfied from more efficient facilities, and energy consumers are expected to use more efficient devices.

Table 12.5: Forecast of energy demand, 2000-2010

PJ

	2000	2005	2010
Total	**158**	**218**	**272**
Industry and construction	28	43	51
Agriculture	10	17	24
Transport	29	38	50
Public and commercial sectors	53	69	84
Other	38	51	62

Source: Armenia – Country Study on Climate Change, October 1998.

The forecast demand for the major fuels is shown in Table 12.6. Natural gas is planned to be the dominant fuel, with a share of more than 70 per cent.

Table 12.6: Forecast of fuel demand, 2000-2010

PJ

	2000	2005	2010
Total	**162**	**234**	**271**
Natural gas	110	169	193
Coal	1	1	1
Petrol	22	29	36
Diesel	9	13	18
Kerosene	6	6	7
Residual	15	16	17

Source: Armenia – Country Study on Climate Change, October 1998.

The forecast of electricity generation from 2000 to 2010 appears in Table 12.7. It shows an increase that will bring generation back to its 1990 level. This scenario includes nuclear power generation from a new nuclear power plant as from 2005. CHP production is planned from natural gas, and generation from renewables would be emission-free.

Table 12.7: Forecast of electricity generation, 2000-2010

GWh

	2000	2005	2010
Total	**6 820**	**8 040**	**10 200**
Thermal Power Plants (CHP)	2 720	3 030	2 708
Hydro Power	1 600	1 767	2 731
Nuclear Power	2 500	3 160	3 300
Geothermal and Wind	0	83	1 461

Source: Armenia – Country Study on Climate Change, October 1998.

Energy costs and prices

In 1999, the electricity production costs of the three main producers were: 18-19 drams per kWh at Yerevan TPP, 14-15 drams at Hrazdan TPP and 11 drams at the NPP. Electricity is provided to the private sector at a progressive tariff. Retail prices for electricity have been increased since 1994 (roughly threefold). In 1999, the kWh price for consumption of less than 100 kWh per month was 15 drams (4.4 US cents), between 100 and 250 kWh the price was 22 drams and consumption of more than 250 kWh cost 25 drams. Night-time industrial use cost 12 drams. Since October 1999, the night-time tariff has also been applied to residential and commercial users.

So the tariff is such that large electricity users subsidize small users. The average price is estimated to be about 80 per cent of short-term marginal cost, and tariffs now cover direct operating costs, including some allowance for commercial losses and debt service.

Armgazprom imports natural gas at contract prices. However, natural gas is not distributed and the consumer prices are not relevant. Other fuels, such as petrol, are imported at market prices. As transport is difficult, fuel prices are high.

A programme for tariff calculations and structure has been developed for natural gas and electricity. From 1996 an operation-and-maintenance-cost tariff was imposed, and from 1997 full-cost tariffs are calculated. All consumer tariffs are intended to be calculated to cover all costs.

Air emissions

Table 12.8: Emissions of CO_2, CH_4 and N_2O from the use of natural gas and coal, 1990-2010

Million tonnes

	1990	2000	2005	2010
CO_2	21 283	6 688	10 092	11 501
CH_4	80.3	0	0.1	0.1
N_2O	0.1	0.2	0.4	0.4

Source: Energy figures from "Armenia - Country Study on Climate Change; emission factors from IPPC.

Table 12.8 shows air emissions from the use of energy in 1990 and the corresponding forecast for the planning period 2000 to 2010. Increases in emissions are expected, but at rates below those of economic growth.

Table 12.9 shows the calculated emission of CO_2 from energy use in the period 1991 to 1998. Emissions decreased by about 80 per cent between 1991 and 1998. Compared to 1991, the 1998 emissions from coal decreased to 13 per cent, from petroleum products to 11 per cent and from natural gas to 39 per cent.

Table 12.9: CO_2 emissions from energy use, 1991-98

1 000 t of CO_2

	Total	Coal and wood	Petroleum products	Natural gas and LPG
1991	21 036	519	13 228	7 289
1992	11 143	250	7 326	3 568
1993	5 278	16	3 681	1 581
1994	2 941	16	1 185	1 741
1995	3 533	4	844	2 685
1996	3 440	87	1 239	2 114
1997	4 051	63	1 317	2 671
1998	4 371	67	1 438	2 866
Emission factors ($kg\ CO_2/GJ$)		94.6	72.0	56.1

Source: 1991-1995: IEA, 1996-98: Energy Strategy Centre of Armenia/TACIS, emission factors by IPCC.

12.3 The situation in the energy sector

Electricity generation

Electricity is produced by thermal (three plants), hydro (two cascades and small plants) and one nuclear power station. During the 90s, there was a sharp overall fall in energy use, especially in the use of petroleum products. At the beginning of the 90s, the main fuels used for electricity production were (heavy) petroleum products, but they are currently replaced by natural gas.

The electric power production capacity of Armenia includes 1.8 GW of thermal power, 1.0 GW of hydropower and 0.4 GW of nuclear power. Total generation capacity is 3.2 GW. The capacity, age and production of the individual plants during 1996 and 1997 are shown in Table 12.10.

Prior to the reopening of the nuclear plant, the national supply situation was poor and the usual heating systems were not operated but replaced by electricity, for many the only source of heat. The supply of natural gas through the only pipeline through Georgia was frequently interrupted. Since the reopening of the nuclear power plant, the reliability of the natural gas pipeline has improved.

According to Armenian experts, current use of overall capacity is around 50 per cent, while about 60 per cent are considered possible. There is an inverse relationship between electricity generation at the nuclear station and hydro production: limitations on one are compensated by increases in the other. Hydro production shrank during 1997, but has increased to its 1996 level since. Production on the Sevan-Hrazdan cascade is limited by environmental concerns. Nuclear electricity is considered to be the least costly option.

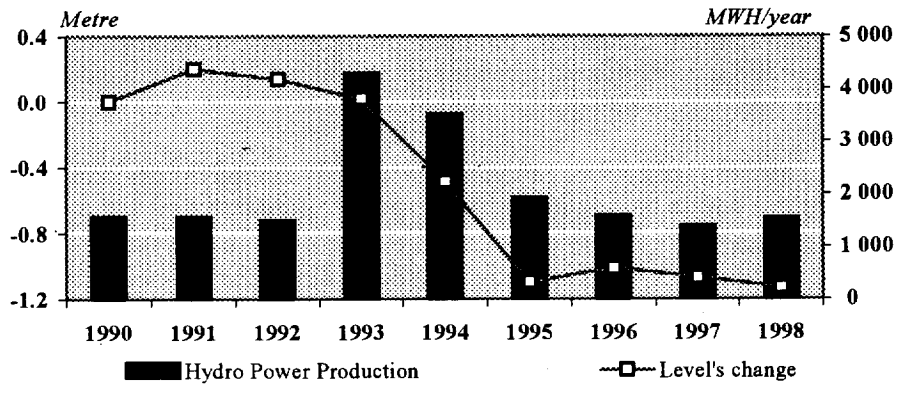
Table 12.10: Power plants*

	Year of commissioning	Capacity	Production			
			1997	1998	1997	1998
		MW	*GWh*		*1 000toe*	
Power plants total		**3 211.2**	**6 029.8**	**6 190.7**	**518.4**	**532.3**
Thermal power plants, total		**1 754.0**	**3 031.7**	**3 064.1**	**260.7**	**263.5**
Hrazdan		**1 110.0**	**2 273.3**	**2 425.9**	**195.5**	**208.6**
Section 1	1966 and 1967	2x50				
	1969	2x100				
Section 2	1971-74	3x200				
	1974	1x210				
Yerevan		**550.0**	**758.4**	**638.2**	**65.2**	**54.9**
Section 1	1963-65	5x50				
Section 2	1966-68	2x150				
Vanadzor	1964-76	**94.0**	**0.0**	**0.0**	**0.0**	**0.0**
Hydro power plants, total		**1 017.2**	**1 380.5**	**1 537.1**	**118.7**	**132.2**
Sevan-Hrazdan Cascade		561.2	534.7	475.5	46.0	40.9
Sevan	1949	34.0				
Hrazdan	1959	81.6				
Argel	1953	224.0				
Arzni	1956	70.6				
Kanaker	1936	102.0				
Yerevan 1	1961	44.0				
Yerevan 3	1956	5.0				
Vorotan Cascade		400.0	759.7	951.8	65.3	81.8
Spandarian	1984	75.0				
Shamb	1977	168.0				
Tatev	1971	157.0				
Small HHP	1913-54	56.0	86.1	109.8	7.4	9.4
Nuclear power plant	1976, closed 1989	**440.0**	**1 617.6**	**1 589.5**	**139.1**	**136.7**
Unit 1	Out of operation	(440.0)				
Unit 2	Refurbished in 1995	440.0				

Source: "Energy Sector of Armenia" by Energy Strategy Centre of Ministry of Energy of Republic of Armenia.

* The production figures do not entirely match the figures of the energy balances prepared by the Energy Strategy Centre / Tacis.

Figure 12.1: Hydro power production and change in water level of Lake Sevan



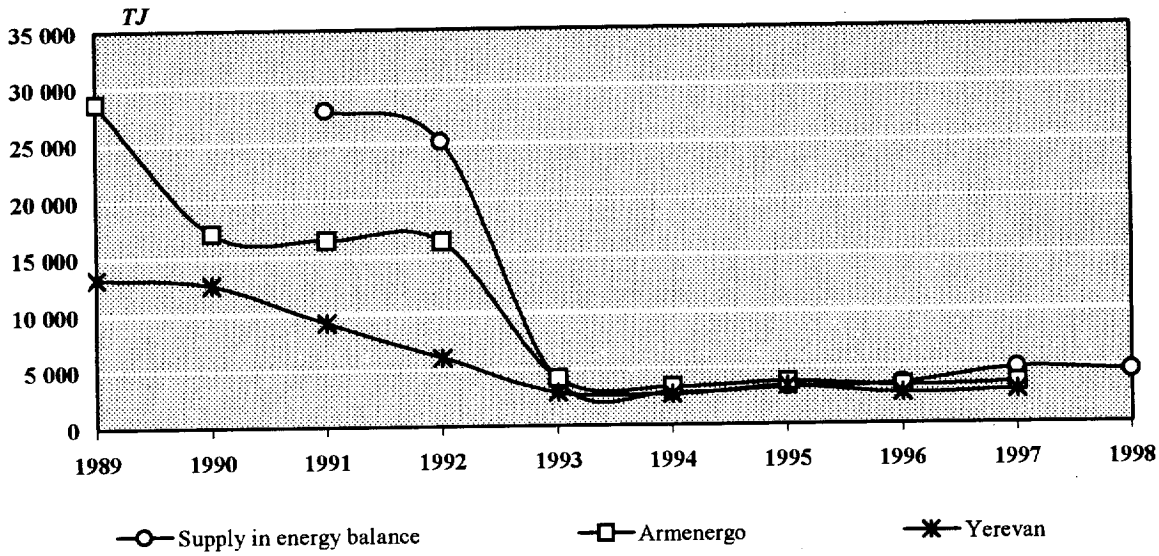
Source: UNDP, GEF, Project document PDF Block B.

Hydropower production at the Hrazdan-Sevan cascade uses water from Lake Sevan. It may have substantial impacts on the Lake's water level. During 1993 and 1994, the need for hydropower was very high and the water level dropped by one metre. The Lake's water is also used for irrigation. Today, the operation of the Hrazdan-Sevan cascade is subordinated to the need for irrigation water. Figure 12.1 shows the result of the management strategy since 1990.

Heat supply

Figure 12.2 shows the collapse of supply from almost 30 000 TJ in 1989 to 5 000 TJ. The CHP plants are operating at low load, as fuel supply is insufficient to feed the boilers. The total supply comprises industrial supply and the supply from boilers in city systems.

Figure 12.2: Supply of district heat, 1989-97



Source: Energy Balances, UNDP-GEF Project Document PDF Block B, and Report on Assistance for a National Energy Saving Strategy, BCEOM 1994.

Notes:
Supply in energy balances for 1992 is an interpolation between figures from 1991 and 1993.
Total supply is from various sources and therefore not directly comparable.

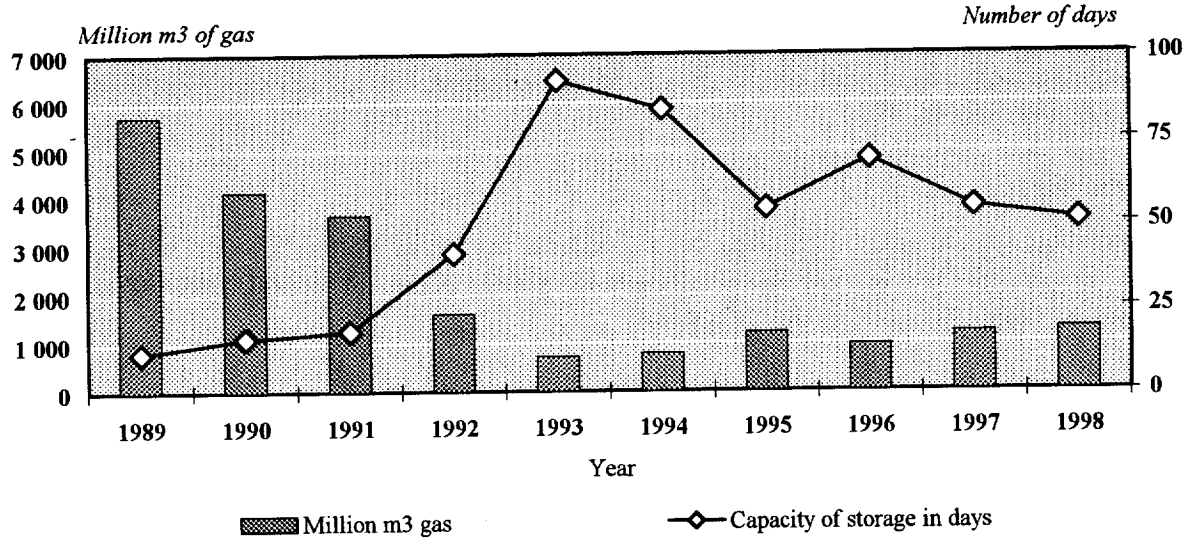
Hot water was also supplied by district heating systems, but not to all district-heating customers. Electrical heating for hot water supply therefore continues to be widely used. The widespread use of fuel wood was the cheapest option, but prices soared as it became scarce.

Natural gas supply

In Soviet times, the consumption of natural gas was in the range of 5 to 6 billion m^3 or above. In 1987, it amounted to 5.76 billion m^3. Since then, consumption has plummeted, to 4.6 billion m^3 in 1990, 4.5 in 1991, 1.9 in 1992, 0.78 in 1993, 0.84 in 1994, 1.0 in 1995, 1.12 in 1996 and 1.2 in 1997.

Three high-pressure gas pipelines of a combined capacity of 0.045 billion m^3 per day enter the country along the eastern border with Azerbaijan. These pipelines have been shut down for years. Two other gas lines come from Tbilisi in Georgia and have a capacity of 0.015 billion m^3 per day. Those pipelines were sabotaged in Georgia and out of commission for some time, but have been rendered partly operational and sparingly supply Armenia with Russian natural gas.

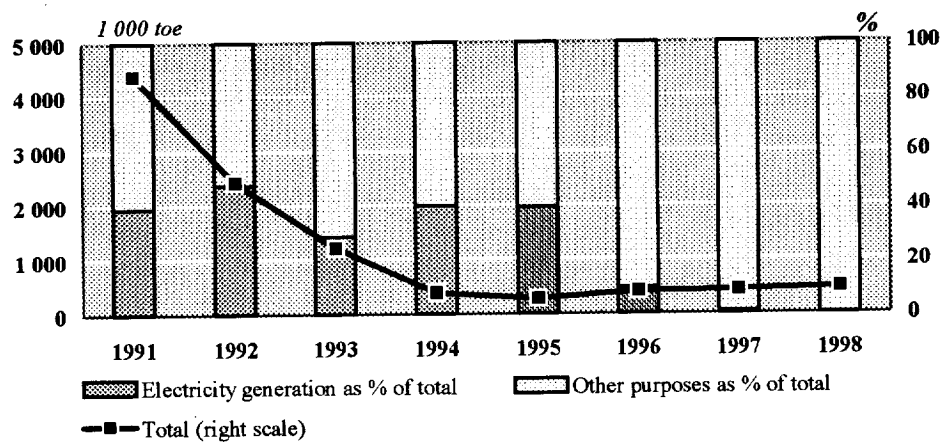
Figure 12.3: Natural gas supply 1989-98 and days of maximum available supply



Source: Energy Balances and Report on Assistance for a National Energy Saving Strategy, BCEOM 1994.

Oil supply

Figure 12.4: Consumption of petroleum products, 1991-98



Source: Energy Balances.

Figure 12.4 shows the development of petroleum product consumption. The use of petroleum products for purposes other than electricity generation increased marginally from 1995 to 1996 and stabilized during 1997 and 1998. Transport costs have increased, because only Georgia and the Islamic Republic of Iran are open for the transit or import of oil products for Armenia.

12.4 Management of the energy sector

Legal instruments and institutions

The Energy Law adopted in 1997 regulates the energy sector. It establishes the right of consumers to receive electricity, heat and gas on a contractual basis. The main principles of the Law and of the energy policy conducted by the Ministry of Energy are:

- To ensure a reliable and efficient transmission and distribution of natural gas, electricity and heat
- To ensure the reliable and efficient generation of power and heat
- To improve the safety of the energy system
- To set a framework of conditions for developing a competitive energy supply system
- To privatize energy industries.

Furthermore, the Law obliges the Government to develop a framework for local energy resource development, for energy savings and for environmental protection - these are under preparation.

The Energy Law created the Energy Commission. It is responsible for both direct anti-monopoly regulation and the regulation of licences and tariffs. The Commission is an independent body of five members, appointed by the President and reporting directly to him.

A Law on Standardization was approved in October 1998, as part of the country's strategy towards membership in the World Trade Organization. Using European experiences, the Law is relevant to technical regulations and work flows in the energy sector. The Government decided that all international requirements in these areas were to be met.

An energy efficiency law is in Parliament. Its main focus is the energy transformation sector, targeting reductions in the use of energy by the sector, as well as losses in transformation and distribution. The law was based on west European and Russian practices and experiences. Its eventual implementation is currently being prepared by the development of conceptual approaches.

Strategies and policies

Armenia's energy policy is subordinated to general economic policy. The overall strategy for energy policy is to create self-sufficiency, this being one of the country's principal targets. The implication for the supply side is that all indigenous energy resources are to be used, including nuclear power. As hydropower is not totally harnessed, options for the construction of new hydropower plants will be explored.

Regarding the low capacity use of existing facilities, efforts are concentrating on adjusting capacity to the expected future demand. New technology is to increase energy efficiency by the rehabilitation of present capacity, before adding new capacity. The primary approach focuses on rehabilitating the district heating systems linked to combined heat and power production. However, the success of this strategy depends on consumers' ability to pay - closely related to overall economic development, which is another objective in the strategy.

Environmental concerns play a major role in the energy development strategy. Energy efficiency is part of the national strategy and it has been estimated that there is a potential for large savings. However, energy efficiency requires large investments and preference is given to low-cost measures such as improving energy conversion and distribution facilities. With a recovering economy, preference will be given to measures implying large capital costs.

The Government's medium-term objectives are:

- To strengthen the regulatory capacity of the Energy Commission
- To adopt a financial rehabilitation plan for the power sector (originally foreseen by October 1997), restoring the financial viability of sector's enterprises by June 1999
- To adopt a sector privatization strategy.

As the intention is to privatize major parts of the energy sector, the need for regulating capacity is greater. Giving resources and training to the Energy Commission is needed if it is to exercise its authority. The Financial Rehabilitation Plan includes the provision of capital, and among the options are donor financing and the provision of private capital through privatization.

Action already taken by the Government to reform the sector demonstrates its commitment to commercializing the power sector. This commitment is underscored in particular by these facts:

- Since 1994, average electricity retail tariffs have been increased. Collection has also improved from less than 50 per cent in 1995 to an average of 63 per cent in 1996 and 70 per cent in the second quarter of 1997 (about 35 per cent of collection is in barter).
- The Energy Law was adopted and the Energy Commission established.
- The 12 Yerevan distribution enterprises were consolidated into a single corporation, and the other 40-odd distribution companies have been consolidated into 10 regional companies.
- The separation of generation from transmission enterprises was completed.

The merging of distribution companies into 14 companies and the separation of production and transmission could be regarded as strengthening the efficiency of the energy sector and at the same time as preparation for privatizing the companies, now with a larger commercial basis.

The main obstacle for the energy sector and the introduction of energy efficiency is the lack of capital. Furthermore, the conflict with Azerbaijan keeps the energy sector in limbo, awaiting the return of normal conditions.

International commitments

Armenia ratified the United Nations Framework Convention on Climate Change in May 1993. Since 1996, to fulfil the Convention's basic provisions, Armenia has implemented the "Armenia - Country Study on Climate Change" project as the first national communication.

Management instruments

Licences are required for (1) the distribution, import and transport of natural gas, (2) the construction of power plants, (3) the generation, import, export and distribution of electricity, and (4) the generation, transmission and distribution of heat. Conclusive results of the licence system are not yet available.

Applications for entering the energy sector are forwarded to the Energy Commission, together with all envisaged prices and tariffs, i.e. the purchase prices for energy used in transformation have to be specified. Individual applications are assessed to see how they serve overall energy and environmental strategy. Thus, an application has to include energy-efficient technology and, if possible, also has to support the country's energy self-sufficiency. The Commission approves the application, including all energy prices and tariffs, or rejects it.

Renewable energy sources are given high priority and the licensing system enables the Energy Commission to approve an application based on its financial viability. Compared to a system with a fixed financial regime, the Armenian system offers flexibility and the opportunity to promote desired technologies.

In April 1993, EBRD approved a loan of EUR 49.2 million to complete the construction of a new 300 MW gas-fired power station. The new plant will increase supply and reduce the environmental impact of the power sector.

The loan was backed up with technical assistance to help with the regulatory reform of the energy sector, electricity tariff reform, the installation of modern accounting systems in Armenia's electric utility, the preparation of a medium-term plan for the power sector, and the development of modern oil and gas contracting practices. A new financing plan is being finalized to complete the project and to privatize the unit as part of the Government's overall privatization plan in the power sector. Assistance included preparations for the restructuring of the electricity sector and the preparation of methodologies for calculating full-cost tariffs for electricity and natural gas.

Organization of the energy sector

The State and the municipalities own the energy sector as far as electricity, natural gas and district heating are concerned. Private entrepreneurs undertake other supply services, such as the import and distribution of petrol or the distribution of fuel wood. Municipalities own local heating systems - few facilities are privately owned. The further privatization of district heating systems is being prepared. The supply of electricity and fuels to the main energy consumers, except for the fuel supply to the transport sector, is organized by the State.

Electricity. Till 1995, the State company "Armenergo" managed the electricity sector. It belonged to the Ministry of Energy. The sector was restructured during 1995 to 1998. Armenergo was split into several companies. Today, power plants are independent companies. The high voltage network is one company, delivering to regional distribution network companies. Armenergo continues to be responsible for managing the transport, import and export of all forms of energy, including electricity. Policy and strategy for the electricity sector remain the responsibility of the Ministry of Energy.

Nuclear waste is stored at the nuclear power plant, in dry storage. The storage site is built for a lifetime of 50 years. Fuel is imported from the Russian Federation. Depleted fuel cells are not being reprocessed. The equipment of the nuclear power station is ensured through an agreement with the Russian Federation. During recent years, compatible equipment from the United States has also been installed. The Tacis programme assists Armenia in the development of its energy sector in general, including in the improvement of the safety of the nuclear power plant.

Natural gas. In December 1997, a new joint-stock company was created for the gas economy, ArmRusGasProm. It was established as a joint venture between Armenia (represented by the Ministry of Energy), RAO Gasprom and ITERA, an international energy association registered in the United States. The company succeeds Armgazprom, which was a State-owned company importing and distributing natural gas. Before 1996, natural gas purchases were handled through a complex and inefficient government clearing mechanism. One result was the creation of a complex system of inter-company debt including Armgazprom, Armenergo and industrial natural gas consumers.

12.5 Conclusions and recommendations

Armenia's energy sector is suffering from economic development with huge decreases in energy demand and a hostile fuel supply situation. The developments in the 90s left Armenia with electricity as the only widespread network-supplied energy. The distribution of natural gas and district heating was common before 1990, but is now nearly inexistent. Capacity for distributing natural gas and district heating has eroded during the decade and can only be restored with large capital investments. An important constraint for energy planning is the unresolved conflict with Azerbaijan and its consequences for fuel supply. Energy planning includes the self-sufficiency objective as a benchmark of overriding importance.

The electricity conversion facilities, designed for a much larger demand, are currently far too large, and there has been no incentive to maintain or improve efficiency - despite the difficult energy supply situation. Moreover, funds for renewing the energy conversion facilities have not been forthcoming, despite the number of studies made during the 90s on this issue.

Energy policy and strategy show strong evidence of a willingness to include environmental concerns in the development of the energy sector. The Convention on Climate Change guides the direction of the energy sector and the mechanisms introduced at the Kyoto Conference could provide opportunities for Armenia to develop the energy sector and energy use in an environmentally friendly manner. The Convention has implications for the energy system, as the energy sector is responsible for the bulk of total emissions. The baseline of 1990 shows that the energy system, including transport, was responsible for nearly all CO_2 emission, more than 50 per cent of CH_4 emissions and about 40 per cent of N_2O emissions.

Armenia has signed the Kyoto Protocol and will therefore be part of the international efforts to reduce emissions of greenhouse gases. The basis for the approach is the 1990 emission level and the introduction of joint implementation and emission trading could be a major benefit to Armenia. The strong commitment to

self-sufficiency and the level of economic development could, however, overshadow the environmental concerns if possibilities for polluting, low-cost energy become available on a large scale.

Recommendation 12.1:
The perspective for the development of the energy economy should be widened, by adding environmental concerns to the existing objectives of self-sufficiency and compliance with relevant global conventions.

The need to make use of all sources of energy follows the overall objective of reaching energy self-sufficiency - including plans for the construction of a new nuclear power plant. In particular this option shows the need for a more comprehensive inclusion of environmental concerns into energy planning, as nuclear waste problems are not yet solved anywhere, neither nationally nor globally, and Armenia is in a geologically unstable region. It would therefore be wise to widen energy planning to incorporate a recognition of the potential of renewable energy.

The renewable energy potential is considered to be high. Measurement of the wind energy potential is currently being carried out and the space for siting wind farms is huge, with relatively good access to electricity transmission facilities. Wind energy is included in energy plans up to 2010 with only 14.4 MW capacity. Less than 10 wind turbines could cover this demand. If wind measurements prove positive, energy planning could include efforts to increase the contribution from wind energy.

The former widespread district heating systems were equipped with heat-only boilers for decentralized heat production. The plans to reconstruct the systems should evaluate the inclusion of decentralized natural gas CHP to replace heat-only boilers. Including decentralized CHP will lower the need for capacity in central power plants and require less fuel and would thus reduce the need for additional capacity.

Recommendation 12.2:
Energy planning should evaluate the options for including renewable energy in the energy system (in particular wind and thermal solar energy), and options for the combustion or gasification of biomass in combined heat and power units to replace heat-only boilers in both district heating plants and industry.

The concern for economic growth is a strong constraint on planning as well, and the supply of energy at affordable prices is considered essential. Energy planning assumes an economic recovery that will bring Armenia back to 1990 levels of economic activity. Planning is made in the light of a shortage of capital for investments and of consumers' ability to pay, which means that energy efficiency has to be achieved by low-cost measures until the economic conditions improve. This implies further that energy efficiency will be introduced mainly in the supply systems and not in consumption. It is likely that achieving overall energy efficiency will require complementary measures in the management of the demand side.

The environmental performance of the energy sector is determined by the extensive use of hydropower and natural gas. Despite inefficient facilities, emissions from the energy sector are limited due to the sources used. Emissions from heating and cooking are not counted in the calculated emissions. Emissions could be further reduced, if the efficiency of the facilities were improved. The regulatory framework for the environmental effects of the use of energy should begin to be adapted to an active future policy in this regard.

Recommendation 12.3:
Licences for the production and distribution of energy could include obligations to introduce demand-side management, as well as conditions for energy efficiency of supply facilities in order to limit emissions.

The high cost of energy in Armenia reflects the difficult supply situation. In addition, the ability to pay is low, and making consumers pay for the energy they are actually receiving is an important objective. The supply of energy to households is still abnormally low, and the price structure of normal supply has to change from subsidized to world market prices. If the energy sector's supply lags behind economic development, consumers will use other means for heating and cooking. This could be in the form of individual appliances, using imported fuel that in the long run would be difficult to replace with network-supplied energy. The environmental implication will be an increased use of fossil fuels entailing higher emissions to air.

As a result, a concerted approach is necessary that includes organizational measures within the energy sector, as well as measures that enable and improve payments by households for the energy they consume. The organization of the energy sector is still evolving and Armgazprom is to be reorganized along the same lines as the electricity sector. Armgazprom and ArmRusGasProm are developing their organizational structures and direct contact between consumers and suppliers is increasing consumer's responsibility for payment. At present, the supply of energy to buildings is metered, but not that to individual households. Individual household meters need to be introduced, a measure that would also help conserve energy by these consumers.

Recommendation 12.4:
A plan should be established to introduce meters measuring electricity consumption in individual households, together with organizational measures in the energy supply sector to help improve the supply to households.

The storage of nuclear waste at the premises of the nuclear power plant can only be a temporary measure. Environmental policy requirements have to be specified with regard to radioactive waste management. This is not an easy task and should therefore be started with great urgency. The reprocessing of depleted fuel cells should be seen as an opportunity to reduce the plant's fuel costs.

Recommendation 12.5:
A management plan for radioactive waste should be started as a priority project. Efforts should be made to obtain a contract for the reprocessing of depleted fuel cells.

Chapter 13

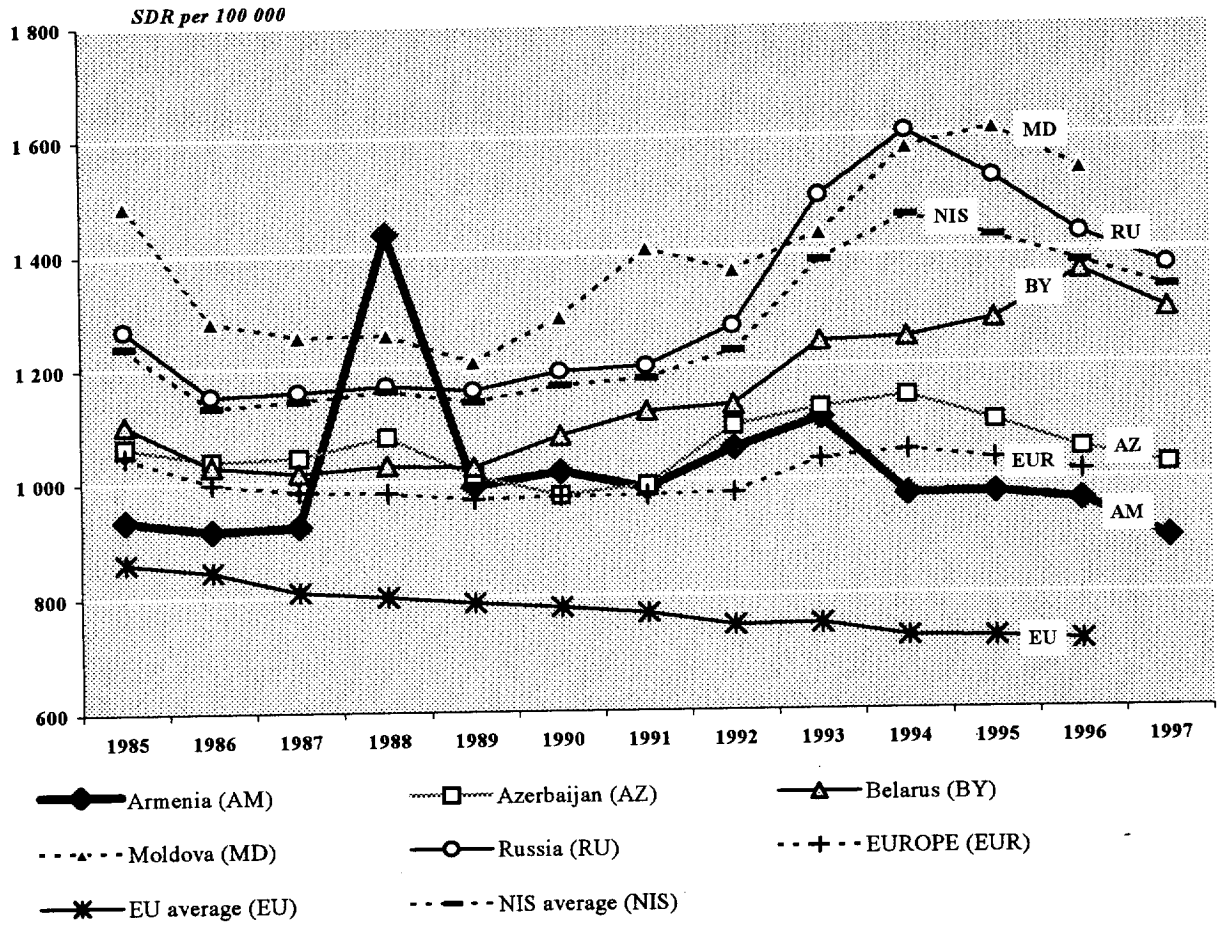
HUMAN HEALTH AND THE ENVIRONMENT

13.1 Overall health status and environmental conditions

Population development

The natural growth of the Armenian population was 5.3 per 1 000 population in 1997, more than three times less than in 1987. Between 1983 and 1997, births have steadily decreased (from 25.1 to 11.60 births per 1 000 population). This decline was paralleled by a dramatic increase in abortions, which almost doubled between 1990 and 1996, reaching 650.7 per 1 000 live births. During the period 1988-1992, more than 330 000 refugees came from Azerbaijan.

Figure 13.1: Mortality rates in a few newly independent States, 1985-1997



Source: WHO - Health For All Database, June 1999.

SDR: Standardized death rate.
EUR: WHO European Region.
EU: European Union.

After a slight decline in the early 90s, which affected all of eastern Europe, life expectancy at birth started to increase again in 1993, reaching an average of 74.1 years in 1997. This relatively high level places Armenia much closer to the European Union's average (77.6 years) than to that of the newly independent States (NIS) (67.4 years). Women's life expectancy is 5.5 years longer than men's. The proportion of the population over 65 years old is 8.3 per cent and constantly increasing.

Since the end of the 1980s, infant mortality has been reduced. It is some 40 per cent down, from 24.7 per 1 000 live births in 1985 to 15.4 in 1997. Interregional differences are still relatively high, ranging from 10.0 deaths per 1 000 live births to 18.0. Although the average rate is about 3 times higher than that of the European Union, it is better than the NIS average (21.1 per 1 000 live births). Approximately 50 per cent of infant deaths are caused by diseases of the perinatal period. Acute diarrhoeal and respiratory infections are still a major concern. According to UNICEF worldwide statistics for under-5 mortality rates, Armenia ranked 108th, out of 189, in 1996.

Crude death rates peaked in 1988, the year of a disastrous earthquake in the areas of Spitak and Gumayri (previously named Leninakan) with 25 000 deaths, and decreased thereafter. They were at 6.3 per 1 000 population in 1997. International comparisons based on standardized mortality rates indicate that Armenia has the lowest mortality rates among east European countries and did not experience the sharp increase in mortality recorded in that part of Europe in the early 1990s (Figure 13.1). It is not possible to single out specific reasons for this overall better status in spite of greater social and economic hardship. The possibility that the traditional "extended family" structure may have played a "protective role" has been put forward as one explanation.

Development of selected causes of death

After increasing to a maximum of 639.8 deaths per 100 000 population in 1993, standardized rates have declined to 503.4 per 100 000 population in 1997. This trend is similar to that observed in other NIS, although Armenia's rates remained below the averages reported in that part of the region.

Table13. 1: Standardized mortality rates for the most important causes of death, 1997

	Armenia		EU Average *		NIS Average	
	per 100 000 population	%	*per 100 000 population*	%	*per 100 000 population*	%
All causes	**895.9**	**100**	**718.0**	**100**	**1 334.2**	**100**
Diseases of the circulatory system	503.4	56	284.7	40	733.2	55
Malignant neoplasms	125.0	14	193.7	27	172.6	13
Trachea/bronchus/lung cancer	27.1		39.3		34.3	
Breast cancer	22.8		30.2		21.1	
Cancer of the cervix	5.7		2.8		6.8	
Respiratory diseases	54.7	6	57.1	8	78.6	6
Bronchitis, emphysema, asthma	38.8		13.3		38.7	
External causes	41.5	5	42.6	6	151.6	11
Traffic accidents (all)	6.4		11.2		14.9	
Traffic accidents (males < 65)	8.3		16.2		23.1	
Traffic accidents (females < 65)	2.8		5.0		6.8	
Homicides (all)	2.8		1.2		17.6	
Suicides (all)	2.4		11.2		29.6	

Source: WHO - Health For All Database, June 1999.

* 1996 data.

The most important causes of death are diseases of the circulatory system. Malignant neoplasms are the second cause of death, with a standardized death rate below those in the EU and in the NIS. Death rates for some types

of cancer are reported in Table 13.1. Cancer incidence has decreased since 1989. Diseases of the respiratory system account for 6 per cent of the total. External causes are the fourth cause of mortality, similar to the EU average, and more than three times lower than the NIS average. Traffic accidents, homicides and suicides accounted for some 15 per cent, 7 per cent and 6 per cent of the external causes, respectively. Rates were around four times higher among males than females. Armenia has one of the lowest suicide rates in the WHO European region. The reported incidence of alcoholic psychosis is also comparatively low (1.66 per 100 000 population), although 1997 rates were about three times higher than 10 years previously.

The death rate for traffic accidents is one of the lowest in the WHO European region, almost half the EU average, with a more than threefold decrease between 1990 and 1997. 261 people died and 1 448 were injured as a consequence of traffic accidents in 1997. In spite of these relatively low figures, the number of people who died per 1 000 casualties (severity index) was among the highest in Europe (153). The lack of adequate and timely emergency treatment for casualties partly explains this high number of fatalities. The majority of accidents involved a collision between vehicles and pedestrians, who account for more than 50 per cent of the total number of deaths. This proportion is much higher than that observed on average in the European region (25-30 per cent). Alcohol was a factor in around 4 per cent of traffic accidents.

Trends in morbidity

Hospital admissions for respiratory diseases have been decreasing during the past few years. This may reflect more a crisis in the health care system, than a real improvement, as decreases in hospital admissions have also been reported for other common diseases, such as infectious and parasitic diseases, and those of the circulatory and the digestive systems. Although less dramatic than in other NIS, the increasing incidence of tuberculosis, reaching 37.7 per 100 000 population in 1998, with 1 420 new cases, is an important public health concern.

Since 1994, Armenia has been experiencing a resurgence of malaria. In 1998, 1 167 cases were reported, with an incidence of 31.5 per 100 000 population. This is twice the NIS average, and 10 times the EU's. The majority of malaria cases are recorded in the Ararat valley, and are blamed on deteriorating drainage systems (for details see Chapters 6, 8 and 11), resulting in waterlogging, which in turn provides a breeding ground for mosquitoes. The high number of displaced persons as a result of the conflict with Azerbaijan, the difficulties in obtaining basic equipment and supplies, and the after-effects of the 1988 earthquake have also contributed to creating conditions favourable for the re-emergence of this disease.

Table 13.2: Intestinal and diarrhoeal diseases, 1997-1998

	Total cases		% change
	1997	1998	1997-98
Typhoid fever	28	21	-25.0
Other salmonellosis	436	429	-1.6
Dysentery (Shigellosis)	882	1 216	37.9
Acute intestinal infections caused by:			
- identified pathogens	653	874	33.8
- unknown pathogens	2 457	2 831	15.2
Acute enteric diseases	3 992	4 921	23.3
Cholera	...	229	...

Source: SHESS, Ministry of Health, 1999.

After having peaked in 1989, the reported incidence of hepatitis has decreased more than threefold, and in 1997 it was 84.7 per 100 000 population. In 1998, 2 983 cases of hepatitis A (79.0 per 100 000 population) and 263 cases of hepatitis B (7.0 per 100 000 population) were registered, i.e. hepatitis A accounts for more than 90 per cent of the total.

Data on intestinal and diarrhoeal diseases reported by the State Hygienic-Epidemiological Surveillance Service (SHESS) for 1997 and 1998 are summarized in Table 13.2. They show an overall increase in acute enteric infections and dysentery. These diseases are indicators of poor hygienic conditions, as they are transmitted by contaminated food and water and through the faecal-oral transmission route. One cholera outbreak with 229 cases was reported in 1998.

13.2 Environmental conditions associated with health risks

Ambient and indoor air pollution

The geographic position of the most polluted cities (Yerevan, Ararat, Vanadzor and Hrazdan) in valleys between mountain ranges, where climatic conditions do not favour the dispersion of pollutants, helps maintain urban pollution at relatively high levels. Taking into consideration the number of inhabitants, it can be estimated that up to nearly 1 400 000 people (i.e. slightly less than 40 per cent of the Armenian population) might be exposed to high levels of air pollution in these cities. For details about air pollution levels and management, see Chapter 9.

Monitoring data from the four cities show that suspended particulates and lead are the pollutants of major health concern, and their concentrations often exceed both national maximum permissible concentrations (MPCs) and WHO guidelines. In Yerevan, monitoring data from 1997 indicate that transport emissions (NO_2 and lead) were higher than in 1994. MPCs for dust and NO_2 were also exceeded in Vanadzor and Ararat during the period 1994-97. In Yerevan, SO_2 mean values also often exceed both national MPCs and WHO guidelines, but not in other places. Mean daily dust levels often exceed 0.15 mg/m^3 and the annual mean is also above 0.15 mg/m^3. Episodes of winter smog, which are characterized by the co-presence of SO_2 and total suspended particles (TSP) at relatively high levels, can have an effect on daily mortality fluctuations, as well as on respiratory symptoms and pulmonary function in the exposed population, particularly in vulnerable groups such as children, the elderly, and people suffering from chronic respiratory diseases, such as asthma.

It is extremely difficult to make a quantitative estimate of the health effects attributable to exposure to particles, as data are scarce. An attempt can be made for Yerevan, where dust pollution is particularly high. Estimates from different European cities indicate that between 4 per cent and 13 per cent (i.e. approximately 7 per cent) of all deaths (excluding external causes) in people aged 35 or older can be associated with prolonged exposure to particulate matter. Applying this figure to Yerevan, dust pollution could cause some 500 deaths per year (between 300 and 900). Estimates of the health effects of short-term exposure to dust in Yerevan produced for the NEAP suggest that: (a) 250 - 500 children might suffer from diseases of the lower respiratory tract, (b) 10-20 deaths per year may be related to short-term peaks in pollution, (c) a decrease of over 5 per cent in the mean level of pulmonary function can be expected in 200 000 – 250 000 persons, and (d) 3 - 7 per cent new cases of obstructed respiratory tract disease can be expected in association with TSP peaks above 0.15 mg/m^3.

Although lead is not monitored regularly, and present methods do not guarantee the reliability of data, it would seem that, in Yerevan, lead concentration in air in 1995 was in the range of 1.0 - 3.5 μg/m^3, which significantly exceeds the WHO guideline value of 0.5 μg/m^3 (annual mean).

Other ambient air pollutants of health relevance, such as tropospheric ozone and carcinogens like benzene and benzo-a-pyrene (BaP), are not monitored.

Indoor air quality is not monitored, and very little information is available. Experts assume that indoor pollution was a very serious problem, especially during the 1993-95 energy crisis, when homes had neither electricity nor heating, nor running water, and people used to burn wood and any sort of materials, including coal, oil, polymer material, waste, paper, clothes, shoes, etc., for heating and cooking purposes. As a result, and also due to the high prevalence of smoking, measurements conducted in 1993-95 by the Institute of General Hygiene and Occupational Medicine in 20 domestic environments showed a high dust level (in the range of 0.6-2.1 mg/m^3), a high CO level (in the range of 1.5-4.5 mg/m^3) and low indoor temperatures. As the energy crisis is now under control (see Chapter 12), problems due to the combustion of inappropriate fuels no longer seem as dramatic as

they used to be. Nevertheless, the lack of operational central heating promotes the use of locally produced heating devices, often fuelled with wood or low-quality liquid fuel, which may increase indoor pollution.

No data are available on indoor levels of NO_2. The long-term exposure of children is positively associated with an increased risk of symptoms and diseases of the lower respiratory tract. It appears that this problem should be of relatively minor importance, as only around 15 per cent of households have gas cookers.

In 1998, indoor air measurements were taken in the plastic and metal prefabricated homes given as humanitarian help during the earthquake. Lead was found in the paints, although the use of leaded paint is prohibited in residential and public premises.

During the 1970s and 1980s, outbreaks of acute respiratory problems and general sickness were reported frequently from the areas surrounding the Nairit chemical plant in Yerevan, the cement factory in Hrazdan, the Roubin chemical plant in Vanadzor and the two cement factories in Ararat. Reporting of acute respiratory diseases decreased during the 1990s, while chronic respiratory diseases apparently increased. There has been speculation as to whether the past prolonged exposure to air pollutants may account for some of the reported increase.

The Institute of General Hygiene and Occupational Medicine has also measured lead concentration in Byureghavan, a lead crystal industry centre. The concentration of lead in indoor air samples taken from the classrooms of a school located 300 metres from the factory was in the range of 0.3-1.0 $\mu g/m^3$. The analysis of lead in settled dust samples from selected indoor environments (classrooms, dormitories, cafeteria, clinic, store, homes) showed a concentration ranging between 115 and 1 700 $\mu g/m^2$. By comparison, a standard in Germany sets maximum lead fallout at 250 $\mu g/m^2$.

Between 1992 and 1996 the Institute also investigated blood lead level in 54 children in the neighbourhood of Byureghavan in Yerevan, comparing it with that of 218 children from other residential areas of the city. Results indicated a mean lead concentration of some 100 µg/l for the children of Byureghavan, compared to 65 µg/l in the control sample. The average levels of lead observed in Byureghavan children correspond to the lowest-observed-effect (LOE) levels for electrophysiological changes in the central nervous system in children.

No data are available regarding the prevalence of tobacco smoking at national level. It has been estimated that smoking prevalence is about 50 per cent or higher among males, low among middle-aged women, and starting to increase among young women. It is believed that about one third of Armenians smoke, and that smoking among teenagers is increasing (36.6 per cent), with girls accounting for around half of young smokers. Most young people are reported to have started smoking before the age of 16. In 1995, the burden of tobacco-related deaths was estimated to be 4 400, i.e. one quarter of male deaths, and 3 per cent of female deaths. Compared with 1985 estimates, the percentage of deaths (males and females) attributable to tobacco increased from 10 per cent to 16 per cent.

The production of corrugated asbestos sheets in Ararat has ceased. However, such sheets as well as asbestos cement pipes appear to be widely used in construction. They may stem from old national production stocks, but may also be imported. The use of electrical appliances containing asbestos insulators is equally widespread. No data on asbestos concentrations are currently available, and asbestos is not monitored.

Drinking water

Outbreaks of water-borne diseases are reported to be on the rise. In 1995 one outbreak involving 401 persons was recorded, while in 1998 eleven outbreaks were reported, affecting 1 005 persons. There are problems and related health risks at all levels of the management of water resources.

Drinking water disinfection is carried out by chlorination. Shortages in the supply of chlorine, its high price, and the poor maintenance of many of the existing 123 water disinfection plants, result in failures in the microbial

quality of water. Interruptions in water supply decrease the water pressure in the distribution system, and together with leaking pipes, further increase the risk of water contamination. See also Chapter 8.

In rural areas it is even more difficult than in urban areas to ensure an adequate quality of drinking water, due to the scarce professional and technical resources available for the maintenance and repair of the water supply systems which are operated by the local communities. According to information provided by the Ministry of Health, 60 per cent of rural areas cannot disinfect water due to the lack of chlorine, professional staff and/or equipment.

Data from 1998 collected by the SHESS show that 30 out of 298 samples (i.e. 10 per cent) taken from 25 sampling points in first-class open reservoirs were contaminated by faecal bacteria and/or helminths, due to the discharge of untreated waste waters. Approximately 17 per cent of 2263samples taken in 1998 from 245 sampling points in second-class reservoirs were found to be contaminated with microbes and 3.0 per cent with helminths.

35 956 samples from water-supply systems were analysed in 1998. About 16.5 per cent of the samples taken from central water-supply pipes and about 29.5 per cent taken from non-centralized systems did not meet microbial standards. The same was true for 14.7 per cent of the 32 737 samples of tap water analysed in 1998. Also, 10 per cent of samples taken from kindergartens and schools were found to be biologically contaminated.

The major problem with chemical-physical parameters in drinking-water samples is the low level of residual chlorine (14.2 per cent of the 18946 samples analysed in 1998 did not meet the standards). In drinking water analysed in Yerevan in 1995, the proportion of samples showing an insufficient level of residual chlorine was found to be 43.5 per cent, while 20 per cent of the samples exceeded the threshold limit value (TLV) of nitrate, indicating that the problem of water quality is particularly acute in the capital.

All samples taken from the first-class reservoirs in 1996 were found to have levels of chemical contaminants below the TLV. By contrast, 11.3 per cent of samples from second-class reservoirs were found to exceed TLV for at least one parameter. A high natural level of lead was found in the Debet river basin, in the north of Armenia, where concentrations in freshwater are 5 to 200 times higher than those in the medial biogeochemical zone, where conditions are considered optimal. Water samples taken in the villages of Tumanyan and Akhtala were found to contain on average 18 µg/l and 15 µg/l, respectively. In this area, endemic diseases of the nervous system (cephalgia, myalgia, ischialgia, and gastralgia), gingivitis, and hypermenorrhoea have been reported, and related to the possible exposure of the population to lead-rich water.

The costs associated with water-borne diseases were estimated during the development of the NEAP. They were based on disability adjusted life years (DALYs) and calculated for three different sets of assumptions. The resulting cost estimates range from US$ 16 to 68 million. Based on the assumption that approximately 37 per cent of water-borne diseases could be prevented by repairing the water pipes or combining this with increasing the water pressure, it is estimated that the implementation of remedial action could save between US$ 4 and 25 million annually.

Food

Food-related disease outbreaks are rarely reported to doctors, also because of the frequency of self-diagnosis and medication. This results in a possible underestimation of the number of food-borne related diseases. The exceptions are botulism and certain types of food poisonings (e.g. from mushrooms), where reporting is required. The cases of botulism are mostly due to contaminated home-made canned produce (greens, other vegetables), and seem to have been increasing over the past three years. In 1996, an outbreak of food poisoning by chemicals affected 22 persons.

Food safety monitoring is done on the basis of the Sanitary-Epidemiological rules "Hygienic requirements of the quality and safety of food and raw foodstuff" of 1996. The chemical contamination of food was tested in 1996, in

13 085 samples. They showed very low contamination of meat with nitrites, and of vegetables with nitrates, and no indication of contamination with heavy metals in the 1 648 tests for these parameters. Chemical contaminants were found in 19 samples.

The most frequent micro-organisms found in foodstuff samples by the State Hygiene and Epidemiological Surveillance Service (SHESS) were *Escherichia coli, Staphylococcus aureus, Salmonella* and *Proteus*. Around 3 to 9 per cent of samples collected between 1993 and 1998 were contaminated, and the figure increased two to threefold during the period. The SHESS also examines foods for their content of heavy metals, pesticides, food additives, nitrosamines, nitrates, nitrites, aflatoxins, antibiotics, histamine and radionuclides. Food industries are inspected once or more often a year depending on their potential to pose an epidemiological risk (for example, factories producing dairy products are inspected more frequently than bakeries). Food shops and places where food is prepared and served to the public (including cantines and restaurants) are also inspected.

In 1999 for the first time the SHESS carried out a major survey by sampling foods on sale by street vendors in Yerevan. Out of around 300 and 120 samples analysed in two rounds of sampling, 46 per cent were contaminated with microbes, most frequently hot dog sausages, salads with different types of sauces and dressings, cheese and milk. These findings led to interest in the press and to an intervention in newspapers and TV to warn consumers against eating food sold in the street. However, no remedial intervention was directed at the vendors to improve the safety of food on sale in their kiosks.

Soil contamination and waste

Oil spills and lead are reported to be the main soil pollutants. The lack of developed waste management (for details, see Chapter 7) and of regulations for the production, import, marketing and use of chemicals such as pesticides and fertilizers (see Chapter 11) poses major risks of accidental poisoning and environmental contamination. The risk of exposure to dangerous chemicals affects a significant number of people, as approximately one third of the Armenia population lives in rural areas, and agriculture employed about 550 000 workers (i.e. 41 per cent of the labour force) in 1997.

High levels of heavy metals, and of lead in particular, have been detected by the Academy of Sciences in Yerevan. Most of the contamination stems from factories (crystal, ceramics and paints) and leakage of leaded fuels. Very little research is available on health effects related to exposure to contaminated soil and waste. Research carried out 1996 by the National Institute of Health found an association between perinatal mortality and areas with soil pollution with lead and copper. It is also believed that the relatively high concentration of lead in children's blood is in part due to the ingestion of contaminated soil particles.

Also, save for a small department of clinical toxicology operating in a general hospital in Yerevan, there is no toxicological information centre in the country. The Institute of Environmental Hygiene and Preventive Toxicology (part of the SHESS) is willing to develop related projects and has developed relevant competence and skills in this area.

Risks of the transmission of vector-borne diseases, such as leptospirosis and tularaemia transmitted through contact with rodents, cats and dogs, are associated with current waste management. In 1997, the Ministry of Health estimated the rat population at 2 million, of which 1 million in Yerevan. While the number of registered cases of tularaemia and leptospirosis between 1992 and 1996 was low (38 in total, of which 2 of leptospirosis), the growing population of rats and the generally deteriorating hygienic conditions may lead to increases in this type of diseases.

Ionizing radiation

It is reported that since the re-opening of the Armenian NPP in 1995, radiation levels did not exceed the 0.5 μSv/h standard prescribed for the NPP facilities, nor the limit of 0.2 μSv/h in the 9 km zone of monitoring surrounding the plant (with 8 monitoring points) as well as in the other 14 monitoring stations which are present

in the rest of the country. An emergency preparedness plan for this installation was drawn up in 1997, with the training of personnel, and a simulation exercise has been performed. For details about the "Magate" NPP and the relevant institutional and managerial aspects regarding nuclear energy, see Chapter 12.

The geological characteristics of Armenia make the presence of a high natural level of radon very likely, although no surveys have been carried out to investigate this issue. In addition, the use of tuff (and other local stones such as basalt and granites) as building material poses a potential risk of indoor contamination. Reports from the 1980s suggest that indoor concentrations are not a problem, but the methods used in the studies are not documented. On this basis, nothing can be concluded on the actual level of health risks due to the exposure to radon, nor on the possible risk posed by using local stones, and tuff in particular, as building material. Although the Armenian experts have a theoretical knowledge of how to investigate the issue, the lack of measuring instruments and of practical training has not allowed so far to start such activities. Armenian experts have requested IAEA to include the country in the radon programme and take radon measurements.

Noise

Transport activities account for approximately 90 per cent of the noise emissions in urban areas. Leisure time facilities and industrial enterprises are also reported to be sources of ambient noise. Noise is not regularly monitored at present. In the past, surveys were carried out in 14 towns every five years. Acoustic maps of road noise were produced for five cities, using mobile laboratories. These labs are still in working condition. According to their maps, nearly 30 per cent of the population in Yerevan and 20 per cent of the population in Etchmiadtzin were exposed to more than 65 dB(A)Leq.

During the period 1980-1992, noise levels in Yerevan increased rapidly. In residential areas near highways, levels of 80-86 dB(A)Leq were measured. West European standards consider 65 dB(A) as the maximum permissible level for noise measured during the day-time in urban areas, and 55 dB(A) as the limit during the night-time. It can be assumed that noise decreased between 1992 and 1997, although the improvement in the economic situation after 1997 is expected to have brought noise back to high levels. Possible causes are increasing motor vehicle traffic, the declining quality of road pavements and the ageing motor vehicle fleet.

Air traffic has also increased. Two towns are located near the international airport in Yerevan, Etchmiadtzin with a population of 64 900 and Parakar with 10 000 inhabitants. Noise measurements in these towns was up to around 75-90 dB(A) in 1993. Another small airport near the centre of Yerevan affects about 100 000 to 115 000 inhabitants, who are exposed to sound levels around –65-75 dBLeq 24 hrs and often complain, especially about the annoyance caused by night flights.

The problem of noise in urban settlements is exacerbated by the fact that buildings are not protected against noise, by the proximity of buildings to roads with heavy traffic and by narrow streets. Road traffic in Yerevan is intense, with 101 out of the 106 areas having a traffic flow of 4 000 – 9 000 vehicles per hour (with measured levels of noise around 85 dB(A)), and only 5 areas showing a traffic flow of less than 1 000 vehicles/hour (with noise measurements of 72 dB(A)).

Only very few studies have attempted to investigate the health effects of exposure to ambient noise. One surveyed 4 500 inhabitants of Yerevan, and showed that people living in apartments where noise exceeded 60 dB(A), and even those living in less noisy buildings, experienced serious annoyance and sleep disturbance. Another study involved audiometric research among students and found a higher prevalence of hearing problems among students from the noisiest areas. Other epidemiological investigations carried out between 1985-1990 in the same areas of Yerevan and in Hrazdan found that residents in noisy areas were more often ill than residents in control areas, and that the health effects were more serious in those who had lived longer in the noisy areas.

Further research compared people living in quiet (below 40 dB(A)Leq) and noisy (70-80 dB(A)Leq) environments, while working in noisy and quiet environments, respectively. Those who lived in a noisy home and worked in a quiet place had worse hearing and autonomous nervous system reactions than those living in a quiet

home and working in a noisy place. Hearing was measured through tonal audiometry, audio-motor neuronal reflexes and skin galvanic reactions. Noise was measured once at peak times during the day and once past midnight. In spite of the availability of equipment and trained personnel, at present there is no noise monitoring because of a lack of resources.

Natural disasters

Almost all regions of Armenia suffer catastrophic consequences of flash floods (covering an estimated 30 per cent of the territory), which occur every 2-3 years in the Meghri and Vedi river basins and near Goris.

About 80 per cent of Armenia is subject to the risk of moderate or strong earthquakes. Particularly disastrous was the earthquake of 7 December 1988 in the area of Spitak and Gumayri. This resulted in an estimated 25 000 deaths and 130 000 injured persons. In addition, between 500 000 and 700 000 people became homeless. The most common cause of injury resulted from the vibration-induced collapse of buildings, which trapped victims.

A study assessing the relation of increased mortality and morbidity to personal loss and damage following the 1988 earthquake shows that the highest number of deaths from all causes and from heart disease were observed within the first six months after the earthquake. The study indicated also that longer-term increased rates of heart disease and chronic disease (hypertension, diabetes mellitus, and arthritis) were related to the degree of loss of family members and material possessions as a consequence of the earthquake.

Occupational health

The diagnosis and reporting of occupational diseases has dramatically decreased due to the decline in industrial activity, unemployment and emigration of young workers. It is very difficult to assess the working conditions and occupation-related pathologies of self-employed workers, and of those employed in informal economic activities. The result is that little information is available about occupational health status and issues. Occupational diseases are registered and certified by the Institute of General Hygiene and Occupational Diseases, which reports annually to the SHESS at the Ministry of Health. The negligible monetary value of compensation awarded to workers diagnosed with occupational diseases is an additional disincentive to report these diseases. Other reasons for under-reporting include the lack of adequate information available to general practitioners on occupational diseases and the dismantling of medical centres that used to be attached to the workplace (at the moment, only the Nuclear Power Plant, the railways and airlines still maintain these centres). In 1999, out of only nine cases of occupational diseases registered, five involved civil aviation pilots, who were diagnosed with neuritis (it should be noted that this category of employee is entitled to high sick-leave allowances).

Vibration disease accounts for about 40 per cent of all reported cases and neuropathy of the hearing nerve accounts for about 30 per cent. Exposure of workers to molybdenum (used in the steel and electricity industry), silicosis, chronic bronchitis, dermatitis, sensitization and chronic poisoning were among the other occupational diseases that were investigated. Exposure to lead, especially in crystal factories, has been investigated through analyses of lead concentration both in the working environment and in blood samples taken from exposed workers. Results showed that the blood of some groups of workers of the mixing, melting and casting areas had lead levels exceeding United States and European occupational threshold concentrations. The examination of 16 workers with high lead levels in their blood revealed signs of chronic lead intoxication in four of them, dust bronchitis in three and early symptoms of pneumoconiosis in one.

Armed conflict

The armed conflict between Armenia and Azerbaijan lasted from 1992 to May 1994, when a cease-fire was enforced. It resulted in an estimated 15 000 deaths and more than a million displaced persons. According to UNHCR estimates, there are at present 311 000 refugees and displaced persons registered in Armenia. It is also estimated that 64 000 have temporarily left the country, because of the difficult economic situation.

The main health problems of refugees are related to their precarious sheltering conditions (including access to and quality of water and sanitation systems; access to suitable fuels for heating and cooking purposes), and to the economic hardship which affects particularly the most vulnerable groups, including the elderly (more than 30 per cent of the refugees are over 60), the disabled and female-headed households.

13.3 Environmental health policy and management

Legal instruments

The main legal instruments relevant to environmental health are:

- *The Law on Medical Aid and Services to the Population of 4 March 1996.* It is the basis of the present health care system.
- *The Law on Ensuring Sanitary-Epidemiological Safety of the Population* (Law 418 of 18 November 1992) and *Resolutions N518 of 1993 and N107* of 1998. They oblige the Government to protect the population (including future generations) against the negative effects of environmental conditions, and establish the responsibilities of the State Hygienic-Epidemiological Surveillance Service (SHESS), as a Department within the Ministry of Health and Social Security.
- The government decree *On the Protection of the Public in Emergency Situations* of December 1998, providing an elaboration of the bills and norms which govern the work of the Emergency Medical Care Service.
- *The Law on Safe Utilization of Atomic Energy for Peaceful Purposes" of March 1999*
- *The Law on Food Safety of 1999*
- *The Law on Certification of products of 1999*
- *The Law on Veterinary*
- *The Law on Flora*

In addition, many of the environmental legal instruments reviewed in Chapter 1 include provisions that are relevant to environmental health management, notably the Fundamentals of Legislation on Nature Protection, the Air Protection Law, the Water Code and the Land Code.

Policy commitments relevant to environmental health

Such commitments exist in national programmes as well as in international instruments that are ratified or accepted by Armenia. The National Environmental Action Plan (NEAP) provides a general framework of priorities, and an action plan addressing the various aspects of environmental protection and improvement, including environmental health. For details, see Chapter 1.

The development of the National Environmental Health Action Plan (NEHAP) is being carried out with the support of UNDP and of WHO, and with input from the Ministry of Nature Protection. It aims at providing a basis for placing environmental health higher on the political agenda, at creating a common understanding of the priority of environmental health, and at agreeing on the required actions. The draft NEHAP lists the creation of a unified monitoring system for the collection of data on environment and health as a priority. It also indicates the need to include environment-related diseases and hazardous environmental factors in the statistical forms currently used for the collection of health information.

Armenia is showing a strong interest in and political commitment to keeping pace with relevant international developments in environment and health matters, establishing and reinforcing cooperation with the European Union and relevant international organizations. The following initiatives should be noted in addition to the relevant topics covered in Chapter 4:

- The "Health for All National Approach - The health policy development in Armenia", being developed by the Ministry of Health, provides a framework for the health sector and all involved ministries over the next 10

years. The policy includes commitments related to environmental health and to inter-sectoral cooperation, and sets quantitative targets to be achieved by the year 2010, in line with the new WHO Health For All 21 policy.

- By adopting the Declaration of the Third Ministerial Conference on Environment and Health (London, 16-18 June 1999), Armenia is committed to implementing the principles set out in the document "Towards good practice in health, environment and safety management in industrial and other enterprises". This entails assessing, strengthening or establishing national policies designed to facilitate good practice in all types of enterprises.
- By signing the "Protocol on Water and Health to the 1992 Convention on the Protection and Use of Trans-boundary Watercourses and International Lakes" in 1999, Armenia has taken a legally binding commitment to protect and improve health through improving water management, including the protection of water ecosystems, and through preventing, controlling and reducing water-related disease.
- The adoption of the Charter on Transport, Environment and Health commits the country to making transport sustainable with regard to health and the environment, and to implementing a plan of action setting quantitative targets for transport safety, for reducing air and noise pollution, and for cycling and walking.
- Participation in the UN/ECE Programme of Joint Action on Transport and the Environment provides the framework for developing and implementing a comprehensive set of policies and actions towards more sustainable transport.
- Armenia is a member of the World Organisation for Animal Health (OIE), and receives information on relevant epizootic diseases, including those that may pose a threat to human health.

More specific policy goals are defined as follows:

- The problem of increasing tuberculosis is being addressed through the National TB Programme, which includes the DOTS (Directly Observed Treatment, Short-course) strategy, in cooperation with WHO.
- The prolonged absence of malaria for 30 years has weakened preventive services. The Ministry of Health has identified the fight against malaria as one of the country's public health priorities, on which cooperation with WHO is under way.
- Interruptions in the supply of pumped drinking water are among the leading causes of microbial contamination. The switch to gravity-fed water supply is one of the key priority measures to reduce the high demand for electric power by pumps.
- Improved radiation safety is sought by controlling and upgrading nuclear medicine and radiotherapy, improving the infrastructure for handling and managing radioactive waste, developing a register of sources of all ionizing radiation, improving the preparedness for emergencies through the training of technical and medical personnel and implementing a Quality Assurance (QA) programme in diagnostic radiology.

More specific events and programmes are also developed in international cooperation. A WHO consensus meeting held in Yerevan on 9-11 April 1997 with the support of Italy and UNDP brought together representatives of the Ministries of Health, Nature Protection, Agriculture, Economy, Finance, Urban Construction, and Local Government authorities. The meeting formulated a set of resolutions to address water policies and legislation, as follows:

There is a need to revise drinking-water legislation. The new law should:

- Identify the authorities and the responsibilities of specified agencies, including responsibilities for developing, coordinating and applying specific regulations and standards
- Specify the responsibility of water suppliers for monitoring and reporting on supply service quality, and the responsibility of regulatory agencies for enforcing the laws, regulations and standards
- State the financial bases and regulatory mechanisms governing water-supply agencies
- A pilot project should be implemented to gain experience with the management of water supply by independent agencies. It should address supplier financing; tariff setting and collection, and the monitoring of compliance with agreed service quality targets.
- An intersectoral governmental commission should be created to coordinate the multisectoral impacts of water use on water flow

- A master plan for water management should be established, with sub-elements addressing drinking water and water for rural development
- Priority issues should be implemented without delay, in particular the need to ensure the adequacy and operation of existing water supply and sanitation infrastructure, and to ensure the availability of chlorine for water disinfection.

As a follow-up to the above recommendations, Armenia has started at the end of 1999 a project "Integrated Water Resources Management", supported by the World Bank.

Ambient standards

The existing system of (GOST) standards dates back to the former Soviet Union. The most recent among them were developed at the end of the 1980s. They need both simplification and updating. In particular, current thresholds limits for a number of pollutants need to be harmonized with WHO guideline values for both drinking water and air quality.

The present system of standards covers hygiene norms and quality control for drinking water, air, waste, soil, food and noise. Standards and related technical requirements are registered with the Management Administration of Standardization, Metrology and Certification. There can also be technical norms, e.g. those issued by the Ministry of Health, which are not centrally registered.

Air quality standards are based on the concept of maximum permissible concentrations (MPC) and threshold limit values (TLV), and cover 420 indicators, often with more stringent limits than those set in the WHO Air Quality Guidelines. Table 9.5 compares national standards and WHO Quality Guidelines.

Water and food quality standards are from 1982 and 1984. Table 13.3 compares some Armenian water quality standards and WHO Water Quality Guidelines.

Noise norms for residential areas require that noise measurement taken at a distance of 2 metres from new buildings do not exceed 55 d(B)Laeq during the day-time and 45 d(B)Laeq during the night-time. For existing buildings, the day-time and night-time limits are 65 / 55 d(B)Laeq, respectively.

Table 13.3 Comparison between Armenian and WHO Water Quality Guidelines for selected pollutants

	Armenian Guidelines	WHO Guidelines
Microbiological quality	< 100 micro-organisms / ml < 3 E.coli / l	Not detectable in any 100 ml sample (E.coli and other thermotolerant coliform bacteria; Total coliform bacteria)
DDT	Not available	2 000 µg / l
Lindane	Not available	2 000 µg / l
Nitrate (as NO_3)	45 µg / l	50 000 µg / l
Nitrite (as NO_2)	3.3 µg / l	3 000 µg / l (provisional)
Lead	-	10 µg / l
Cadmium	0.03 µg / l	3 µg / l
Mercury	0.005 µg / l	1 µg / l
Copper	1 000 µg / l	2 000 µg / l (provisional)
Arsenic	50 µg / l	10 µg / l (provisional)

Source: GOST 2874-82 and GOST 2761-84; WHO Guidelines for Drinking water quality (1996, Vol.2).

Selected other management instruments

The advertising of tobacco is still allowed in the Armenian press, television and radio, although advertisements must carry a disclaimer warning consumers against the health risks of tobacco smoking. The Ministry of Health views legislation and the education of teachers and students as the main strategies to control tobacco smoking.

International activities include UNHCR help to displaced persons in Armenia. Assistance is concentrated on rehabilitating residential buildings for refugee accommodation, providing health care to the elderly living in public retirement homes, working with the Ministry of Health, UNFPA, UNICEF and NGOs to improve the conditions of women who are at high risk of sexually transmitted diseases and who often terminate pregnancies (women represent 70 per cent of the unemployed). In addition, as refugees often have to resort to felling trees for heating and cooking purposes, the World Food Programme (WFP), with UNHCR collaboration, in 1998 implemented several community-based tree-planting and irrigation programmes. WHO has been assisting the health care system, for instance through capacity building in water and sanitation, with emphasis on engineering aspects, epidemiology and outbreak control.

Armenia is one of the 23 east European countries participating in the Public Health Information Network for Eastern Europe (EUPHIN-EAST) project, funded by the EU INCO COPERNICUS programme. EUPHIN-EAST aims at interlinking the national health databases of participating countries, and facilitating the collection, sharing and transmission of data between national users and the WHO.

Institutions managing environmental health

In addition to the Parliament and the Standing Committee on Health, Social Issues and Environment, several ministries share responsibilities for different aspects of environmental health. These include the Ministry of Health and Social Security, the State Health Agency, the Ministry of Nature Protection (through the State Inspectorate of Nature Protection, regional nature protection inspectorates, city and community departments, State Hydro-meteorological service), the Ministry of Agriculture (through the State Veterinary Inspectorate), the Ministry of Education and Science, the Ministry of Finance, the Ministry of Economy, the Ministry of Internal Affairs (State Automobile Inspectorate and fire department), the Ministry of Defence (State department of emergency situations), and the Ministry of State Register and Statistics.

Within the Ministry of Health, the main institution for environmental health is the *State Hygienic-Epidemiological Surveillance Service (SHESS)*. Its responsibilities include the surveillance of food, occupational, and communal hygiene, as well as of hygiene of children and adolescents. The main tasks performed by the SHESS and its centres encompass:

- Development and approval of sanitary norms
- Implementation of state sanitary surveillance directed towards the improvement of nutrition and food safety; environmental quality of air, water and soil; conditions of built environment (residential, recreational, etc) to reduce the exposure to noise, vibrations and electromagnetic fields, sanitary conditions of workplaces; children and adolescents health.
- Methodological management of the sanitary and epidemiological safety of the population
- Conduct of investigations and surveys to clarify environmental health impacts
- Organization of sanitation, hygiene and epidemiological measures to prevent communicable and non-communicable diseases, including food poisoning and food-borne diseases
- Organization of public information and health education campaigns
- Monitoring of food safety, communal hygiene (sources of nuisance such as noise, vibrations, air pollution, electromagnetic fields, open water reservoirs, stock breeding and poultry farms, etc.), occupational hygiene and the hygiene of children and adolescents.
- Surveillance and inspection (including through sampling and analyses) of relevant "objects", such as food industries and places where food is sold/served to the public; residential and recreational buildings in urban

and rural areas, public buildings (including hotels, hostels, hospitals, pharmacies, schools, pre-school institutions) and work places.

Following the 1996 reform, which established 11 administrative-territorial regions, the activities of the SHESS are now being carried out through the National Institute, 11 regional centres, and 41 city/rural centres. Although not all of the centres are fully equipped to perform the comprehensive surveillance and analytical work that in theory they are supposed to carry out, most centres are reported to be able to perform at least the most basic measurements. The financial resources available to SHESS are very small. The 1997 budget was around US$ 1.2 million. This is 5 per cent of the total budget available to the Ministry of Health, and 0.46 per cent of the total State budget.

An *Information-Analytic Centre* is part of the Ministry of Health and has the main responsibility for collecting and reporting health-related data and statistics.

The *Emergency Medical Care Service (EMCS)* was established, as part of the Ministry of Health, in 1991. At the moment, there are 2 national and 10 regional EMCSs, with 426 medical and 1 056 paramedical teams. They provide medical care in emergencies, preventing epidemics and reducing mortality and disability caused by disasters.

The Institute of Environmental Hygiene and Preventive Toxicology (part of the SHESS) is a research institution involved in experimental and epidemiological work. It was a reference centre for the former USSR for determining the levels of chemicals (pesticides, fertilizers) in agricultural produce, and for testing the safety of these chemicals, including imported products. The Institute also established safety standards for toxic chemicals (especially for those used in the agriculture) and carried out research on the impacts of pesticides on the rural population health. Current projects with regard to pesticide and fertilizer use include:

- The provision of information on pesticide health risks, the diagnosis of poisoning and its treatment
- The retrospective study of pesticide morbidity, using hospital and outpatient records.

Until recently, the Institute had no access to relevant information systems, such as POLTOX (a database containing pollution and toxicology information relevant to agriculture and forestry), or INTOX. The latter is a package for poison information centres developed by the International Programme on Chemical Safety (IPCS) to help prevent poisoning and minimize damage to health from toxic exposure. INTOX also provides capabilities to set up and operate efficient and effective poison information centres.

The Institute of Public Health is the organization most involved in the control of tobacco. Other actively involved institutions include the Department of Public Health of the American University of Armenia and the Scientific Association of Medical Students of Armenia. The Teenage Medical Hygiene School was internationally recognized for its work in promoting the concept of a tobacco-free society.

The past activities of the Research Institute of General Hygiene and Occupational Diseases included toxicological assessments, the establishment of occupational safety standards for chemicals and the running of a hospital for occupational diseases, which is a reference hospital of national relevance for this type of diseases. The Institute was reduced from 400 to 178 staff. The hospital has been temporarily closed, and present work concentrates on epidemiological studies (investigating the effects of worker exposure to heavy metals).

The monitoring of the levels of radiation background in the country is the responsibility of Armhydromet, while the development of standards is the responsibility of the Ministry of Health and of the Armenian Nuclear Regulatory Authority (ANRA) (MPL = 0.2 μSv/h throughout the country and 0.5 μSv/h on the NPP facility). The commission "ANRA" is responsible for inspecting safety procedures and regulations within the nuclear power plant and enterprises for the utilization of radioactive waste. Within the United Nations "Appeal Framework", the Emergency Management Administration (EMA) carried out an awareness raising campaign targeted at those living near the NPP. The campaign distributed leaflets, informed the population of the potential

dangers of living close to the reactor, and provided instructions on response/evacuation procedures to be followed in the event of an emergency.

At national level, several ministries are responsible for different aspects of water management (see Chapter 8).

The *Emergency Management Administration* is under the supervision of the Prime Minister, and has responsibility for the prevention and control of technological disasters, natural disasters and large environmental crises. This is being effected by planning and implementing relevant legislation and action plans, planning rescue activities and humanitarian needs, and actions to combat the health consequences of accidents and disasters. Its activities are coordinated with those of other ministries, such as those of Transport and Internal Affairs.

The promotion of cross-sectoral integration between the health, environment and transport sectors is the key element of the "Charter on Transport, Environment and Health" adopted by the countries of the WHO European region, including Armenia, at the Third Ministerial Conference on Environment and Health, held in London on 16-18 June 1999. The Charter, with its strategies, health targets and plan of action, provides a framework for more sustainable transport and land-use policies. The implementation of the Charter in Armenia may present a major opportunity for initiating intersectoral cooperation. Another important opportunity for cross-sectoral cooperation is the implementation of environmental impact assessments.

Monitoring and information systems

Armenia has been reforming its health care information system since 1996. The reform programme led to the re-organization of statistical information services in all 11 regions of the country, the training of specialists assigned to work in these services and the establishment of a national system of monthly reporting on the main health care problems. The main challenge seems to be to collate and link data that are collected using different levels of aggregation, different indicators and without standardization by different agencies. The current situation is as follows:

- The Republic's Information-Analytical Centre at the Ministry of Health collects indicators on the basis of the WHO Health for All strategy and routine reports
- The State Service of Hygiene and Epidemiological Surveillance collects data on health care activities related to communicable diseases, food safety, radiation, hygiene of the working and living environment
- The Ministry of Social Security and the Central Councils of Trade Unions collect data on the social and economic situation, and on work-related disabilities
- The Ministry of State Register and Statistics collects demographic indicators and data from all sectors (including environment and health)
- the Ministry of Nature Protection manages different databases and cadastres related to environmental indicators.

Responsibility for outdoor air quality monitoring lies with the Centre of Monitoring of the Ministry of Nature Protection, which is also responsible for air quality near industrial sites. Regional inspectorates control compliance with emission standards. Indoor air quality monitoring is the responsibility of the SHESS. The Ministry of Health is responsible for control monitoring of overall radiation levels in the area surrounding the NPP through 8 measurement points, while the NPP monitors radiation permanently through a network of stationary points. Analysis includes measurements of sedimented radionuclides, air, food, drinking water, surface water and soil. The total number of Armenian monitoring stations for radiation is 22.

The SHESS regularly tests water and food for microbial and chemical-physical parameters and contaminants. The SHESS is also responsible for investigating the outbreak of water-or food-borne diseases and food-poisoning and takes noise measurements. However, noise measurements were in fact taken only until 1992 by the Republic's Acoustic Scientific Centre. The SHESS has also been assigned responsibility for the surveillance and protection of municipal hygiene quality. No measures have been put into practice so far, owing to the lack of resources and of a clear legal and policy framework.

For drinking water, microbiological indicators analysed include E coli and heterotrophic plate count. In the bacteriological investigation of well-water faecal coliforms or faecal streptococci are the preferred indicators. Data are collected through regular monitoring and occasional tests (e.g. at sites reporting outbreaks of water/food-borne diseases).

Responsibility for food safety rests with food producers and handlers. Responsibility for controlling the safety of food is shared by three main agencies: the Department for Standardization, Metrology and Certification, the SHESS of the Ministry of Health and the Ministry of Agriculture. The Department for Standardization, Metrology and Certification is responsible for the certification of imported, exported and locally consumed food. Certificates of compliance are released on the basis of analyses carried out by accredited laboratories.. The Ministry of Agriculture analyses raw agricultural products, and takes samples from farms, factories and markets. The Veterinary Inspectorate (of the Ministry of Agriculture) controls the safety of meat at the same locations, in relation to the risk of animal diseases which may pose a threat to human health. The SHESS inspects the safety and quality of food through its network of Centres of Hygienic Epidemiological Surveillance (CHES). Each Centre takes samples from the food industry, shops, cafeterias, and, since recently, street vendors. The National Programme of Food Security (adopted by the Government in September 1999, document No. 47)includes food safety issues. It proposes that the relevant information, at present collected by three ministries, should be centralized.

Occupational diseases and injuries are monitored by the SHESS, based on the data reported by the Institute of General Hygiene and Occupational Diseases, whose hospital is the national reference centre for the official diagnosis of occupational diseases.

The Environmental Research and Management Centre of the American University of Armenia has developed maps to visualize some health indicators in the different regions of the country, including birth defects, cancer incidence, and perinatal death rates.

13.1 Conclusions and recommendations

The key health indicators place Armenia in a relatively better position than other NIS. The evolution of environmental health problems during the past few years can be described as a shift from the problems of poorly controlled industrial production, to those of a severe socio-economic crisis, with increasing outbreaks of water-borne diseases, the re-emergence of malaria and tuberculosis, and increasing problems of alcohol consumption and tobacco smoking. The fast pace of motorization is increasing the contribution of mobile sources to the health burden caused by air and noise pollution. Armenia's particular vulnerability to natural disasters (earthquakes and floods) and the consequences of the armed conflict with Azerbaijan (including a severe energy crisis) represent additional environmental health challenges.

An obstacle towards achieving major progress in environmental health matters is the inadequate recognition of the need to address these problems through integrated strategies that involve relevant stakeholders and cross-sectoral actions. Positive signs of a changing attitude are provided by the new health policy that Armenia is drawing up within the framework of the new WHO "Health for All 21", where the importance of cross-sectoral cooperation is acknowledged and corresponding plans are made. The conclusions of the consensus meeting "Policy Aspects of Water-related issues", held in Yerevan on 9-11 April 1997, provide a starting point for the development of an integrated approach.

The development of a fully coordinated approach to the management of environmental health will have institutional consequences. For example, the need for a toxicological information centre may appear or become stronger. In particular, more effective coordination mechanisms should be established to enhance the pursuit of common objectives and priorities between the Ministry of Health and the Ministry of Nature Protection. These could include monitoring, environmental health impact assessments, the identification of priorities, the development of joint plans of action, coordinated strategies to achieve goals of common interest (e.g. on air

pollution, noise, drinking water, sectors of the economy, etc.). Some cooperation appears to have occurred between the Ministries of Health and of Nature Protection in the development of the National Environmental Action Plan (NEAP) and the National Environmental Health Action Plan (NEHAP). However, this does not sufficiently appear from the two plans so far. Common structures and mechanisms could be explored in joint work on the NEAP and the NEHAP. Of strategic importance for the long-term sustainability of development plans will be the establishment of appropriate mechanisms to ensure the full involvement of both ministries, as well as of relevant stakeholders, local authorities and representatives of civil society, in the performance of environmental and health impact assessments.

Recommendation 13.1:
The Ministry of Nature Protection and the Ministry of Health should cooperate closely in the revision and development of the NEAP and the NEHAP as a step towards the development of an integrated approach to environmental health management and in the development of effective and participatory procedures to carry out environmental health impact assessments. *See Recommendation 1.5.*

The transition towards decentralized functions and responsibilities for environmental and health management needs to be further encouraged. In particular, the work of networks of cities such as the WHO Healthy Cities can represent a useful starting point for promoting a new attitude towards health and its environmental determinants, and for sharing experiences with cities that may face similar problems.

Recommendation 13.2:
Armenia's municipalities should be encouraged to consider the possibility of joining networks of cities, such as the WHO Healthy Cities.

A successful environmental health management requires reliable environmental data, the dissemination of sufficiently trustworthy information on related health risks, and the enforcement of information-dependent measures. The current severe economic depression in Armenia has led to substantial deficiencies in this regard. The most serious are:

- Neither the number of sites affected by soil contamination (especially heavy metals and oil products), nor the seriousness of soil pollution is known. Standards establishing concentration thresholds for soil contamination by some pesticides (e.g. DDT, DDE) exist, but are not enforced.
- No information on poisoning by pesticides or other chemicals used in agriculture is available. Health experts believe that rural doctors are not well prepared to deal with the clinical aspects of such poisoning, leading to incorrect diagnoses and under-reporting.
- Particulates and lead appear to be the priority air pollutants of health concern, especially in urban areas. WHO considers as "black spots" (i.e. areas requiring remedial action) those areas where the annual mean level of TSP exceeds 0.12 mg/m^3. Areas in Yerevan seem to fall into this category, but the quality and precision of the respective monitoring data are unclear. Reliable data would be needed to assess health risks. In addition to TSP, respirable particles, such as PM10, should be monitored.
- Ambient noise in urban environment is a very serious cause of annoyance for the exposed population, but regular noise surveys have not been carried out since 1992.
- Extremely few data appear to be available on the quality of indoor air. While indoor air quality has probably improved since the 1993-95 energy crisis, particulates and tobacco smoke are reported to be important indoor pollutants. Smoking bans should be enforced in public places, e.g. offices, canteens, restaurants, schools, public transport, theatres, cinemas, etc. Present heating and cooking practices should be surveyed. Although there is a potential problem of indoor contamination by radon, due to the use of tuff as building material, no reliable information is available on this issue. Asbestos is not monitored.
- Very few data are available on the possible effects of ionizing radiation on the environment and the health of the population living around the Metsamoor NPP reactor.
- Hygiene and safety conditions at workplaces are no longer verified. General practitioners should be enabled to cope more effectively with the diagnosis and reporting of occupational diseases. The principles of "good

practice in health, environment and safety management in industrial and other enterprises" should be regarded as a key reference for restructuring the occupational health sector.

Recommendation 13.3:
The identified major gaps in the system of monitoring and disseminating data needed for environmental health management should be remedied. See Recommendation 1.7.

A health information system, including information on environmental health, is being developed by the Ministry of Health, with the SHESS playing a particularly important role. The usefulness of the system for policy requires its integration with the corresponding information system under development in the Ministry of Nature Protection. The selection of key indicators for policy decisions should be made by all interested user groups. Relevant methods, experience and references are available internationally. The development of the NEHAP may provide the appropriate platform for bringing forward this discussion ensuring the involvement of all interested parties.

Recommendation 13.4:
Current projects for the development of information systems by the Ministries of Health and of Nature Protection should be reviewed to optimize their joint use. The review should include the selection of indicators, the types of analysis to be carried out, and the presentation of information and communication strategies to be chosen as a function of the interested groups of users. This work should take into account the WHO Guidelines. See Recommendation 1.7.

The microbial contamination of drinking water is at the very top of environmental health priorities in Armenia. Water supply is heavily dependent on the availability of electricity, as pumped water accounts for a very large proportion of the total supply. Water chlorination is frequently inefficient, due to the lack and relatively high cost of disinfectants and the poor maintenance of disinfection plants. The bad condition of water pipes leads on the one hand to large losses in water distribution, and on the other, it increases the risk of microbial contamination. The risk of transmission of micro-organisms through the oral-faecal route is further increased by the reported difficulty in applying basic hygiene principles in public places, including offices and public buildings, due to the scarce availability of water. Waste water reaches surface water bodies almost untreated, as waste-water treatment plants are either poorly maintained or not operating at all. See Chapter 8.

Waste management appears to be underdeveloped in many municipalities. Waste disposal represents an important source of exposure to dangerous chemicals, also due to the lack of any control and policy provision regarding hazardous industrial wastes, which are often disposed of together with municipal waste. See Chapter 7.

Present standards for the quality of food, air, water, levels of noise, etc. are still based on those from the former Soviet Union. Standards for the quality of water, food, air and noise levels should be aligned on international and WHO guidelines. In particular, the number of parameters to be controlled should be reduced to a more manageable size. Focus should be on improving the quality and relevance of monitoring information, rather than on expanding the number of indicators to be monitored. See Chapters 6 to 9.

Food safety control does not yet meet all international standards and there is duplication of work and lack of coordination among the institutions responsible for food monitoring. Food-borne diseases are under-reported, with the exception of botulism and some food poisoning. It is expected that small food businesses (involving both food production and retail) will expand at a steady pace, and even be boosted by special events, such as the celebrations of the Gregorian Church in the year 2001, which will bring to Armenia a large number of pilgrims. Experience in other countries shows that if street vendors of food and beverages are trained and given access to basic sanitary facilities (toilets, running water), the sanitary quality of the food they sell can be improved.

Sampling procedures and analytical methods for food sampling need to be revised and brought in line with those of the *Codex Alimentarius*. This will be necessary also in view of Armenia's plans to join the World Trade Organization (WTO), which has adopted the *Codex* as the reference for international trade of foodstuff, and in

arbitrage. Of particular relevance to Armenia will be the implementation of methods for rapid analyses of food contamination, and the improvement of methods for the analysis of histamine, food additives and dioxins.

Recommendation 13.5:
Armenia should adopt the Codex Alimentarius for food sampling. Consideration should be given to accelerating the introduction of Hazard Analysis Critical Control Point (HACCP), including through building local capacity on how to implement the HACCP and taking advantage and further developing the professional skills and infrastructures already existing within the SHESS. A specific project to improve the safety of both home-made and street-sold food should be started.

There is insufficient control of the production, import, marketing, use and labelling of agrochemicals. Also, there are inadequate institutional structures, both at the level of rural health services and of central administration to cope effectively with toxicological issues. A system for the registration and labelling of pesticides and fertilizers should be created. See Chapter 11.

There is also an urgent need to disseminate information about the risks of exposure to agrochemicals among farmers and rural health workers. In addition, the health risks of such exposure should be better estimated, requiring the availability of adequate data.

Recommendation 13.6:
The initiative of the Institute of Environmental Hygiene and Preventive Toxicology to develop a database on health risks of exposure to agrochemicals should be supported, including by providing access to internationally available databases, such as POLTOX and INTOX. See Recommendation 7.3.

Specific health problems related to housing and shelter conditions are posed by the presence of more than 300 000 refugees and displaced persons and by the completion of rehabilitation in the areas of the country devastated by the earthquake of 1988. Also, the vulnerability of the country to natural disasters such as earthquakes and floods requires an excellent level of emergency preparedness, and the adoption of rigorous engineering criteria for the construction of new buildings/productive sites and the rehabilitation of damaged structures.

Recommendation 13.7:
The provision of shelter and basic services to refugees, especially the most vulnerable among them, should remain a priority. Permits for the construction and rehabilitation of residential and productive sites should be granted only if adequate construction standards are followed. Cooperation between the Emergency Management Administration and the Emergency Medical Care Service should be improved.

Although Armenia has a lower incidence of traffic accidents than other east European countries, the very high number of accidents involving pedestrians indicates that road safety is a major problem. In anticipation of a strong rise in road traffic, other health impacts, such as those caused by increasing emissions of pollutants and noise, need to be urgently addressed, together with those resulting from traffic accidents. An adequate, comprehensive approach should tackle the various issues simultaneously and include the following elements:

- Assessment of impacts on transport resulting from urban development plans and land-use strategies.
- Inclusion of noise prevention concerns into the urban environmental health impact assessment of housing and transport policies
- Development of training programmes regarding road safety principles for drivers
- Stricter enforcement of speed limits
- Phasing out of leaded fuels
- Enforcement of controls on vehicles' exhaust emissions and of measures to prevent the registration and circulation of the most polluting road vehicles
- Reduction of traffic in city centres, including through the promotion of public transport
- Improvement of the emergency treatment of road accident casualties.

Recommendation 13.8:
A comprehensive approach to the improvement of transport-related health effects should be developed between the Ministries of Transport, Health and Nature Protection, building on the strategies and plan of actions of the Charter on Transport, Environment and Health.

ANNEXES

Annex I

RECOMMENDATIONS CHAPTERS 1 TO 13

PART I: THE FRAMEWORK FOR ENVIRONMENTAL POLICY AND MANAGEMENT

Chapter1: Legal instruments and institutional arrangements for environmental protection

Recommendation 1.1:
A revised, comprehensive environmental protection law should be developed and enacted possibly step by step. *It should specify the subjects of environmental protection, the mandates for environmental management at different levels of public administration and the management instruments, possibly including an environmental fund.*

Recommendation 1.2:
Environmental legislation in general should be prepared under greater public scrutiny. A procedural routine should be established to ensure the swift enacting of ratified international obligations into national law. The use of references to foreign legal frameworks and to related national laws already in force should be facilitated in national legislative processes.

Recommendation 1.3:
The development of all necessary legal instruments regulating liability for past environmental damage should be considered a priority.

Recommendation 1.4:
Inspectors from the State Inspectorate for Nature Protection as well as from the regional inspectorates should be involved in all institutional strengthening projects relevant to them and their tasks. Control and inspection practices should be complemented by coordination instruments that help law enforcement.

Recommendation 1.5:
The National Environmental Action Plan (NEAP) should be revised on the basis of a broad discussion, with public participation. The coordination of all NEAP projects, including those funded internationally, should be ensured by the International Cooperation Department within the Ministry. The development of regional environmental management programmes should be encouraged, including, if possible, through international funding. See Recommendations 6.4, 10.2 and 13.1.

Recommendation 1.6:
The organizational structure of environmental management in general and of the Ministry of Nature Protection in particular should be reconsidered. Provision should be made for upgrading the technical equipment of its key departments.

Recommendation 1.7:
A project for strengthening the national monitoring system should be developed as a top priority and in full coordination with all ministries and institutions involved in monitoring, such as the Ministry of Health, possibly as part of the National Environmental Action Plan. See Recommendations 10.4, 13.3 and 13.4.

Recommendation 1.8:
Financial bases should be created for the further development of independent NGOs. The creation of a centre to protect the ecological rights of consumers or any other suitable institution serving this purpose should be considered.

Recommendation 1.9:
The NGO community should review its internal organization with a view to improving its coordination. The Ministry of Nature Protection should systematically associate NGOs with the discussion of all environmental issues of public interest.

Chapter 2: Economic instruments, regulatory instruments and their enforcement

Recommendation 2.1:
The Ministry of Nature Protection should begin, at an early date, to develop a comprehensive and satisfactory system of economic instruments for environmental protection by undertaking research into the environmental and economic effects of the potential components of the future system.

Recommendation 2.2:
Environmental charges should be increased to the minimum level producing the desired result in terms of enterprise behaviour. Their administrative cost could be reduced, if they were limited to those few substances which actually contribute substantially to revenues from charge collection. The rates should also be stabilized in real terms, i.e. they should be indexed to a suitable measure of inflation. The charges should be strictly enforced.

Recommendation 2.3:
The funding situation and/or budgetary authority of administrative regions and municipalities should be improved together with their mandate for environmental management and their respective managerial capacities.

Recommendation 2.4:
The joint development of reliable statistics on environmental expenditures by all the ministries and other State institutions involved should start as soon as possible. The work should lead to internationally comparable statistics on environmental expenditures.

Recommendation 2.5:
The regulatory instruments should be comprehensively revised to adapt them to the new socio-economic realities and make them less costly to apply.

Chapter 3 Spatial planning

Recommendation 3.1:
The remediation of the areas that were affected by the 1988 earthquake should remain the absolute priority for territorial planning. In addition:

- *A political consensus should be developed on the future role of territorial planning, its relationship to economic development, and its optimal level of decentralization*
- *A consistent system of planning instruments should be prepared for all levels of public administration*
- *An integrated system of information for territorial planning purposes that supports the sustainable development of the economy should be designed.*

Recommendation 3.2:
Construction standards should be strictly followed together with zoning. Enforcement of the standards should be energetically pursued, including an information campaign targeting constructors. The process should be strengthened through the development of appropriate regulations and management tools.

Recommendation 3.3:
High priority should be given to the enforcement of all legal instruments required for a full application of the EIE procedure. Towards this end, the system of public participation should be simplified to one or two stages of formal public hearings. See Recommendation 6.1.

Chapter 4 International cooperation

Recommendation 4.1:
Awareness of international environmental policies, conventions and issues and their interrelationship with social and economic issues at the national level should be raised within the Government and among the public. Funding should be sought to translate international legislation into Armenian and Armenian legislation into English, and to train officials in the Armenian Government, judiciary and other stakeholders in international environmental issues.

Recommendation 4.2:
Armenia should work at strengthening its environmental cooperation with neighbouring countries, particularly in the areas of biodiversity and water. Armenia should ratify the Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

Recommendation 4.3:
National implementing legislation for the Basel Convention should be developed and training for customs officers should be organized. See Recommendation 7.1.

Recommendation 4.4:
Armenia should ratify and enforce the recent Protocols to the Convention on Long-range Transboundary Air Pollution, the Bonn Convention on the Conservation of Migratory Species of Wild Animals, the Convention on International Trade in Endangered Species of Wild Fauna and Flora and the Bern Convention on the Conservation of European Wildlife and Natural Habitats.

PART II: MANAGEMENT OF POLLUTION AND OF NATURAL RESOURCES

Chapter 5 Forest, biodiversity and nature management

Recommendation 5.1:
A priority list should be established of all legal instruments that are required for the implementation of existing laws aiming at biodiversity and nature management, in particular the newly adopted Laws on Flora and Fauna. The process of harmonizing the nature protection and forestry legal systems with relevant laws concerning private ownership should be initiated.

Recommendation 5.2:
The Ministry of Nature Protection should develop and set up the biodiversity inventory and monitoring systems, in order to provide a reliable information basis for sustainable nature conservation and forestry policies.

Recommendation 5.3:
The Red Data Books should be updated in cooperation with all governmental and non-governmental institutions holding relevant expertise and information.

Recommendation 5.4:
The Ministry of Nature Protection and the Ministry of Agriculture should review the arrangements governing responsibility for the management of all protected areas. See Recommendation 11.3.

Recommendation 5.5:
The network of protected areas should be extended to cover all characteristic habitat types in Armenia. See Recommendation 11.3.

Recommendation 5.6:
Biodiversity protection should include ex-situ measures, with special emphasis on establishing and maintaining botanical and zoological gardens, nature museums, collections in competent institutions, dendrological parks, animal breeding centres and nurseries.

Recommendation 5.7:
Management and nature conservation strategies and plans should be created or updated for each protected area.

Recommendation 5.8:
The Ministry of Nature Protection should encourage scientific institutions to consider the development of agro-forestry systems in Armenia.

Recommendation 5.9:
A comprehensive evaluation of forest management should be undertaken to optimize the sustainable use of wood as well as the non-wood benefits of the forest.

Recommendation 5.10:
It is necessary to update education and training in the management of natural resources, in particular of biodiversity, protected areas and forest management.

Chapter 6 Land management and soil protection

Recommendation 6.1:
The Ministry of Nature Protection should take all possible initiatives to strengthen the priority level of environmental policies in general, and of land resource and soil protection in particular, by:
- *proposing the creation of a council for sustainable development*
- *initiating programmes for monitoring and strengthening public interest in environmental issues*
- *and by increasing further public participation in environmental decision-making. See Recommendation 3.3.*

Recommendation 6.2:
Revision of the existing legal and economic instruments governing the management of land use and soil protection should be considered a priority.

Recommendation 6.3:
A revision of land taxes and payments for land use should be considered, differentiating them for all land users, depending on whether they apply resource-saving technologies or carry out activities to protect nature. A framework for economic activities by 'budgetary institutions' should be developed to help guarantee minimum activities for land and soil protection.

Recommendation 6.4:
A comprehensive programme for land improvement and soil protection should be given priority. It should include specific action, its timing and means of implementation, on the basis of an analysis of needs and effects of the measures. The programme should be coordinated with all relevant administrations and with the proposed revision of the National Environmental Action Plan. See Recommendations 1.5 and 11.6.

Recommendation 6.5:
Research and development, as well as the production of special agricultural machinery adjusted to use in mountains and on small plots, should be promoted by the Ministries of Agriculture, Nature Protection and Finance. Likewise, the introduction of soil protecting technologies in land use and cattle breeding should be supported. Investments in these activities should be encouraged by legislative and fiscal measures.

Recommendation 6.6:
The exchange of scientific information on land and soil protection problems should be intensified, and the work on joint scientific projects promoted from all possible sides. Structures of the Commonwealth of Independent States (like the Intergovernmental Parliament, the Commission of Environment Protection, the International Association of the Academy of Sciences) should be used to this end, as should the international science community at large.

Recommendation 6.7:
It is necessary to work out and gradually establish a system for the education and training of specialists in soil protection and land management. To this end, the most urgent needs for experts at all affected levels need to be established, and possibilities for training in Armenia and abroad identified. See Recommendation 11.2.

Chapter 7 Hazardous chemicals and waste management

Recommendation 7.1:
The Ministry of Nature Protection in cooperation with relevant ministries and institutions should speed up the development and implementation of a law on waste management and a law on the management of hazardous chemicals.. Such laws should include institutional arrangements for their enforcement. See Recommendation 4.3.

Recommendation 7.2:
A regulation should be issued as quickly as possible to guarantee the strict control of waste transport and transboundary waste traffic.

Recommendation 7.3:
The Government should consider launching a wide public information campaign to promote the minimization of waste at the source. It should be complemented by educational and training programmes to prepare the separate collection of municipal wastes.

Recommendation 7.4:
The collection and dissemination of reliable data on the most important environmental risks related to hazardous chemicals and waste management should be seen as urgent tasks. A register of enterprises which store and generate hazardous wastes, including their qualitative characteristics, should be urgently developed. See Recommendations 10.5 and 13.6.

Recommendation 7.5:
The implementation of urgent measures to improve landfilling practices should be paralleled by the development of a comprehensive action plan, including specification of funding requirements and means, for the establishment of a conclusive system of waste treatment in the long run.

Recommendation 7.6:
The possibility of incinerating high-calorific waste in the cement plants should be assessed.. Their incinerators must have efficient equipment to treat the exhaust gas.

Recommendation 7.7:
The Ministry of Nature Protection, the Ministry of Agriculture and the Ministry of Health and Social Security should strengthen their control of the application of fertilizers and especially pesticides in agriculture, for instance by training new farmers in the adequate use of these substances and monitoring the content of pesticides in food and soil.

Chapter 8 Management of water resources and quality

Recommendation 8.1:
The setting-up of a national water management board should be accelerated. NGOs should be encouraged to take part in all actions aiming at improving water management, in particular the protection and conservation of water resources.

Recommendation 8.2:
A law on drinking water should be drawn up and the Water Code revised.

Recommendation 8.3:
A national awareness campaign should be launched on domestic water use practices and a policy on sustainable and healthy water use practices should be developed. NGOs should play an active role in the campaign.

Recommendation 8.4:
Armenia should require management practices and training components for managing concessions and financing methods to be included in any cooperation projects, in particular when such projects concern the public water supply.

Recommendation 8.5:
The future waste-water treatment system should favour small units. Options for waste-water treatment in rural areas should be adapted to the site's conditions. A balanced level of treatment should be sought for the country as a whole.

Recommendation 8.6:
The extension of water user associations to all rural areas should be encouraged, with the general introduction of flow meters becoming one of their aims.

Recommendation 8.7:
Water monitoring should be considered a key element of water policy and decision-making. Armenia should improve the monitoring of water and modernize the management and techniques of the existing monitoring bodies. The possibility of allowing the above bodies to work partly on a contractual basis should be considered. Also Armenia should strive to attract all possible help from abroad regarding monitoring, be it laboratory equipment or training of laboratory staff in modern analytical and computing techniques, data management and processing, etc.

Chapter 9 Air management

Recommendation 9.1:
Maximum permitted concentrations for a limited number of pollutants (short term and annual) should be adopted, and be harmonized with World Health Organization guiding values and/or European Union standards. Technology-based emission limits for new and reconstructed sources should be incorporated into the air protection legislation. Existing sources should be given enough time to comply with those emission limits.

Recommendation 9.2:
The air quality and meteorological monitoring programmes should be maintained at least at their 1996 level. A new monitoring strategy should be developed along with the adoption of harmonized ambient air quality standards in the future.

Recommendation 9.3:
The possibility of incinerating high-calorific waste in the cement plants should be assessed.

Recommendation 9.4:
Both legislative measures and economic incentives should promote a gradual phase-out of leaded petrol.

Recommendation 9.5:
The technical parameters of imported cars should be regulated, and imported cars equipped with three-way catalysers should benefit from a lower import tax than other cars.

Chapter 10 Management of mineral resources

Recommendation 10.1:
The current legal and regulatory basis for the management of mineral resources should be updated. The revision should include the preparation of detailed guidelines for environmental impact assessment in mining, and the introduction of more differentiated payment schemes for the use of mineral resources.

Recommendation 10.2:
Realistic medium- and long-term policy objectives and environmental strategies should be developed for the mineral sector as a top priority. These policies and strategies should be included in the NEAP as soon as possible. See Recommendation 1.5.

Recommendation 10.3:
The creation of a geological survey is a prerequisite for the introduction of modern management of mineral resources in Armenia. Technical assistance, modern computing equipment and staff training will be essential to achieve its important tasks.

Recommendation 10.4:
All existing possibilities should be used to allocate the necessary funds to modernize and enlarge the monitoring network, increase its concentration in mining regions and modernize laboratory equipment, analytical techniques and standards. See Recommendation 1.7.

Recommendation 10.5:
An inventory should be established of environmental problems in mining regions, in particular of the volume and quality of tailings and waste-water discharges, and of areas damaged by mining activities. It should be used to guide feasibility studies for old and recent tailing reclamation, as well as to evaluate the extent of soil, water and air contamination in these regions. See Recommendation 7.3.

Recommendation 10.6:
An environmental management system according to international mining standards and practices should be adopted as a requirement for licences and permits for mineral exploitation. A gradual introduction of cleaner technologies in mining and metallurgy, and the training of staff at all levels of mineral resources management should be envisaged as well.

PART III: ECONOMIC AND SECTORAL INTEGRATION

Chapter 11 Environmental concerns in agriculture

Recommendation 11.1:
An integrated land-use policy should be developed as a basis for Armenia's sustainable development. Sufficient credit facilities and a land registration system should be created for farmers as a matter of priority, in order to facilitate the purchase of agricultural land as well as investments in land maintenance. An assessment of the potential of agricultural land should help in setting sales prices.

Recommendation 11.2:
Land degradation, forest use and soil and fertility preservation measures should be monitored. The agricultural extension services should systematically promote the introduction of new agricultural techniques, including through the practical training of farmers. Existing third-level training programmes for agriculture (and forestry) should be strengthened. See Recommendation 6.8.

Recommendation 11.3:
The in-situ conservation and sustainable use of agro-biodiversity should be sought by all possible means, including:
Recommendation 11.3 a : protection of Armenia's endemic species:
- *the legal definition of rules of quarantine for imported plant material*

- *the monitoring of range conditions and botanical surveys of pastures*

Recommendation 11.3.b : protection of the specificity of Armenian cultivars:

- *the monitoring of agro-biodiversity and use of local cultivars*
- *the adoption and implementation of a law on the labelling of agricultural products of Armenian origin*
- *the introduction of standards for organic farming*

Recommendation 11.3.c : protection of Armenia's wild biodiversity:

- *the implementation of the planned GEF project*
- *improving education of the population for the sustainable use and collection of wild plants*
- *the cultivation by farmers of those wild species that are particularly demanded and threatened*

Recommendation 11.5:

The promotion of measures to support soil fertility is based not only on sound crop rotation but also on measures like using manure as fertilizer or other organic fertilizers (biohumus), collecting liquid bovine manure from large animal farms for the same purpose, or letting animals graze stubble. The use of sewage sludge produced by waste water treatment plant should also be envisaged. The proper use of those fertilizers should be promoted by the agricultural extension service.

Recommendation 11.6:

Soil erosion, compaction and decline in fertility should be addressed in an integrated approach. The implementation of a comprehensive system of measures aiming at combating soil erosion should be seen as an urgent, joint task of the Ministry of Agriculture and the Ministry of Nature Protection. The Land Code, which is currently under revision, should include provisions aiming at an integrated approach to agricultural practice (so-called "good agricultural practices"). See Recommendation 6.4.

Recommendation 11.6 a:

Irrigated and desalinized land for agricultural purposes should not be extended at the expense of precious natural ecosystems. Nature reserves for valuable dry steppes or halophytic ecosystems, and eventually rocky surfaces, should be established and compensation measures provided to the owner or land users. See Recommendations 5.4 and 5.5.

Recommendation 11.6 b:

Projects for the extension of irrigated surfaces and for the use of water for irrigation, and for the extension of drained and desalinated surfaces should be subject to (a) environmental impact assessment, and (b) economic assessment.

Recommendation 11.7:

Soil pollution should both be recognized and fought with measures mitigating its consequences. The following measures are recommended:

- *the legal provisions concerning the use of waste water for irrigation should contain minimal water-quality requirements*
- *a law on plant protection should be adopted. It should control the trade in agrochemicals and establish a treatment permit for farmers who want to use them*
- *large animal farms should be charged fees for emitting water polluting agents, as long as they do not spread their slurry*
- *fees might also be introduced for the use of some or all pesticides*
- *ecologically safe agricultural products should be promoted, the growing of sensitive crops and grazing on heavily polluted soils should be banned. See recommendation 13.5.*
- *a vegetation cover that can mitigate the scattering of heavy metals in the environment should be chosen for heavily polluted soil.*

Chapter 12 Environmental concerns in energy

Recommendation 12.1:
The perspective for the development of the energy economy should be widened, by adding environmental concerns to the existing objectives of self-sufficiency and compliance with relevant global conventions.

Recommendation 12.2:
Energy planning should evaluate the options for including renewable energy in the energy system (in particular wind and thermal solar energy), and options for the combustion or gasification of biomass in combined heat and power units to replace heat-only boilers in both district heating plants and industry.

Recommendation 12.3:
Licences for the production and distribution of energy could include obligations to introduce demand-side management, as well as conditions for energy efficiency of supply facilities in order to limit emissions.

Recommendation 12.4:
A plan should be established to introduce meters measuring electricity consumption in individual households, together with organizational measures in the energy supply sector to help improve the supply to households.

Recommendation 12.5:
A management plan for radioactive waste should be started as a priority project. Efforts should be made to obtain a contract for the reprocessing of depleted fuel cells.

Chapter 13 Human health and the environment

Recommendation 13.1:
The Ministry of Nature Protection and the Ministry of Health should cooperate closely in the revision and development of the NEAP and the NEHAP as a step towards the development of an integrated approach to environmental health management and in the development of effective and participatory procedures to carry out environmental health impact assessments. See Recommendation 1.5.

Recommendation 13.2:
Armenia's municipalities should be encouraged to consider the possibility of joining networks of cities, such as the WHO Healthy Cities.

Recommendation 13.3:
The identified major gaps in the system of monitoring and disseminating data needed for environmental health management should be remedied. See Recommendation 1.7.

Recommendation 13.4:
Current projects for the development of information systems by the Ministries of Health and of Nature Protection should be reviewed to optimize their joint use. The review should include the selection of indicators, the types of analysis to be carried out, and the presentation of information and communication strategies to be chosen as a function of the interested groups of users. This work should take into account the WHO Guidelines. See Recommendation 1.7.

Recommendation 13.5:
Armenia should adopt the Codex Alimentarius for food sampling. Consideration should be given to accelerating the introduction of Hazard Analysis Critical Control Point (HACCP), including through building local capacity on how to implement the HACCP and taking advantage and further developing the professional skills and infrastructures already existing within the SHESS. A specific project to improve the safety of both home-made and street-sold food should be started.

Recommendation 13.6:
The initiative of the Institute of Environmental Hygiene and Preventive Toxicology to develop a database on health risks of exposure to agrochemicals should be supported, including by providing access to internationally available databases, such as POLTOX and INTOX. See Recommendation 7.3.

Recommendation 13.7:
The provision of shelter and basic services to refugees, especially the most vulnerable among them, should remain a priority. Permits for the construction and rehabilitation of residential and productive sites should be granted only if adequate construction standards are followed. Cooperation between the Emergency Management Administration and the Emergency Medical Care Service should be improved.

Recommendation 13.8:
A comprehensive approach to the improvement of transport-related health effects should be developed between the Ministries of Transport, Health and Nature Protection, building on the strategies and plan of actions of the Charter on Transport, Environment and Health.

Annex II

SELECTED ECONOMIC DATA

	Armenia
TOTAL AREA (1 000 km²)	29.73
POPULATION	
Total population, 1998 *(100 000 inh.)*	37.95
- % change (1993-1998)	1.70
Population density, 1998 *(inh./km²)*	127.64
GROSS DOMESTIC PRODUCT	
GDP, 1998 *(US$ billion)*	1.88
- % change (1993-1998)	104.35
per capita, 1998 *(US$ per capita)*	495.43
INDUSTRY	
Value added in industry, 1998 *(% of GDP)*	21.9
Industrial output	
- % change (1993-1998)	.
AGRICULTURE	
Value added in agriculture, 1998 *(% of GDP)*	32.2
Agricultural output	
- % change (1993-1998)	.
ENERGY SUPPLY	
Total supply, 1998 *(Mtoe)*	2.229
- % change (1994-1998) a)	55
Energy intensity 1998 *(toe/ US$ 1 000)*	1.19
- % improvement (1993-1998)	-52.10
Structure of energy supply, 1998 *(%)*	
- Coal	1.4
- Oil and oil products	40.3
- Gas	19.6
- Others b)	38.7
ROAD TRANSPORT	
Road traffic volumes, 1998	
- million veh.-km	237.9
- % change (1993-1998)	-26.91
- per capita *(1 000 veh.-km/inh.)*	0.06
Road vehicle stock, 1996	
- 10 000 vehicles	25.8
- % change (1993-1996)	-8.66
- private cars per capita *(veh./1 000 inh.)* 1996	68.37

Sources: Armenia and UNECE.

Notes:

a) % change 1991-1998: -250%.

b) of which 27% produced by nucleo power plant.

Annex III

SELECTED ENVIRONMENTAL DATA

	Armenia
LAND	
Total area *(1 000 km²)*	29.73
Protected areas *(% of total area)*	10
Nitrogenous fertilizer use, 199. *(tonne/km² arable land)*	NA
FOREST	
Forest area *(% of land area)*	10
Use of forest resources *(harvest/growth) % 1993*	0.5
Tropical wood imports *(US$/inh.)*	..
THREATENED SPECIES	
Mammals *(% of known species)*	..
Birds *(% of known species)*	..
Freshwater Fish *(% of known species)*	..
WATER	
Water withdrawal *(% of gross annual availability) 1998* a)	26.3
Fish catches *(t)*	..
Public waste water treatment *(% of population served) 1996*	70
AIR	
Emissions of sulphur oxides, 1998 *(kg/inh.)*	0.98
Emissions of sulphur oxides, 1998 *(kg/US$ 1 000 GDP)*	1.97
Emissions of nitrogen oxides, 1998 *(kg/inh.)*	2.90
Emissions of nitrogen oxides, 1998 *(kg/US$ 1 000 GDP)*	5.85
Emissions of carbon dioxide, 1998 *(tonne/inh.)*	1.18
Emissions of carbon dioxide, 1998 *(tonne/US$ 1 000 GDP)*	3.46
WASTE GENERATED	
Industrial waste *(kg/US$ 1 000 GDP) 1998*	17.58
Municipal waste *(kg/inh./day)*	NA
Nuclear waste *(tonne)*	NA
NOISE	..
Population exposed to leq > 65 dB (A) *(million inh.)*	..

Sources: Armenia and UNECE.

Note:

a) 26.3% based on 10.5billion m^3 available; 34.6% based on 8 billion m^3 available.

N.A: non available either because monitoring has been interrupted or because statistical reporting does not exist anymore.

Annex IV

SELECTED BILATERAL AND MULTILATERAL AGREEMENTS

	Worldwide agreements as of 1 January 2000		Armenia
1949	(GENEVA) Convention on Road Traffic	y	
1957	(BRUSSELS) International Convention on Limitation of Liability of Owners of Sea-going Ships	y	
1958	(GENEVA) Convention on Fishing and Conservation of Living Resources of the High Seas	y	
1963	(VIENNA) Convention on Civil Liability for Nuclear Damage	y	
1969	(BRUSSELS) Convention on Civil Liability for Oil Pollution Damage	y	
	1976 (LONDON) Protocol	y	
1969	(BRUSSELS) Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualities	y	
1971	(RAMSAR) Convention on Wetlands of International Importance especially as Waterfowl Habitat	y	R
	1982 (PARIS) Amendment	y	
	1987 (REGINA) Amendments	y	
1971	(GENEVA) Convention on Protection against Hazards from Benzene (ILO 136)	y	
1971	(BRUSSELS) Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage	y	
1972	(PARIS) Convention on the Protection of the World Cultural and Natural Heritage	y	R
1972	(LONDON) Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	y	
1973	(WASHINGTON) Convention on International Trade Endangered Species of Wild Fauna and Flora	y	
	1983 (GABORONE) Amendment		
1973	(LONDON) Convention for the Prevention of Pollution from Ships (MARPOL)	y	
	1978 (LONDON) Protocol (segregated baiast)	y	
	1978 (LONDON) Annex III on Hazardous Substances carried in packaged form	y	
	1978 (LONDON) Annex IV on Sewage		
	1978 (LONDON) Annex V on Garbage	y	
1974	(GENEVA) Convention on Prevention and Control of Occupational Hazards caused by Carcinogenic Substances and Agents (ILO 139)	y	
1977	(GENEVA) Convention on Protection of Workers against Occupational Hazards from Air Pollution, Noise and Vibration (ILO 148)	y	
1979	(BONN) Convention on the Conservation Migratory Species of Wild Animals	y	
	1991(LONDON) Agreement Conservation of Bats in Europe	y	
	1992 (NEW YORK) Agreement ASCOBANS	y	
1982	(MONTEGO BAY) Convention on the Law of the Sea	y	
1985	(VIENNA) Convention for the Protection of the Ozone Layer	y	R
	1987 (MONTREAL) Protocol on Substances that Deplete the Ozone Layer	y	R
	1990 (LONDON) Amendment to Protocol	y	
	1992 (COPENHAGEN) Amendment to Protocol	y	
	1997 (MONTREAL) Amendment to Protocol		

Source: UNECE and Armenia.

y = in force; S = signed; R = ratified.

Worldwide Agreements (continued)

1986	(VIENNA) Convention on Early Notification of a Nuclear Accidents	y	R
1986	(VIENNA) Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	y	R
1989	(BASEL) Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	y	R
1990	(LONDON) Convention on Oil Pollution Preparedness, Response and Cooperation	y	
1992	(RIO) Convention on Biological Diversity	y	R
1992	(NEW YORK) Framework Convention on Climate Change 1997 (KYOTO) Protocol	y	S
1994	(VIENNA) Convention on Nuclear Safety		R
1994	(PARIS) Convention to Combat Desertification		R
1998	(ROTTERDAM)Convention on the Prior Informed Consent Procedure for Hazardous Chemicals and Pesticides in International Trade		S

Source: UNECE and Armenia.

y = in force; S = signed; R = ratified.

	Regional and subregional agreements		Armenia
	as of 1 January 2000		
1950	(PARIS) International Convention for the Protection of Birds	y	
1957	(GENEVA) European Agreement - International Carriage of Dangerous Goods by Road (ADR)	y	
1958	(GENEVA) Agreement - Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts.	y	
1968	(PARIS) European Convention - Protection of Animals during International Transport	y	
	1979 (STRASBOURG) Additional Protocol	y	
1969	(LONDON) European Convention - Protection of the Archeological Heritage	y	
1976	(BARCELONA) Convention - Protocol - Mediterranean Sea against Pollution	y	
	1976 (BARCELONA) Protocol - Dumping	y	
	1976 (BARCELONA) Protocol - Co-operation in Case of Emergency	y	
	1980 (ATHENS) Protocol - Land-based Sources Pollution	y	
	1982 (GENEVA) Protocol - Special Protected Areas	y	
	1994 (MADRID) Protocol against pollution from exploration/exploitation		
1979	(BERN) Convention - Conservation European Wildlife & Natural Habitats	y	
1979	(GENEVA) Convention - Long-range Transboundary Air Pollution	y	R
	1984 (GENEVA) Protocol - Financing of Co-operative Programme (EMEP)	y	
	1985 (HELSINKI) Protocol - Reduction of Sulphur Emissions by 30%	y	
	1988 (SOFIA) Protocol - Control of Emissions of Nitrogen Oxides	y	
	1991 (GENEVA) Protocol - Volatile Organic Compounds	y	
	1994 (OSLO) Protocol - Further Reduction of Sulphur Emissions	y	
	1998(AARHUS) Protocol on Heavy Metals		S
	1998(AARHUS) Protocol on Persistent Organic Pollutants		S
1991	(ESPOO) Convention - Environmental Impact Assessment in a Transboundary Context	y	R
1992	(HELSINKI) Convention - Protection and Use of Transboundary Waters and International Lakes	y	S
1992	(HELSINKI) Convention - Transboundary Effects of Industrial Accidents		R
1992	(BUCHAREST) Convention - Protection Black Sea Against Pollution	y	
1993	(LUGANO) Convention - Civil Liability for Damage from Activities Dangerous For the Environment		
1994	(LISBON) Energy Charter Treaty		R
	1994 (LISBON) Protocol on Energy Efficiency and Related Aspects		R
1994	(SOFIA) Convention on Cooperation for the Protection and Sustainable Use of the Danube River		
1998	(AARHUS) Convention On Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters		S

Source: UNECE and Armenia.

y = in force; **S** = signed; **R** = ratified.