State Committee for Nature Protection

United Nations Development Programme
in Uzbekistan

"Enhancement of the environmental indicators database with GIS application to monitor the state of the environment in Uzbekistan"

ENVIRONMENTAL PROFILE of UZBEKISTAN based on indicators

TASHKENT 2008

Environmental profile was prepared within the framework of the joint project of the Government of the Republic of Uzbekistan and the United Nations Development Programme on "Enhancement of the Environmental Indicators Database with GIS Application to Monitor the State of the Environment in Uzbekistan".

In the publication the data gathered in the database of "Environmental Indicators" and the materials provided by the main ministries and agencies conducting the monitoring of the environment of the country were used.

The publication is intented for use by specialists in the field of protection of the environment, management and use of the natural resources, decision-makers as well as for general public interested in the problems of the environment.

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LIST OF ABREVIATIONS

API	Air Pollution Index
ASBP	Aral Sea Basin Program ("Program of Measures on Improvement of Ecological and Socioeconomic Situation in the Aral Sea Basin for 2003-2010")
BOD	Biochemical Oxygen Demand
BTF	Biochemical Treatment Facilities
CAPP	Climatic Air Pollution Potential
ChFC	Chlorine Fluorine Carbon
DAT	Dry Atmospheric Deposition
DDE	Pesticide, dichlorodiphenylethylene
DDT	Pesticide, dichlorodiphenyltrichloroethane
EC	Efficiency coefficient
EEA	European Environmental Agency
EECCA countries	Eastern Europe, Caucasus and Central Asian countries
GEF	Global Environmental Facility
GG	Greenhouse gases
HClFC	Hydroclorine Fluorine Carbon
IFAS	International Fund for Saving the Aral Sea
ISDC	Interstate Sustainable Development Commission
IWRM	Integrated Water Resources Management
MDG	Millennium Development Goals
MPC	Maximum permissible concentration
NEAP	National Environmental Action Plan
NEHP	National Environmental Hygiene Plan
NGO	Non-governmental organization
ODS	Ozone Depleting Substances
PM	Particulate matter
RBA	River Basin Authorities
REAP	Regional Environmental Action Plan
SDW	Solid domestic waste
UN	United Nation
UNDP	United Nation Development Program
UNEP	United Nation Environmental Programme
UWPI	Underground Water Pollution Index
WB	World Bank
WPI	Water Pollution Index (see Annex 9)
EEC UN	European Economic Commission of United Nation

MEASURE UNITS

ha	Hectare
c/ha	Centner per hectare (100 kg per hectar)
mcR/h	Microrentgen per hour
km^3/y	Cubic kilometer per year
l/day	Liter per day
T/Y	Tonne per year
T.O.E	Tonne oil equivalent
mg/l	Milligram per liter
mcg/l	Microgram per liter
mge/l	Milligram equivalent per liter
m^3	Cubic meter
m^3/s	Cubic meter per second

CONTENT

Foreword

Time is going very fast. Assessment of current situation is improving and coming more comprehensive and complex with passing days. During the last decades, environmental indicators have been extensively used for environmental assessment all over the world. Environmental indicators are dedicated composite indices characterizing the state of environment and anthropogenic impact levels. Environmental indicators are very important and useful, as they enable to promptly consider responsiveness of the environment to the undertaken measures, to intensify monitoring activities and to develop and substantiate subsequent environmental improvement measures.

On the other hand, environmental indicators are not a doctrine; they are permanently updated and improved. Therefore, the offered Bulletin is the first practical result of the work accomplished and is presented in the form of the generalized analytical material. “Environmental Profile of Uzbekistan” is one of the achievements of the joint Government of Uzbekistan/UNDP Project “Enhancement of the environmental indicators database with GIS application to monitor the state of the environment in Uzbekistan”.

Publication of the Bulletin the same year when State Committee for Nature Protection of the Republic of Uzbekistan celebrates the 20th anniversary of its activities may be considered as a symbolic event. The State Committee for Nature Protection has been always focusing on application of different, in many cases, new methods for protection and conservation of the unique native habitats, along with revival of old traditional methods developed by the previous generations.

State of the atmosphere, water resources, soils, population health, flora and fauna, as well as natural factor effects and anthropogenic impact can be traced and measured by the environmental indicators that have been developed and brought together into the common database. These indicators characterize the state of environment in Uzbekistan and reveal anthropogenic impact and environmental responsiveness levels. This allows not only promptly revealing the emerging problems, but also developing optimal methods for their solving.

Environmental indicator analysis has shown that one of the most serious global environmental problems – the Aral Sea and Priaralye problem that has already affected adversely flora and fauna genetic resources – should be solved using all currently available methods, which involve measures on forest plantation at the dried Aral seabed area, restoration of wetlands, drinking water supply to population, etc. However, all these measures require donor support and assistance and efforts of the world community.

We do hope that this publication will be helpful not only to specialists and decision makers in the field of environmental protection and rational use of nature resources, but to all people who are concerned about nature conservation.

BORIY ALIKHANOV
Chairman of the State Committee
for Nature Protection
of the Republic of Uzbekistan

Foreword

The increasingly recognized effects of global warming, as well as the results of soil, water and air pollution have galvanized the world community to focus on environment and sustainability. Led by the United Nations, numerous conferences and conventions have codified approaches to development that takes into account the impact of human actions on the environment. It is the responsibility of us all to ensure that socio-economic development to enhance today's conditions does not compromise the ability of future generations to meet their own needs. Key concepts in this regard are the carrying capacity of the environment and the ecological footprint of the economic development options chosen.

As always, the first step in attempting a solution is to define the problem well and that requires reliable information on a multitude of dimensions. In Uzbekistan, UNDP supported the Government in creating the Environmental Indicators System which is a good, robust and dynamic information management tool, using a geographic information system. It helps the country to assess its own state of environment, to analyze causes of the changes and to develop alternatives to resolve problematic trends. The system can be expanded into a full-fledged sustainable development tool by the addition of socio-economic indicators. That would facilitate a comprehensive monitoring and evaluation of the national development initiatives such as the Welfare Improvement Strategy.

This publication, together with the Environmental Atlas, is an analytical product of the Environmental Indicators System. It provides analysis on the state of air, water, soil, biodiversity and health in Uzbekistan for the period 2000-2006, and provides some recommendations for the resolution of the more significant problems. We hope it will promote discussion and help the decision makers to formulate solid programs to achieve sustainable development targets embedded in the national MDGs.

FIKRET AKCURA
UNDP Resident Representative

INTRODUCTION

Nowadays, large numbers of different environmental indicators are used for preparation of the governmental reports on the environmental state and the statistical digests in the countries of the Eastern Europe, Caucasus and Central Asia (EECCA). The international practice shows that with every passing day environmental indicators are more intensively used all over the world to assess the state of environment, to analyze the causes of environmental changes and to develop recommendations on stabilization of the ecological situation in different countries and regions.

Environmental indicator is "A parameter or a value derived from parameters that describe the state of the environment and its impact on human beings, ecosystems and materials, the pressure of the environment, the driving forces and the responses steering that system. An indicator has gone through a selection and/or aggregation process to enable it to steer action" (Multi-lingual Glossary of the European Environment Agency – EEA).

In the international practice, environmental indicators are classified based on their role in the assessment of the problem by the DESIR scheme:

- ***Driving motives*** are socio-economic factors or activities that cause intensification or mitigation of environmental impact.
- ***Environmental load*** is the direct anthropogenic pressure or impact on the environment, for instance, pollutant emissions or natural resources utilization.
- ***State of environment*** is the current state and trends of the environment, which determine air, water and soil pollution levels, biodiversity species within the geographic regions, and access to natural resources such as timber and drinking water.
- ***Impacts*** are the effects that the environmental changes have on human and non-human health status.
- ***Response*** is the public's attitude to the environmental problems and environment related governmental measures such as, for instance, taxes on the utilization of natural resources. The decisions taken could be either of general (companies) or individual character, for instance, corporate investments into pollution control measures or purchase of recycled goods by households are also important.

In Uzbekistan, task-specific use of the environmental indicators in environment-related activities started in 2005, when the State Committee for Nature Protection together with the UNDP and a number of relevant ministries involved in environmental surveillance activities set about the implementation of the Project "Environmental Indicators for Environmental State Assessment in Uzbekistan".

Introduction of the national environmental indicators into the environmental activities is in line with the Law "On Nature Conservation" (Article 28), Resolution # 111 (dated April 3, 2002) of the Cabinet of Ministers of the Republic of Uzbekistan "On Approval of Regulations for the National Environmental Monitoring in the Republic of Uzbekistan", # 16 (dated January 13, 2003) "On Approval of Environmental Monitoring Program of the Republic of Uzbekistan for 2003-2005", and # 48 (dated March 16, 2006) "On Approval of Environmental Monitoring Program of the Republic of Uzbekistan for 2006-2010".

The Republic of Uzbekistan is a party to the UNECE (United Nations Economic Commission for Europe) Program "Environment for the Europe". Therefore, indicators have been selected based on the criteria used by the UNECE and EEA (European Environmental Agency) experts for the EECCA countries.

91 indicators and sub-indicators characterizing the atmosphere, water and land resources state, waste disposal and treatment problems, biodiversity conditions, human health and ecological situation in the near Aral Sea area were recommended for use out of more than 300 monitored factors. The recommended for use environmental indicators meet the recognized international requirements and, at the same time, reflect the most important environmental priorities of Uzbekistan. These indicators, which are measured over a period of years, allow forecasting the efficiency of measures undertaken to help decision makers to take adequate and proper decisions on the environmental management and improvement.

Ministry of Health, Ministry of Agriculture and Water Resources, State Committee for Nature Protection, State Committee for Land resources, Geodesy, Cartography and State Cadastre, State Committee for Geology and Mineral Resources, and Hydrometeorological Service (Uzhydromet) under the Cabinet of Ministers of the Republic of Uzbekistan took part in the development of the environmental indicators database. The responsibility for coordination of the efforts of different ministries, agencies, administrative and managerial bodies involved in the field of environmental assessment is rested with the State Committee for Nature Protection of the Republic of Uzbekistan.

With the frame work of further development of the Project "Enhancement of the environmental indicators database with GIS application to monitor the state of the environment in Uzbekistan" a GIS/Database interface has been developed. This Interface allows direct data input in the GIS-project (ArcGIS), where data are further analyzed by the GIS software system. The interface has considerably increased capacities of geographic interpretation and analysis of the data.

The developed database is the open-ended system and allows for including new indicators and data. Long-term goals of system development, as well as indicators, planned to be included into the database in the mid-term and long-term prospects, have been identified in the course of project activities. In order to ensure the wide use of the database in the day-to-day environmental activity, the access to the database is provided through the Internet.

Social survey carried out among the specialists of different ministries and agencies, khokimiyats and NGOs have revealed that potential users are greatly interested in this database since they may use its data to prepare environmental reviews and reports on the state of environment.

The main objective of the survey was to analyze environmental changes occurred in the Republic of Uzbekistan during the period of 1996-2006. The monitored indicators have demonstrated the most important trends of the environmental components.

The review provides the results of analysis of the current state of the main environmental components – air, climate change, water and land resources, air and soil pollution by the industrial and domestic wastes, and dynamics of the Aral Sea shrinking. Biodiversity loss and desertification problems have been also analyzed. Environmental impact on the human health is considered in a separate section.

The integrated analysis of the database data has confirmed that Uzbekistan has considerably high natural resources potential, rational use of which provides the sustainable development of the country and wellbeing of the recent and next generations.

At the same time, the data have shown that there are several areas suffering from unfavorable anthropogenic impact. The data have also revealed the number of problems regarding water quality, drinking water supply to the population, soil deterioration and increase of salinity level, local air pollution in the areas of industrial agglomerations and heavy traffic, desertification and the Aral Sea problems, which are still needed to be solved. The developed database allows analyzing of the current situation at the national, regional and district level, as well as at separate observation points.

This release is intended for the use of a wide range of experts and specialists of research and training centers, business and public organizations, representatives of local authorities and decision makers, and can be used as the basis for the development of the effective measures on improvement of environmental situation in the republic and rational use of its natural resources.

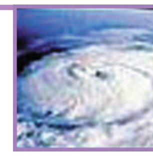
The emotional masks given below (in addition to the basic indices indicators) provide, as far as possible, the shortest evaluation of the indicators and have the following meaning:

Positive progress representing qualitative or quantitative achievements of the certain objective.

Limited progress, which is either not sufficient to achieve the qualitative objective levels or represents variable trends within the given indicator

Unfavorable trend

Chapter 1. CLIMATE CHANGE



The global climate changes that is currently being observed is having a serious impact on the different components of the environment and their individual characteristics and on socio-economic sector. In this context, indices characterizing climatic conditions, anthropogenic load and responsiveness of the climatic system to the increased concentration of greenhouse gases (GG) in the atmosphere are used in many countries as ecological indicators.

The following are considered as ecological indicators:

- Air, precipitation and temperature trends;
- Information on snow cover and river runoff;
- GG total emissions and forecast of main GG emissions;
- Reduction potential and measures on decreasing GG emission level.

Climate monitoring data for the territory of Uzbekistan provides evidence of a steady process of climate warming that started in the 20th century and still continues at the beginning of the 21st century: warming rates exceeded 0.2°C for the last decade which is more than 40% higher than the average warming rates for the Northern hemisphere. Climate warming has resulted in degradation and reduction of the area of snow and ice resources feeding the rivers of the Aral Sea basin. The glaciological data show that during the last half a century the area covered by mountain in Central Asia has already declined by more than one third.

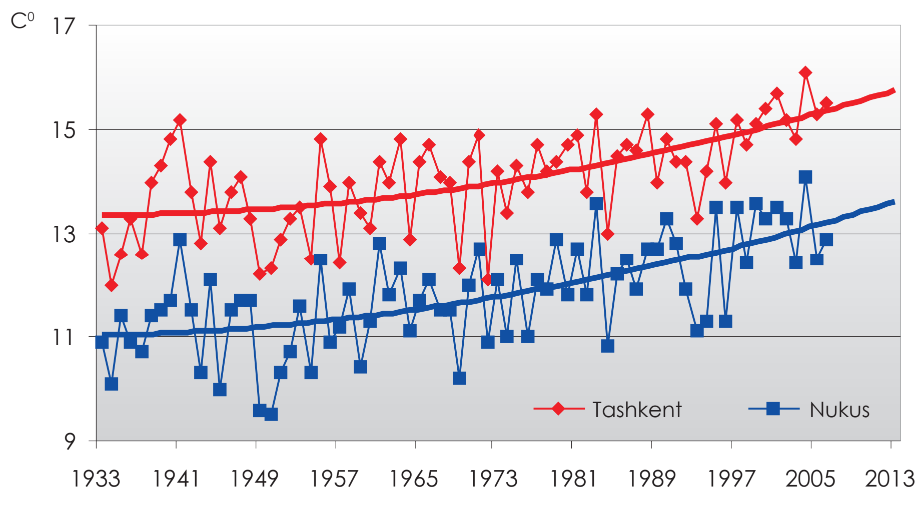
1.1. Air temperature

This indicator is widely used to estimate a number of agroclimatic and hydrophysical characteristics. Thermal conditions predetermine plant productivity, sowing times and the duration of plant development phases. The duration of the warm season and fuel requirements also depend on annual thermal conditions. Thus, this indicator plays a very important role and should always be taken into account in developing ecological and social-economic policies and prediction estimates.

Air temperature, expressed in terms of deviations from the basic climatic norms, also reflects climatic change in Uzbekistan. This indicator shows the rates of climatic warming in the country, i.e. the responsiveness of the regional climatic system to global warming resulting from the increased concentration of GG in the atmosphere. Data from the around the country shows a similarity of climate warming in the region against the background of the increased interannual climate variability (Fig.1.1).

Figure 1.1

Changes in average annual air temperatures for Uzbekistan



1.2. Precipitation

Precipitation is the next important ecological indicator; expressed as a percentage from the base climatic norms (1961-1990) it is called "standardized precipitation index" and is used to monitor the frequency and intensity of droughts being one of the most hazardous events for agricultural crops, pastures and natural ecosystems. Soil salinization and erosion processes activate during droughts; fluctuating lakes dry up. Extremely precipitation shortage may result in demise of whole ecosystems, for instance coastal and delta ecosystems. Since severe droughts (in the extremely dry years) cover large territories, the "standardized precipitation index" also can be used as an indicator of the depth of the impact on the hydrological cycle, including impact on river runoff.

Analysis of the historic records of this indicator allows the estimation of the frequency and intensity of water deficit. The actual long-term data have revealed that during the last decade, the intensive climate warming in the region has resulted in an increase in the year-to-year variability of precipitation; it should be mentioned that precipitation regime has displayed only a slight tendency to increase (Fig.1.2).

1.3. Number of days with snow cover

The number of days with snow cover is also an ecological indicator. In Uzbekistan, stable snow cover deposits are observed in the northern parts of the country and in the mountain areas at a height of more than 1000 meters. In the other areas of the plain territories and in the foothills, stable sow cover is only observed during intermittent years.

The snow cover indicator is used to estimate the cold period of a year based on a time-space distribution of snow cover over the whole territory of the republic. In cold periods, snow accumulation and snow cover duration to can be used for a remote pasture cattle breeding, rainfed farming and water supply organizations. Snowy day numbers increases in the northern parts of the republic, and in the mountainous areas where the increase is related to altitude.

Snow accumulation and snow cover duration to a considerable extent predetermine volumes of spring-summer runoffs; snow cover also predetermines melt water supplies to the catchment's basins and melt water constituent of the vegetation runoff. A reduction in numbers of days with snow cover has been reported for majority of the regional river basins, thus confirming the trend of air temperature increase reported by meteorological stations of the regions.

The number of days with snow cover for the mountain areas of Uzbekistan varies within a

Figure 1.2

Changes in the standardized precipitation index for Uzbekistan

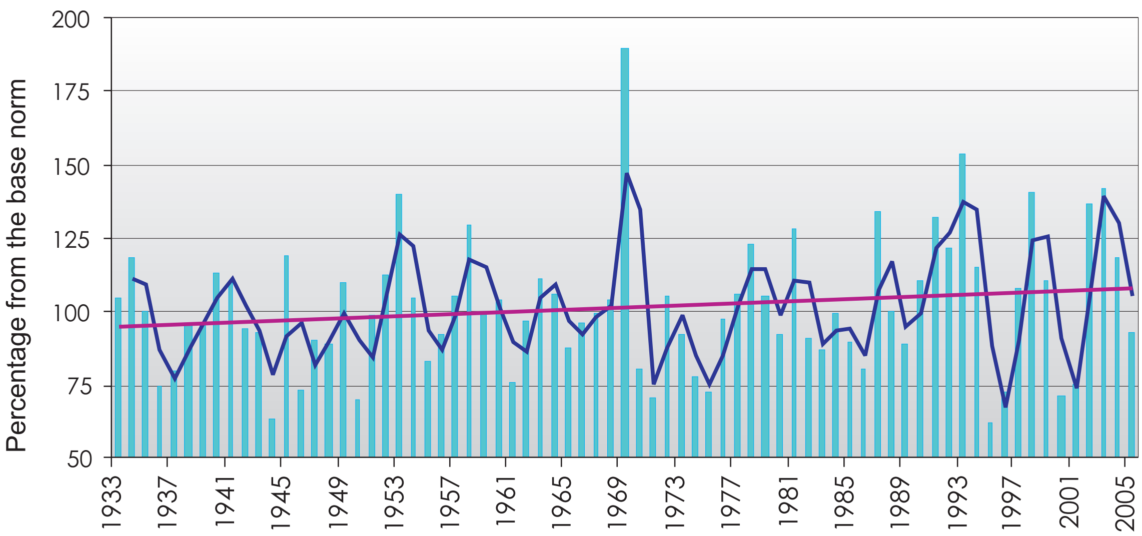
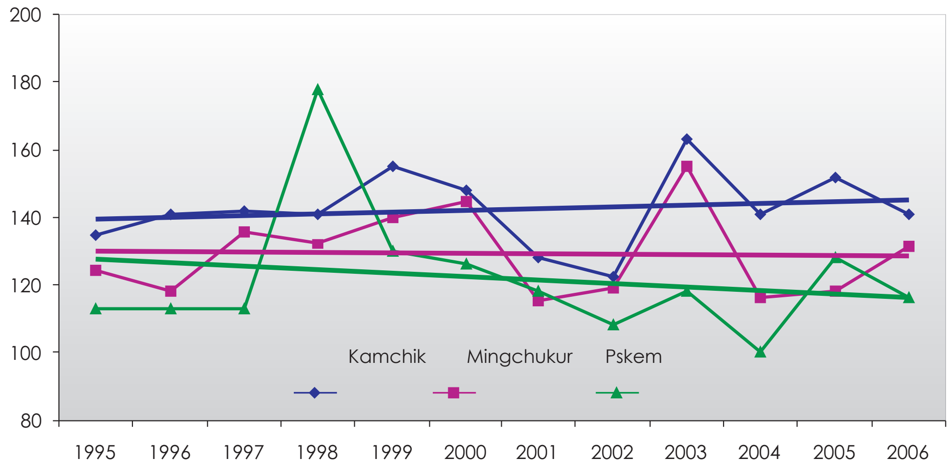


Figure 1.3

Numbers of days with snow cover in separate mountain stations for the last decade



wide range depending on individual peculiarities of snow accumulation conditions in different river basins.

1.4. Total volume of the main GG emissions

Total volume of the main GG emissions is the principle indicator of anthropogenic load on the environment, and *prediction of these emissions* provides a basis for the estimation of future loading which will be determined by different initial conditions and measures undertaken to decrease emission volumes.

Recording of the GG emissions data at a national level allows monitoring and planning of measures aimed to reduce anthropogenic emissions in the key sectors of the economy, thus creating a basis for international cooperation within the framework of the Kyoto Protocol. The national GG register provides data on emission of gases with a direct greenhouse effect (carbon dioxide, methane and nitrogen monoxide) and gases with an indirect effect (carbon oxide, nitrogen oxides, sulphur dioxide, and non-methane hydrocarbons). There are five main sources of GG emissions: “Energetics”, “Industrial processes”, “Agriculture”, “Changes in land and forest resources use” and “Wastes”.

From 1990 to 1994 total volumes of GG emissions in Uzbekistan has decreased by 5.5 % (Table 1.1).

These changes in emissions are conditioned by decrease of energy supplies to all energy users by 6.3% and 2.7 fold increase of natural gas supplies to the population.

Carbon dioxide

Fuel consumption related processes are the main sources of CO_2 emissions. From 1990 to

Table 1.1

GG emissions in Uzbekistan (million tons of CO_2 equivalents)

Gases	1990	1994	% by 1990
CO_2	114.6	102.2	89.2
CH_4	37.7	41.8	110.8
N_2O	10.9	10.2	93.5
Total	163.2	154.2	94.5

1994, carbon dioxide emissions have decreased by more than 12.4 million tons (10.8 %). Due to the reduction of fuel consumption in the industrial spheres of the economy, total volume of GG emissions attributed to the "Energetic" category has decreased by 10.0%, while in the "Population" and "Public utility" categories, emission volumes have increased by 84.5 % and 46.0 %, respectively.

The Forest Fund inventory results show that in 1990, volumes of CO_2 absorption amounted to 421 thousand tons, and in 1994, to 399 thousand tons.

Methane

Energetic (the oil and gas industry) is the main source of methane emissions. In 1990, 73.5% of the total emission volume fell at the energetic sector, 18.3% at agriculture, and 8.2% at wastes. The contributory sources structure has not changed by 1994, but emission volumes have increased by 10.7%. This increase was caused by the intensification of natural gas extraction and consumption, rice output expansion and an increase in population numbers.

Nitrogen oxide

Cultivated and irrigated lands are the main sources of nitrogen oxide emissions, which in 1994 accounted for 96.8% of the total emission volume. Compared to the 1990 figures, the total volume of nitrogen oxide emissions has decreased by 5% by 1994; it should be noted that in the agricultural sector, emission volumes decreased by only 3.8%, while the "industrial processes" sector reported for a five-fold emission volume decrease due to the reduction of nitric acid production.

Emission of GG with indirect greenhouse effect

Between 1990 and 1994, emission of GG with an indirect greenhouse effect was considerably reduced: carbon oxide emissions volume was decreased by 31.5%, sulphur dioxide gas by 50.2%, nitrogen oxides by 29.2%, and non-methane hydrocarbons by 16.4%. Emission volume reduction is related to changes in consumption patterns: reduction in liquid and solid fuel consumption and increase in gas fuel consumption, as well as the introduction of environmental measures.

1.5. Forecast of GG emissions

Forecast of GG emissions for the period up to 2010 is based on three alternative scenarios of economic development:

- the 1st alternative – the inertial scenario of economic development (slight growth of GDP and the subsequent drop of economic development);
- the 2nd alternative – mobilization scenario (GDP growth up to 6-8%), without regard to energy saving measures;
- the 3rd alternative – mobilization scenario, with regard to the new oil field development and realization of energy saving measures.

Forecast of the main GG emissions (CO_2, CH_4 and N_2O) for the period up to 2010 is given for four separate source categories: "Energetics", "Industrial processes", "Agriculture" and "Wastes"; it shows that in 2010, depending on economic development scenarios and the r alization of emission reduction measures, the GG emission volumes could make up 185.6 – 209.0 million tons in CO_2 equivalent (Fig.1.4), i.e. could increase by 13.7-28.0% compared to 1998 values.

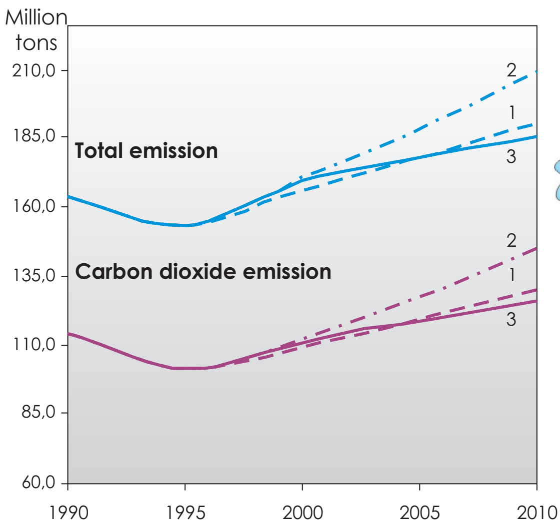
Carbon dioxide will still remain the principal GG (depending on the scenario, its share will amount to 65-70%), with methane comprising 29-25%, and nitrogen oxide 5-6%.

Reduction potential and measures for the reduction of GG emission volumes

In Uzbekistan, the GG emission volume reduction potential (without considering the potential of renewable energy sources) amounts to 27.2 million tons in CO_2 equivalent. The "Energetics" sector has the greatest potential to reduce emission volumes – 25 million tons, while "Industrial processes", "Agriculture" and "Wastes" account for up to 2.2 million tons in

Figure 1.4.

GG emission volumes and their forecasts for the period up to 2010



Sources:
The First National Report of the Republic of Uzbekistan for the FCCC/UN, Tashkent, 1999.
The First National Report of the Republic of Uzbekistan for the FCCC/UN, Phase 2, Tashkent, 2001.

The government of the Republic is pursuing the policy aimed at reduction of green gas emissions.

The Republic of Uzbekistan joined the Framework Convention on Climate Change (FCCC) in 1993. In November 1998, Uzbekistan signed the Kyoto Protocol, which was ratified in August 1999.

The Republic of Uzbekistan does not have quantitative commitments under Kyoto Protocol and FCCC and may participate in realization of Clean Development Mechanism (CDM) projects.

The package of measures have been developed and approved by the governmental regulation # 469 (October 20, 1999) "Environmental Action Program of the Republic of Uzbekistan for 1999-2005" and resolution of the Cabinet of Ministers of the Republic of Uzbekistan # 389 (October 9, 2000) "About realization of Environmental Action Program of the Republic of Uzbekistan for 1999-2005" to support implementation of international obligations of the Republic under the Kyoto protocol and FCCC. General provisions of the National Strategy (2000-2010) on reduction of green gas emissions in the Republic of Uzbekistan and measures on implementation of this Strategy have been also developed and approved.

CO_2 equivalent.

Main trends in reducing GG emissions to the atmosphere:

- Reduction of losses and improvement of fuel and energy use technologies;
- Improvement and introduction of energy saving technologies in production;
- Introduction of natural gas, heat, water and energy consumption meters;
- Usage of biogas and renewable energy sources;
- Improvement of information systems for transfer of ecologically friendly technologies;
- Reforming of legal provisions in the sphere of environmental protection;
- Public awareness on climatic change related problems and the necessity for the introduction of effective energy-saving technologies.

Works on updating the National GG register are under way and are being implemented as part of preparation of the Second National Report of the Republic of Uzbekistan for the FCCC/UN.

1.6. Renewable energy

Utilization of renewable energy sources (RES) decreases the GG emissions into the atmosphere. Considering the specific climatic conditions of the Republic of Uzbekistan the idea of using renewable energy sources looks very promising. A safe power supply is one of the main objectives of the ecological policy which is aimed at the gradual substitution of fossil fuel based energy sources with renewable energy sources.

In this context, the inclusion of renewable energy sources in the overall power consumption of the country is considered as an important ecological indicator. Renewable energy is the energy produced by the energy flows of the environment. They are: solar energy, wind energy, hydro energy, and biogas created by industrial, municipal and agricultural waste.

Potential of renewable energy sources

Uzbekistan has a considerable renewable energy potential estimated as high as 51 billion tons of oil equivalent (TOE). Nowadays, modern equipment and technologies allow the use of 179 million TOE of the abovementioned potential; this volume exceeds by three times the current annual volumes of fossil fuel extraction in the country (Table 1.2).

For the moment, only 0.6 million TOE has been developed or only 0.3% of technical potential; the technical potential structure shows the largest prospects for the development of solar energy (Fig.1.5).

Complete realization of the RES technical potential may substitute such fuel amount, burning of which will result in CO_2 emissions in the volume of 447.5 million tons. However, present conditions do not allow realizing this potential in Uzbekistan in full due to the low level of technical and financial capacities, and also due to the lack of clear characteristics of conventional and non-conventional power stations' environmental impact. Technical potential (Fig.1.5) was estimated without considering biomass resources: crop and animal production wastes, as well as industrial and domestic wastes. Preliminary estimate shows that even 1 ha of land under cotton could produce 2-4 tons of cotton stalks, i.e. cotton stalk resources could amount to 1-2 million TOE. However, ecological aspect of likely consequences of the

Gross potential – theoretical quantity of energy produced at a given territory.

Technical potential – a part of the gross potential that could be developed by using the available technologies.

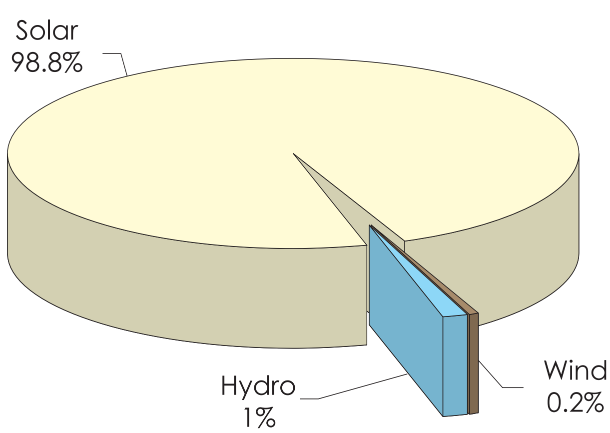
Table 1.2

Potential of renewable energy sources of Uzbekistan

Potential	Total (million TOE)	Including energy (million TOE)			
		Hydro	Solar	Wind	Geothermal waters
Gross	50984.6	9.2	50973.0	2.2	0.2
Technical	179.0	1.8	176.8	0.4	-
Developed	0.6	0.6	-	-	-

Figure 1.5

Structure of renewable energy sources technical potential in Uzbekistan



development of this type of RES has not been estimated yet.

In general, availability of a considerable RES potential is an important precondition for the successful development of the renewable energy sector, and creation of a favorable economic environment in Uzbekistan will enable development of a considerable share of this technical potential.

The proportion of the energy produced by renewable sources in the total annual energy output of the country is also used as ecological indicator.

Production of energy by the renewable energy sources; Utilization of renewable energy technologies in Uzbekistan

With regard to the development of renewable energy sources in Uzbekistan, it should be said that for the moment the greatest progress has been achieved in the development of hydro electric schemes. At the same time, a number of projects on the development and usage of solar and wind energy have also been implemented in the republic during the last few years, but they are mostly for demonstration purposes.

It is also worthy mentioning that Uzbekistan already has the potential for a wider development and use of renewable energy technologies such as:

- Solar panels for water heating;
- Solar photovoltaic power generating systems;
- Micro-hydro power generating plants;
- Wind powered generators;
- Solar-assisted biogas plants for power and heat generation;
- Hybrid solar-wind systems.

There are also plans for the future to consider the availability and development of other technologies such as:

- Usage of domestic waste in large-scale incineration plants and in district heat supply systems in large cities such as, for example, Tashkent or Samarkand;
- Usage of solar electric plants;
- Usage of geothermal energy.

However, when using certain types of renewable energy technologies it should be remembered that they can be used only as additional energy sources since, for example, photovoltaic power plants cannot be operated during the night time, and wind power generators do not produce electric power on windless days or at a slow speed wind. Thus, they are usually used as reserve power sources and, therefore, are mainly considered as facilities supplementing traditional energy sources.

GG emission reduction is the issue of the day, since increase of GG concentration in atmosphere can result in further increase of temperature by 1.0-2.5^{0}C by 2035, which, in its turn, will cause climatic zone boundary displacement, further aridization of the territory and environmental degradation as a whole. The largest likely changes could occur in the northern regions of the republic, namely in the Republic of Karakalpakstan and Khorezm region (Fig.1.6).

1.7. Ozone-Depletion Substances

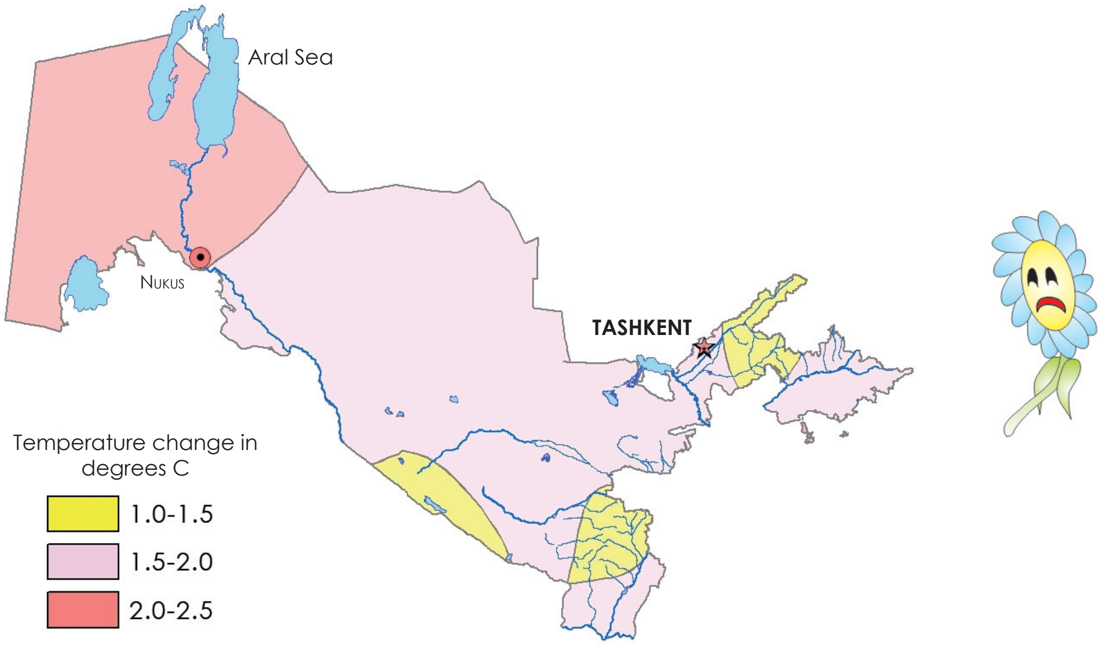
Anthropogenic changes in atmospheric composition result in depletion of ozone layer in the atmospheric top layers, which is a protec-

On the 1 May 1998 the Oliy Majlis of the Republic of Uzbekistan has ratified the London and Conpenhagen ammendments to the Motnreal Protocol. The data on ammendments were effective starting from 8 September 1998.

On 7 September 2006 the President Islam Karimov has signed the Laws of the Republic of Uzbekistan "On ratification of ammendments to the Motreal Protocol on Ozone Depletion Substances (Motreal, 17 September 1997)" and "On ratification of ammendments to the Motreal Protocol on Ozone Depletion Substances (Beijing, 3 December 1999)".

Figure 1.6

Temperature change scenario towards 2035



tive screen for the biological life against short-wave ultraviolet radiation.

Stratospheric ozone at a height of 10-30 km creates a reliable barrier preventing the penetration of ultraviolet light from space.

Depletion of the ozone layer could be caused by the chemical reactions of stratospheric ozone with ozone-depletion substances (ODSs), the most popular of which are coolants or halogenated hydrocarbons (HCFCs, CFCs).

As an ecological indicator, "consumption of ODS (ton per year)" is of global importance and corresponds to the international and national requirements.

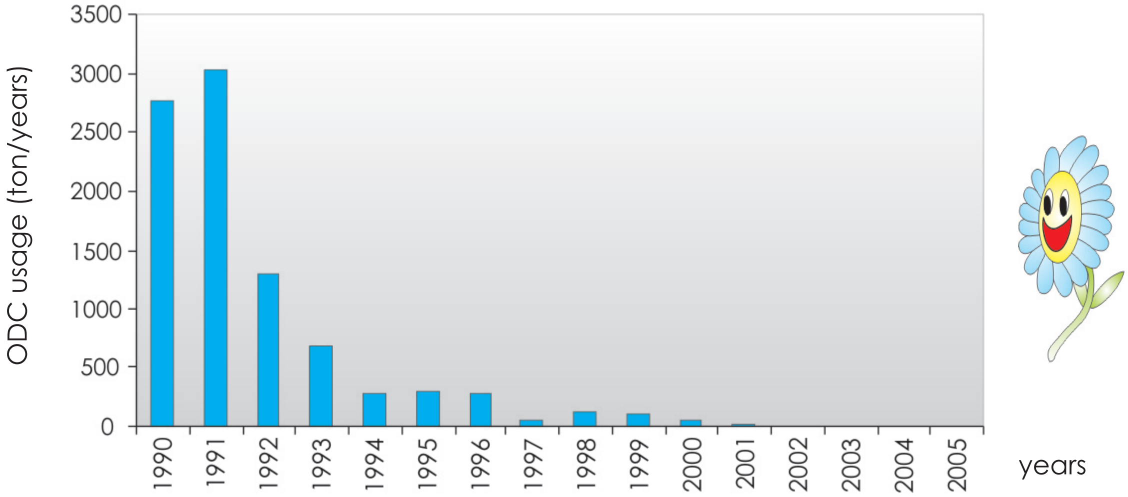
Analysis of ODS consumption actual data has revealed a decrease in overall ODS consumption (Fig.1.7); the rates of decrease are ahead of the staged schedule of ODS withdrawal from the use stated in the National program. Thus in 2000, consumption of controlled substances was considerably decreased:

- Consumption of the first group CFCs (specified in Annex A) decreased by 84% against a planned 40%;
- Consumption of tetrachloromethane decreased by 97% against a planned 35%.

In 2002, import of new ODS, specified in Annexes A and B of the Montreal Protocol, was stopped. Dates of ODS consumption, fixed for the first group specified in Annex C and Annex E of the Montreal Protocol, are being observed.

Figure 1.7

Annual breakdown of changes in ODS consumption pattern for the Republic of Uzbekistan



Chapter 2. ATMOSPHERE

The qualitative and quantitative composition of the atmospheric air in Uzbekistan greatly depends on both, natural and anthropogenic sources of pollution.

In Central Asia, specific character of atmospheric circulation determines climatic characteristics and to a certain degree depends on physical-and-geographical conditions of the area (deserts, semi-deserts with elevations 200-250 m above sea level, mountain systems up to 3500-3600 m). For instance, even lands occupying the larger part of the Turan plain are exposed to cold air intrusions that predetermine the strongly continental climate in the region. On the other hand, recurrent west and northwest intrusions of humid air from the middle latitudes of the Atlantic Ocean also have an effect on formation of qualitative and quantitative characteristics of the atmosphere.

The republic is situated in the arid zone, which includes such large natural sources of aerosol emissions as the Kara-Kum and Kyzyl-Kum deserts with their repeated windstorms, and the Aral Sea area zone (Priaralye) and the dried Aral seabed area (Aralkum). Soil and mineral particles are the main constituents of suspended particulate matters (aerosols) from these sources. In Uzbekistan, SO_2, NO_2 and CO, as well as solid suspended particulates of different composition and origin are the main anthropogenic air pollutants.

The highly developed agro-industrial complex of the republic also considerably contributes to the changes in the qualitative composition of the atmosphere. Specificity of location of large urban conglomerations with high density population, traffic streams, industrial enterprises with environmentally unfriendly production technologies located in narrow intermountain basins, as well as specific environmental and climatic conditions (repeated inversion, stagnant atmospheric conditions) promote accumulation of air pollutants in the atmospheric boundary layer, thus causing adverse health effects.

In 2006 the Centre of the Hydrometeorological Service (Uzgidromet) monitored atmospheric air pollution level at 33 inhabited localities, 60 stationary sites and 10 sampling sites. The following pollutants are being monitored: SO_2, CO, NO and NO_2, airborne dust, ammonia, ozone, phenol, hydrofluoric acid and solid fluorides. As a whole, 24 ingredients, including five heavy metals and benz-a-pyrene are being monitored.

Representative samples of atmospheric precipitates are analyzed at 14 take-off points for water-soluble mineral constituents, pH and conductance. Precipitation sampling is made at meteorological stations located in large cities and in inter-localities areas.

The State Committee for Nature Protection (Goskompriroda) controls emission of pollutants from the industrial and mobile sources. Eighteen Analytic Control Specialized Inspection (ACSI) centers monitor non-mobile sources of emissions, located in 136 inhabited localities of the republic. The number of ingredients being monitored varies from 4 to 25 depending on a profile of industrial enterprises.

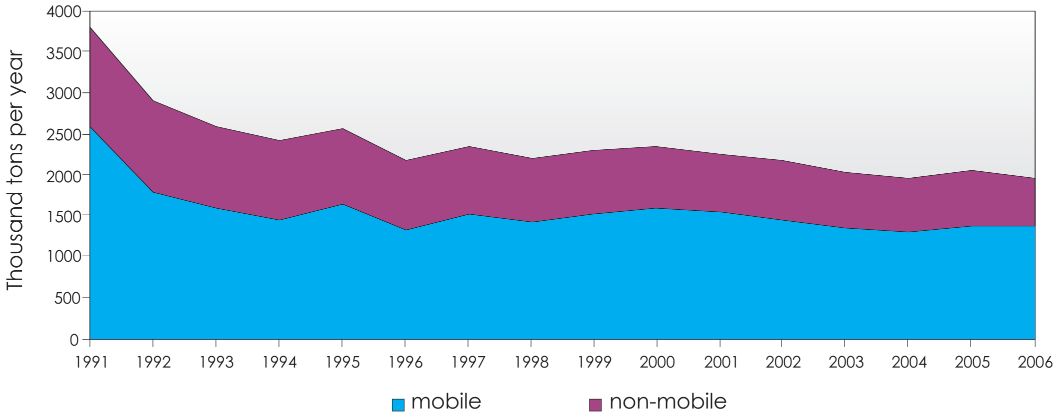
2.1. General atmospheric air pollution

Total gross emissions of pollutants into the atmosphere from non-mobile and mobile sources represent the overall anthropogenic load on the atmospheric air. Quantitative values for this ecological indicator are based on emission inventory data.

Data from the Goskompriroda and the State committee on statistics for the period of 1991-2006 show that total gross emission of pollutants into the atmosphere has decreased by 48.6%: at that, emission from the non-mobile sources has decreased by 46.8% and that from the mobile sources - by 49.4% (Fig.2.1). This trend could be explained by a reduction in production within a number of industrial sectors due to the reformation and reconstruction of enterprises, and also due to environmental

Figure 2.1

Dynamics of total gross emissions of pollutants in the republic



measures undertaken as part of the Environmental Action Program of the Republic of Uzbekistan for 1999-2005 (modernization and reconstruction of outdated equipment, installation of new vacuum cleaning and gas purifying facilities, usage of catalytic agents, etc.).

Total gross emissions have not changed over the last five years: a 50.3% fall in CO, 16% - in SO_2, 15.2% in carbohydrates, 8.5% in NO_2, 6.6% in particulate matters, 3.6% in other specific hazardous substances. SO_2, carbohydrates and particulate matters prevail in non-mobile source emissions (Fig.2.2), while CO, carbohydrates, and NO_2 prevail in mobile source emissions (Fig. 2.3).

There is a close relationship between the distribution of non-mobile and mobile source emissions and the level of the industrial development of the regions (Fig. 2.4).

Karakalpakstan and Khorezm are characterized by a low level of industrial development. High levels of atmospheric dust pollution caused by natural sources such as the dried Aral seabed area, desert and semi-desert zones are typical for these regions. In the industrial centers of the Nukus and Urgench urban areas, the state of the atmospheric boundary layer greatly depends on pollutant emissions from the motor transport, building and food industries.

Industrial production is well developed in the

Figure 2.2

Structure of pollutant emissions from non-mobile sources of the republic

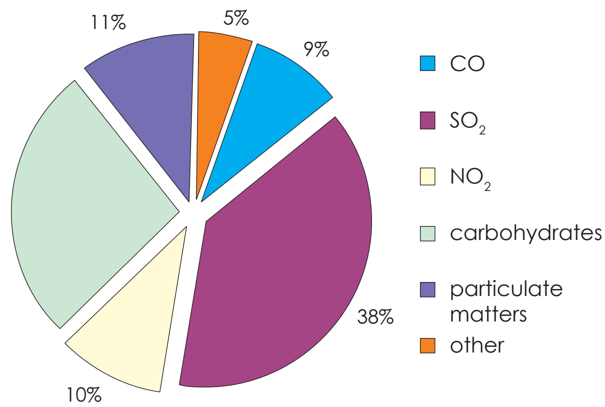


Figure 2.3

Structure of pollutant emissions from mobile sources of the republic

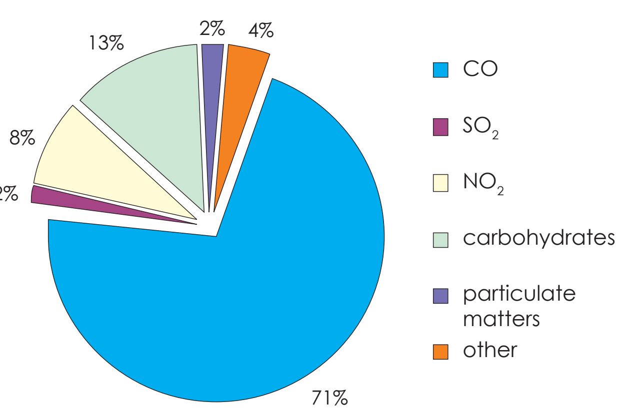
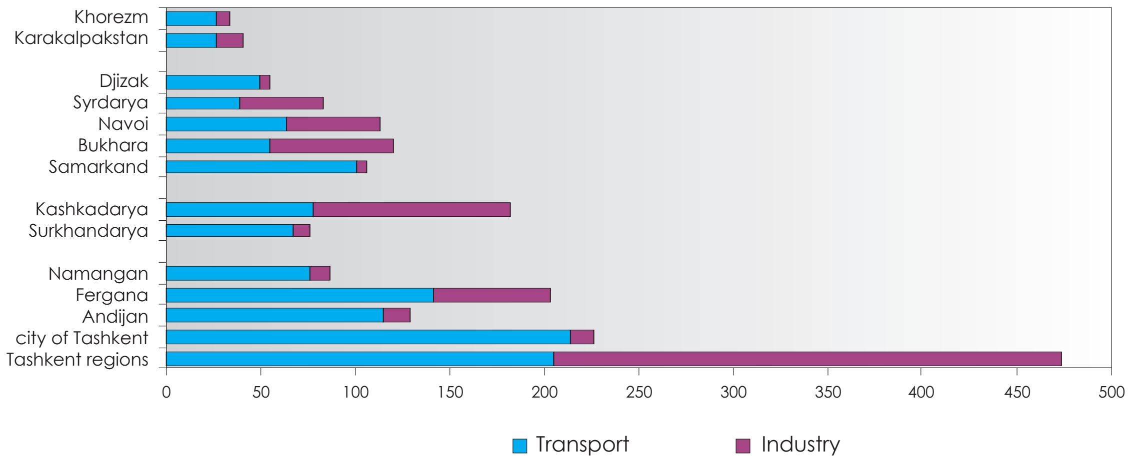


Figure 2.4

Distribution of non-mobile and mobile source emissions (thousands of tons per year) over the regions of the republic



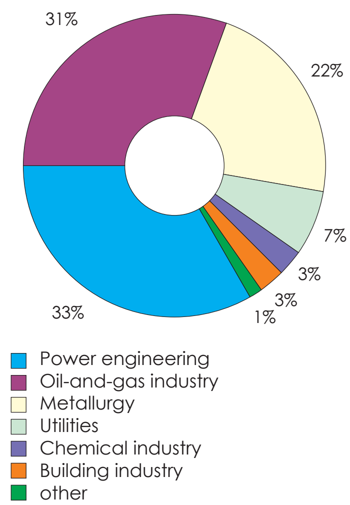
Tashkent, Fergana and Kashkadarya regions of the republic. The major share of total gross emissions falls in power engineering, oil/gas and metallurgy industries.

According to the Uzgidromet monitoring service data, general levels of atmospheric pollution are at the standard level. Climatic Air Pollution Potential (CAPP) and the Atmospheric Pollution Index (API) are used as basic indicators for general pollution levels. API is calculated taking into account the increased MPC daily mean values of five main pollutants and their class of hazard.

During the last five years, a downtrend in the general level of atmospheric air pollution was observed in many industrial areas of the republic.

Figure 2.5

Share of the main industrial branches in the total volume of the gross pollutant emissions into the atmosphere



Atmospheric pollution levels based on API_5 values

API > 14	very high
7 < API < 14	high
5 < API < 7	increased
API < 5	low

Climatic Air Pollution Potential (CAPP)

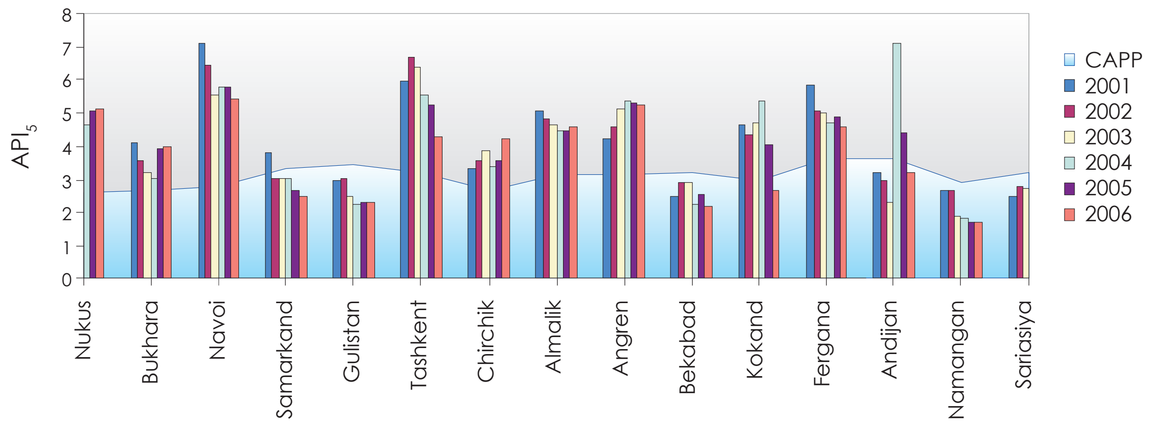
CAPP is a complex index characterizing an area's disposition to pollution considering the area's orography and unfavorable meteorological conditions governing dispersion of pollutants. CAPP daily mean values for the territory of the republic vary within a wide range: from a moderate (2.4) to a very high (3.9).

High and very high APP values are reported for the largest urban industrial agglomerations (Tashkent and Fergana).
CAPP classification

CAPP >3.3	very high
3.0 < CAPP < 3.3	high
2.7 < CAPP <3.0	increased
2.4 < CAPP < 2.7	moderate
CAPP < 2.4	low

Figure 2.6

API_5 for the industrialized urban areas of Uzbekistan (2000-2006)



The National Environmental Action Program of Uzbekistan predetermines the policy of the state aimed to improve the atmospheric air quality due to reconstruction of majority of industrial enterprises and increase in efficiency of gas-cleaning units.

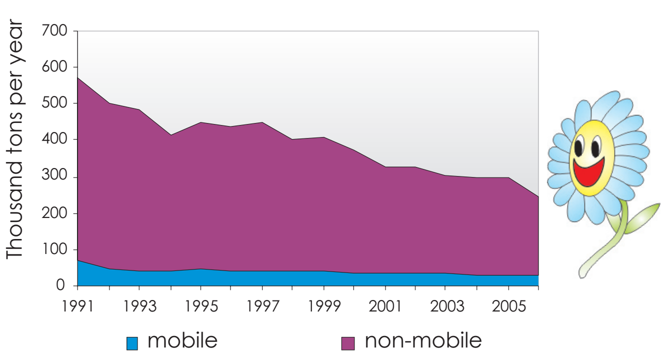
2.2. SO_2 (sulfur dioxide) emissions

SO_2 is one of the main components of air pollutants and makes up 16% of the total gross emissions of pollutants in the republic. From 2000 to 2006, the gross emission volume has decreased by 21%. Heat-power engineering enterprises and boiler plants, primary metal establishments, oil and gas industry enterprises are the main SO_2 emission sources. The dynamic range of the gross SO_2 emissions is given in Fig.2.7.

The largest volumes of gross SO_2 emissions fall at the industrial enterprises of the Tashkent, Kashkadarya, and Syrdarya and Fergana regions with fuel-energy complex location.

Figure 2.7

Gross SO_2 emissions in Uzbekistan (1991-2006)



In the metallurgy industry, the main emission source is the Almalik mining and metallurgical integrated works. In 2006, it accounted for 44.7% of the total volume of SO_2 emissions in the republic. In 2000, SO_2 mean daily concentration in the air in the Almalik area reached 1.2 MPC, in 2001-2002 –1 MPC, 2004 – 0.9 MPC, and in 2006 – 0.9 MPC. During the last five years, excess values of SO_2 MPC have not been reported for other urban industrial areas of the republic.

In 2006, power engineering enterprises accounted for 65,554 thousand tons of SO_2 emissions that made up 58.8% for the industry, and 30.7% for the whole republic. These percentages are related to the fact that power engineering enterprises use sour (high sulphur) gas and crude oil, and the total sulphur content in the coal is at 1.8% level. During the last years, power generation related SO_2 emissions were characterized by a downtrend (Fig. 2.9, 2.10).

Figure 2.8

Gross SO_2 emissions over the regions of Uzbekistan (2002-2006), tons per year

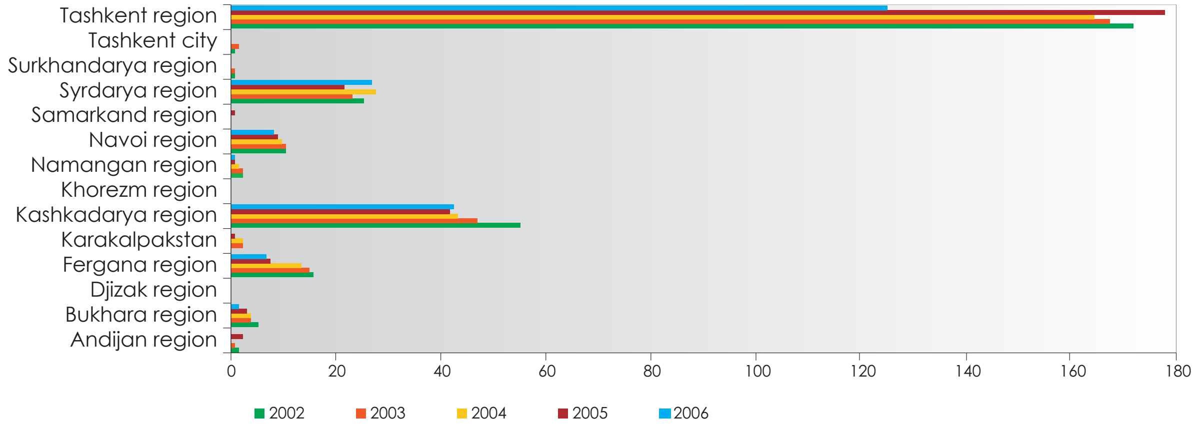


Figure 2.9

Gross SO_2 emissions from power generation (1999-2006)

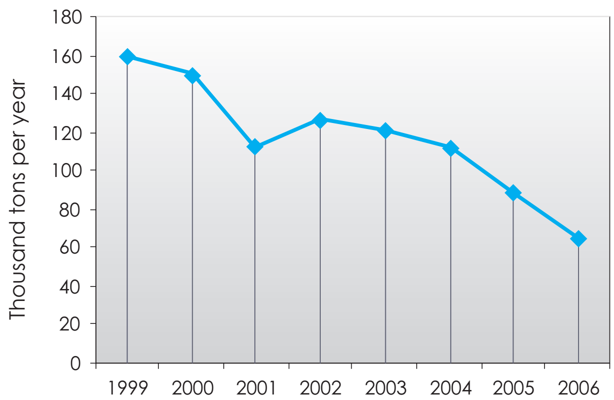
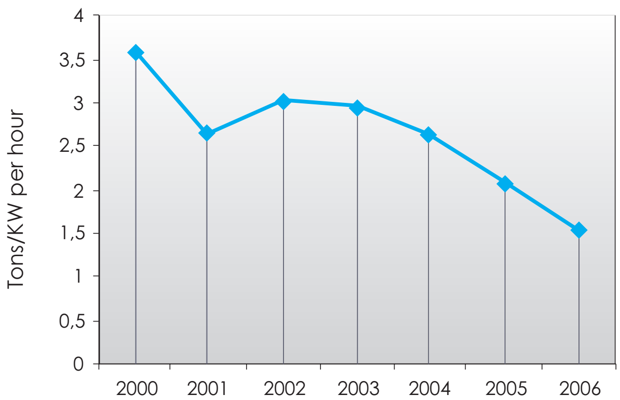


Figure 2.10

SO_2 emissions intensity from power generation (2000-2006)

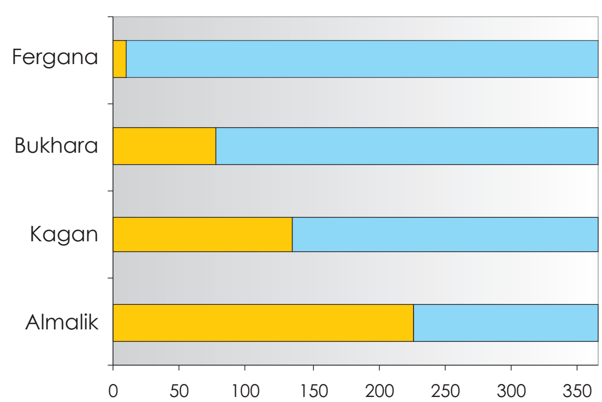


In 2006, 21.8% of the total volume of pollutant emissions from the oil-and-gas industries fell in SO_2; over the republic this value made up 20.7%. Exit gas chimney fires of oil-and-gas production enterprises (Uzgeoburneftegazdobycha) are sources of emissions. In this industry, the largest enterprises accountable for the greatest volumes of SO_2 emissions are the coal mining enterprises “Mubarek GPZ” and “Shurtanneftegas”.

A number of days when SO_2 concentrations were above MPC values were reported for the Almalik, Kagan, Bukhara, and Fergana areas (Fig.2.11). The Uzhydromet monitoring service did not report any excess values of SO_2 MPC for other urban areas of the republic.

Figure 2.11

Maximum number of days when SO_2 concentration in urban areas is above the MPC values (2004-2006)



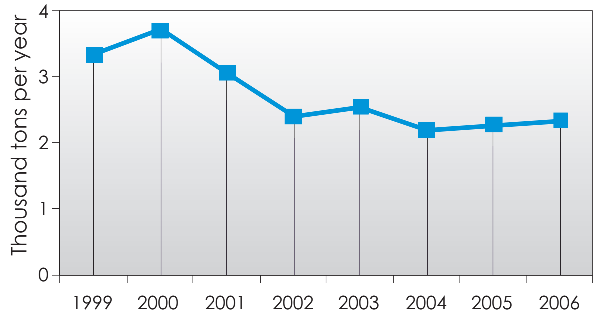
2.3. NH_3 (ammonia) emissions

NH_3 is one of the main pollutants in the chemical industry and its share in the total emissions volume of the industry amount to 14.4%. Production technologies at the main chemical industry enterprises located in the Andijan, Kokand, Navoi, Fergana, Chirchik and Samarkand urban areas do not meet up to date requirements and need modernization or replacement. Though during the period of 1999-2006 the volume of NH_3 emissions into the atmosphere has decreased by 24.5% (Fig.2.12).

The atmospheric air pollution monitoring service still reports that target values have been exceeded (Fig.2.13).

Figure 2.12

NH_3 emissions in Uzbekistan (1999-2006)



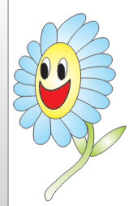
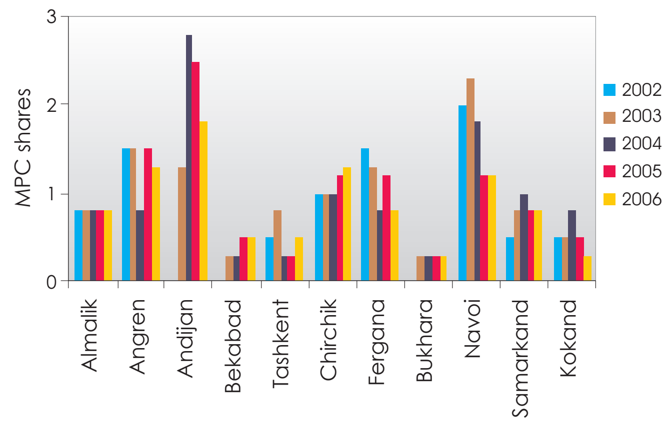


Figure 2.13

NH_3 air pollution in urban areas of Uzbekistan

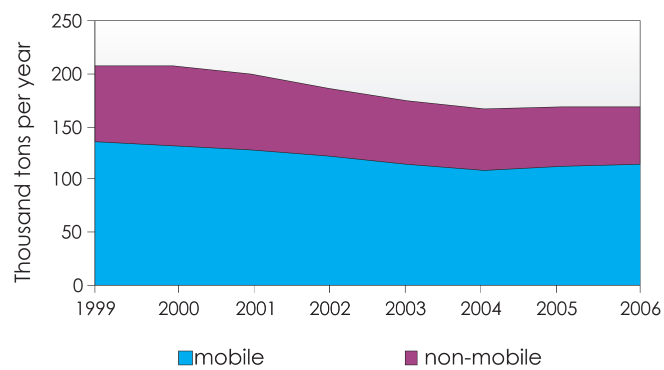


2.4. NO_X (nitrogen oxides) emissions

Non-mobile sources account for 10% of NO_2 emissions and transport for 8.2%. Long-term dynamics of NO_X emissions displays a down-trend (Fig. 2.14). During the period of 1999-2006, volume of NO_X emissions into the atmosphere has decreased by 19.7%. The highest concentrations are reported in urban areas with heavy traffic and large heat-power engineering and mineral fertilizer production enterprises. In 2006, emissions from motor transport made up 67.7% of the total NO_X emissions volume and depend upon the technical state of the motor pool, traffic management, road conditions, and fuel and lubricant quality.

Figure 2.14

Gross NO_X emissions in Uzbekistan (1999-2006)



Industrial complex that includes fuel-and-energy industry, chemical and petrochemical industries is the main NO_X emissions source. These accounts for 86.8% of NO_X emissions in the republic.

Dynamics of power generation related NO_X emissions displayed a downtrend during the last years (Fig.2.15, 2.16).

However, power generation accounts for 54.9% of NO_X emissions in the republic and for 26.7% - in the branch. The main production facilities of large thermal and dual-purpose stations have been in operation for more than 25 years; fuel consumption efficiency is within 33-35%. Low fuel efficiency results in increased volumes of pollutant emissions into the atmosphere, thus increasing air pollution level (Fig.2.17) in the urban areas, where these objects are located.

The highest NO_X concentrations are reported

Figure 2.15

NO_x emissions from power generation (1999-2006)

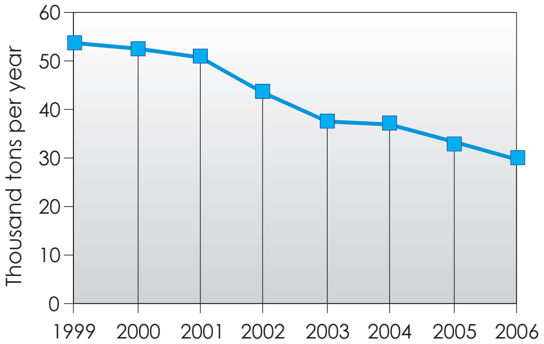


Figure 2.16

NO_x emissions efficiency from power generation (2000-2006)

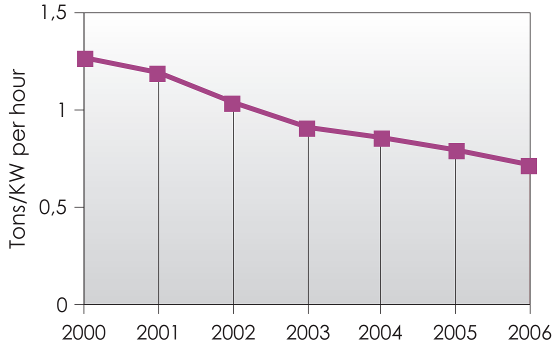
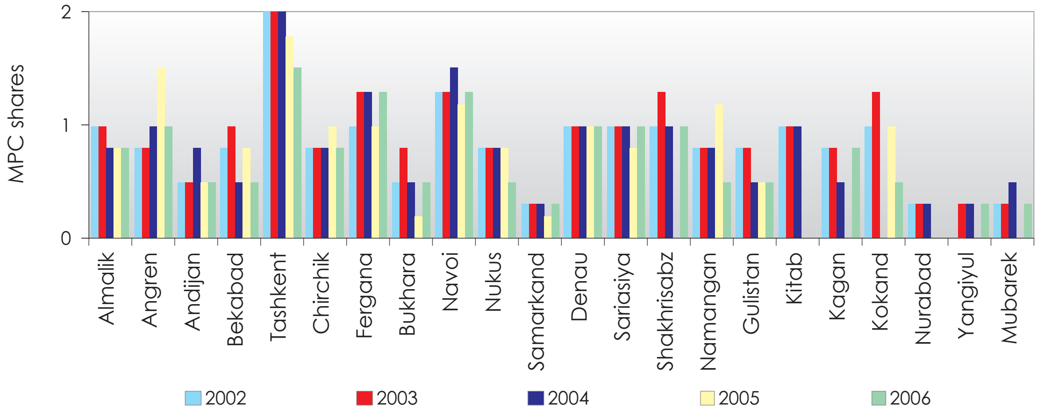


Figure 2.17

Atmospheric air pollution by NO_2 in the urban areas of Uzbekistan



for the Tashkent, Almalik, Angren, Fergana, Navoi, Kokand urban areas.

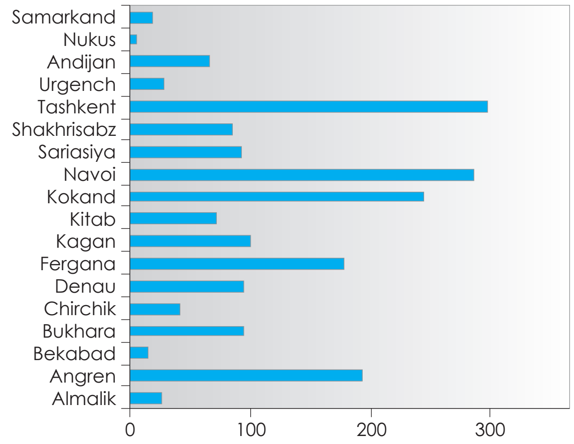
Number of days when NO_2 concentrations are above target values are rather numerous and are reported for many towns of the republic (Fig.2.18).

2.5. CO (carbon monoxide) emissions

CO emissions make up over 50% of the total gross emissions of air pollutants. The CO contributions to motor transport exhaust gases amount to about 70%. The highest concentrations of this ingredient are observed near engineering plants and at crossroads with heavy traffic.

Figure 2.18

Maximum number of days when NO_2 concentration in urban areas is above the values MPC (2004-2006)



The complex that includes fuel-and-energy industry, chemical and petrochemical industries accounts for 53.8% of CO emissions in the republic. The petrochemical works "Uzbekneftegaz" accounts for 42.3% of this component over the republic and for 10.1% over the branch.

Prior to 2004, volumes of CO emissions from mobile sources were reported to have a downtrend, but in the next years they have increased a bit (Fig.2.19.).

In general, the level of atmospheric air pollution by CO is not high and does not display pronounced time trends (Fig.2.20).

Maximum number of days when CO concentrations are above MPC are reported in Nukus and Bukhara towns (Fig.2.21).

2.6. Dust air pollution (particular matters)

Dust is comprised by suspended particulate matters (PM), which disperse and whose origin may be natural or anthropogenic. It includes minerals, soluble salts, metallic oxides and organic compounds.

In the territory of Uzbekistan, there are numbers of large natural sources of dust emission into the atmosphere – unstable sandy soils and saline soil surfaces of Kara-Kum and Kyzyl-Kum deserts, and Aralkum area (dried Aral seabed area). Wind-blown sand and salt production in the dried Aral seabed area reaches on average 40-45 million tons per year. The main dust and salt transport processes occur within 300 km of the coastland. Dust-fall rate in the Southern Aral Sea area (Priaralye) is ten times higher than in the irrigated lands area.

Dust-fall rate in the Southern Aral Sea area (Priaralye) is ten times higher than in the irrigated lands area.

The concentration of sulfate containing salts in the dust from the dried Aral seabed area amounts to 25-48%, chloride containing salts are between 18-30%, and carbonate containing salts - 10-20%.

Figure 2.19

NO_x and CO emissions from mobile sources (1999-2006)

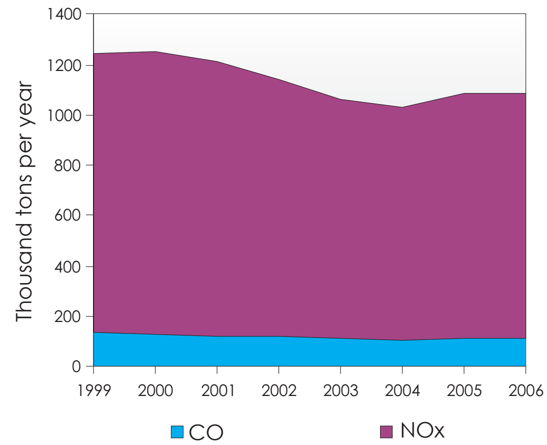


Figure 2.20

Air pollution by CO in the urban areas of the republic

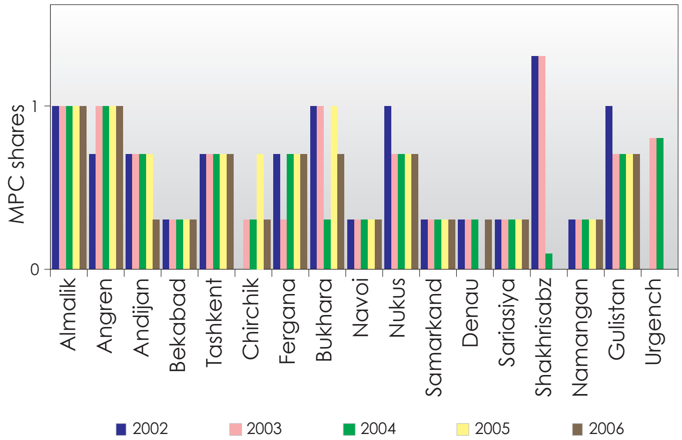
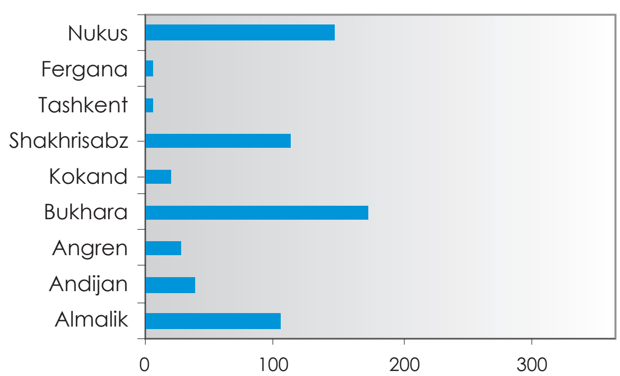


Figure 2.21

Maximum number of days when CO concentration in urban areas is above the MPC values (2004-2006)



The aggregate capacity of anthropogenic sources is considerably lower than that of the natural sources and is estimated as 1,311 million tons per year. Share of PM in the anthropogenic emissions is not high and amounts to 16% for industrial sources and 2% for mobile sources (Fig.2.22).

Totally for the republic, share of PM emissions from industrial sources is considerably higher than that from motor transport (Fig.2.23).

Currently, the "Uzbekenergo", "Uzstroymateriali" and "Uzkhopkoprom" enterprises are considered as the main sources of industrial dust emissions (Fig.2.24).

Based on the industrial statistical data, during the period of 2000-2005 the total volume of particulate matter emissions from non-mobile sources has increased from 88.993 thousand tons to 101.09 thousand tons, but in 2006 it has considerably decreased.

The general atmosphere dustiness index is monitored in 28 industrial towns of Uzbekistan. Increased air dustiness is observed in large towns, whose population makes up over 41% of the total urban population (Fig.2.25). Air dustiness level greatly depends on environmental dustiness and industrial emissions. Dust from urban areas is characterized by the presence of soot resulting from burning processes. Most of the soot is washed out in precipitation. In vehicle exhaust gases, which contribute to pollution of the ground air layer, prevail small particulates of 0.02-0.06 microns.

The higher specific indices of dust emissions are observed in towns having cement productions and thermal power plant (Fig 2.26, 2.27).

Dust, falling out in the industrial centers, contains various mineral matters, metal oxides, silicates, soot, fluorides, arsenic oxides, stibium and selenium. Besides, dust deposits in large industrial urban areas are also reported to contain other metals (cadmium, copper, lead, nickel, zinc and manganese). However, the average values of their concentrations in

Figure 2.22

Share of PM in the emissions:
a) from industrial sources,
b) from mobile sources

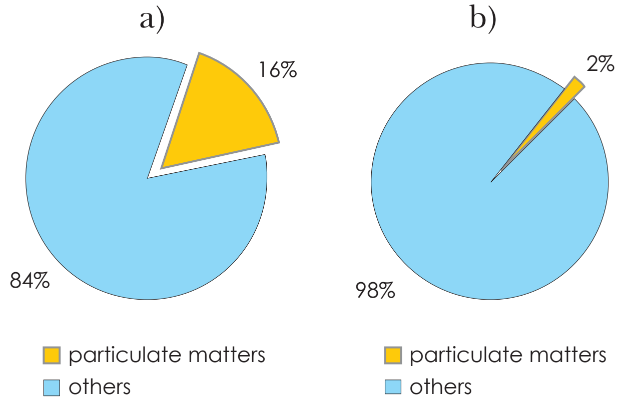


Figure 2.23

Dynamics of gross dust emissions over the republic

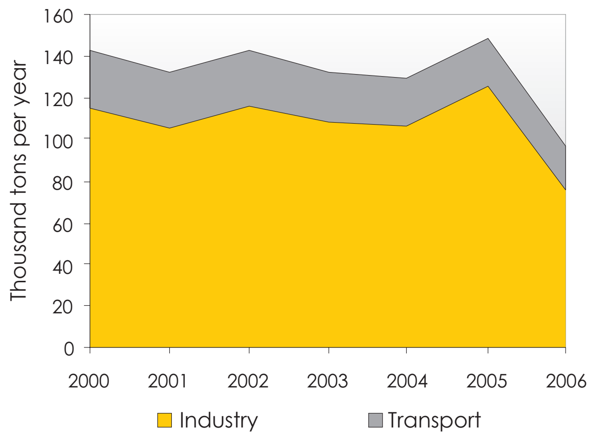


Figure 2.24

PM emissions from the main industries

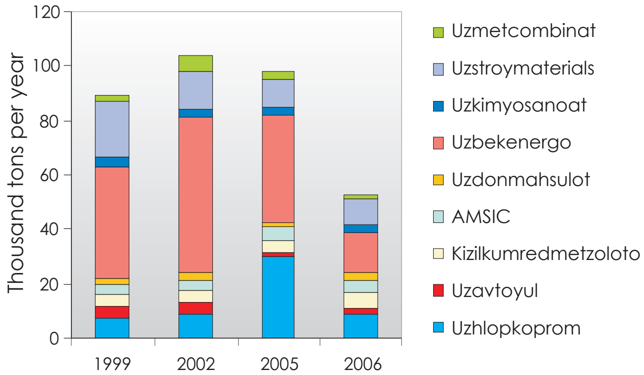


Figure 2.25

Concentration of PM in atmospheric air of the urban areas with population above 100 thousand of people in 2004 (Based on the Uzgidromet sample analysis data)

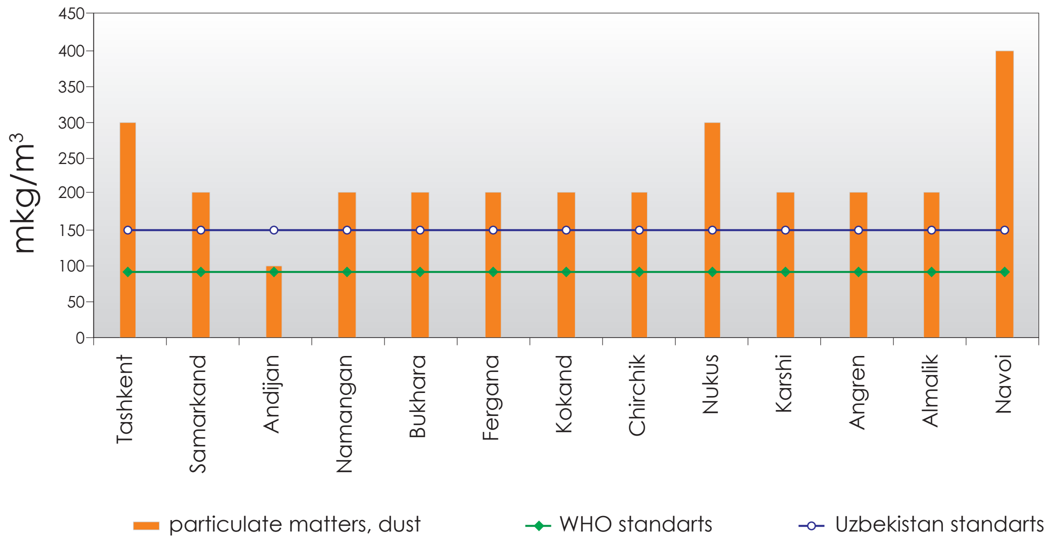


Figure 2.26

Dust emission specific values for the mobile sources in the urban areas, kg per capita)

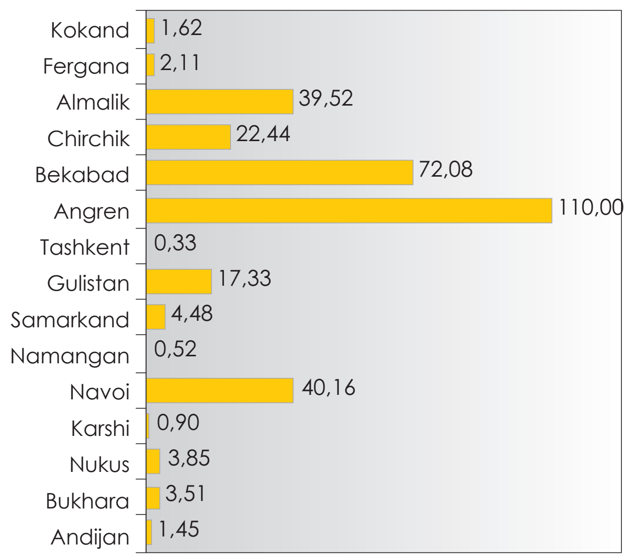
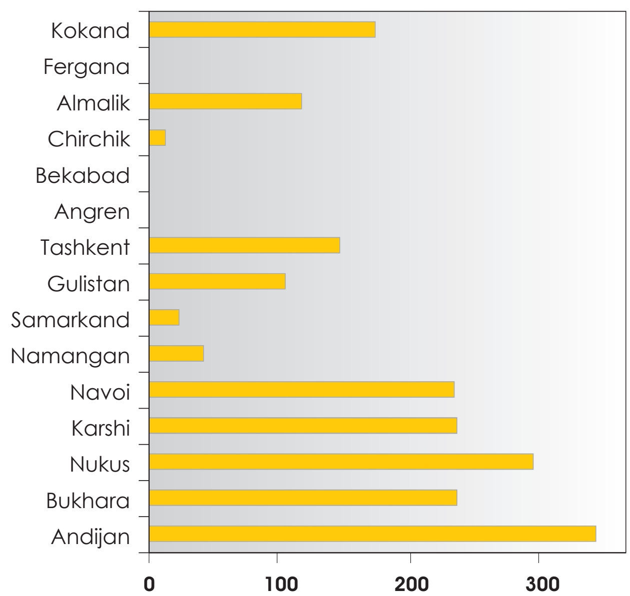


Figure 2.27

Maximum number of days when dust concentration in urban areas is above the MPC



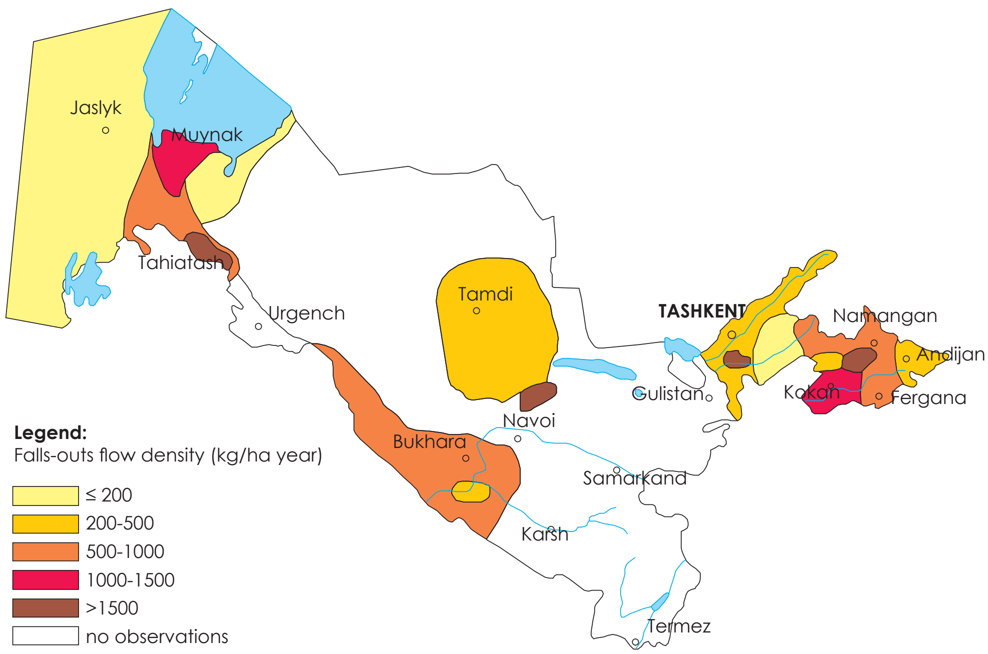
the air (for the last five years) do not exceed MPC values.

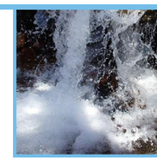
Particulate dust, falling out on the underlying surface due to gravitation attraction, is called dry atmospheric depositions (DAD). Atmosphere dust assessment is based on particulate matters flow density values (kg/ha per year), which are qualitative characteristics of atmosphere dustiness.

Long-term research work of the Uzgidromet Research Institute resulted in the calculation of the average long-term value of DAD flow density for different observation points, and the Uzbekistan territory was zoned based on the density of dust falling out with DAD (five gradations) (Fig.2.28).

Figure 2.28

Schematic-map of DAD flow density for the territory of Uzbekistan





Chapter 3. WATER RESOURCES

The Republic of Uzbekistan and the majority of the neighboring countries are situated in the Aral Sea internal drainage basin, transboundary waters of which are in shared use for economic and environmental needs. The fresh waters of the rivers, lakes and reservoirs are used for irrigated farming, industrial and public utility sector needs. It should be stressed that using low productivity saline lands for agricultural production, in-stream disposal of collector-drainage waters and inefficient wastewater purification systems results in deterioration of water resource quality and in increase in water salinity.

Considering the close relationship between environmental conditions and water availability, many national indicators have been developed for the assessment of water quality. 25 ecological indicators and ten sub-indicators are used to assess the changes in the state of water resources, water consumption volumes in different branches of the economy, stream flow deficit rate and quality change patterns of surface and underground waters.

3.1. Fresh waters

3.1.1. Total water resources

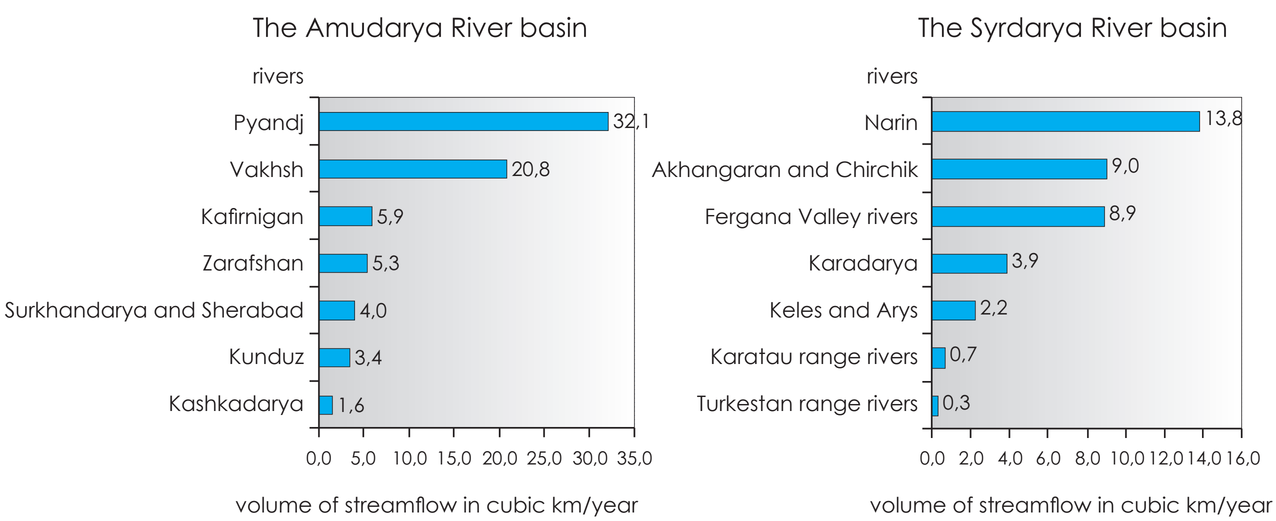
As anywhere else, atmospheric moisture is the main source of regional water formation. On average, annually some 2700 km^3 of water drift with air masses over the Central Asian territory. About 490 km^3 or less than 20% falls out in the form of precipitation (rain and snow). In the mountain areas, this precipitation generates river flows amounting to 132 km^3. Glaciers of the Aral Sea basin accumulate 466 km^3 of water (data from 1980). In the Amudarya River basin, water resources of the mountain lakes are rated at 46.6 km^3, in the Syrdarya River basin, at 5.6 km^3.

Total volume of river flow, generated upstream of the main water intakes for irrigation (or within the mountain area of flow generation zone), is usually considered as the water resources volume, since in the Central Asia plains actually do not contribute to flow generation, and if they do, then it happens only in the extremely wet years, and only in certain places.

Distribution of water resources in the Aral Sea basin rivers are extremely uneven (Fig.3.1) and is determined by different surface flow generation conditions, which are favorable in the mountain area and unfavorable in vast plain areas occupied by deserts and semi-deserts.

Figure 3.1

Water resources of the main Aral Sea Basin Rivers



During the last decade, the Amudarya river flow has been undergoing sizeable fluctuation (Fig.3.2). In dry periods of 2000-2001, the lower reaches and estuary of the Amudarya were experiencing acute water shortage.

Water resources of Uzbekistan

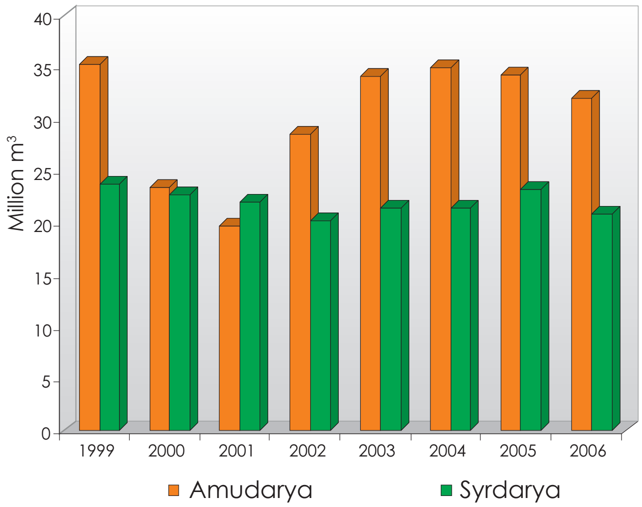
Water resource volumes can be used as indicators of the state of the environment. To analyze the peculiarities of the water resource regime, it is also necessary to use indicators of climatic conditions.

The plain part of the territory is represented by arid lands. Precipitation capacity increases with an increase of height; in the mountain basins the precipitation distribution pattern is complicated and depends not only on the height of the area, but also on its location in the mountain system. At the mountain shoulders exposed to the main moisture laden air flows, the amount of annual precipitation can reach 1500-2000 mm (for example, in the Pskem river basin).

Surface water resources of Uzbekistan may also be generated in the mountain areas of neighboring countries. It should be noted, that part of the water generated in neighboring countries is supplied to the territory of the republic through canals. Internal water resources comprise lakes, water reserves of glaciers situated in the territory of the republic, and underground water deposits. Large and small rivers, as well as underground waters are the main constituents of available water resources of Uzbekistan (Table 4.1).

Figure 3.2

Agricultural land structure and dynamics (thousand km²)



In the Amudarya river basin, share of locally generated (Uzbekistan territory) water resources amounts to 6%, in the Syrdarya river basin, to 16%, and totally for the republic, to about 8% of their total runoff.

3.1.2. Rivers

There are over 17.7 thousand natural water streams in the republic. In the Amudarya river basin their number amounts to 9.9 thousand, in the Syrdarya river basin – to 4.9 thousand, and in the interstream area of rivers - to 2.9 thousand. The greater number is comprised of small gullies (sai), whose length is less than 10 km. These small natural streams prevail in the Amudarya and Syrdarya rivers' interstream area, where they are

Table 4.1

Breakdown of currently available water resources of Uzbekistan (million m³)

River basin	River			Ground waters	Recommended for CD* usage	Available water resources
	stem stream	small	total			
Syrdarya	10490	9425	19915	1590	2600	24105
Amudarya	22080	10413	32493	301	2310	35104
Total for Uzbekistan	32570	19838	52408	1891	4910	59209

CD - collector drain*

represented mainly by temporary streams, and even those whose length exceeds 10 km do not have a regular annual flow.

The Amudarya River is formed by the confluence of the Vakhsh and Pyandj rivers. Its length is 1415 km, but if its length from the origin of Vokhdjira River is included, it will total 2620 km. The water catchment area of the mountain part of the basin is 230,000 km^2. In the plain, the river does not have any feeders over the length of 1200 km; its waters are used for economic needs, mainly for irrigation, and are lost by infiltration and evaporation.

The total average annual run-off of the Amudarya river basin amounts to 73.04 km^3 and 19 km^3 of this volume originate from Afghan territory.

In its lower reaches in the territory of Uzbekistan, the river divides into a wide mouth with an area over 9000 km^2; this region earlier accounted for about 2600 lakes that have almost completely dried up due to the shortage of water inflow to the mouth (estuary) of the river.

The Syrdarya River is formed by the confluence of the Narin and Karadarya rivers. Its length is 2212 km, but if considered from the origin of the Narin river, its length will total 3019 km. The mountain part of the Syrdarya river basin is represented by the complicated topography of the Pamir Alay and Tien Shan ranges, which is a flow generation zone. Its area is 150,000 km^2, and it includes over 2900 rivers and water streams. The average annual run-off of the Syrdarya river basin amounts to 38.82 km^3. In wet years (5% probability), run-off volume increases up to 54.1 km^3, while in dry years (95% probability) it decreases to 21.4 km^3.

Chirchik river flows north-west of Tashkent city and is formed by confluence of Chatkal and Pskem rivers.

The mountain ranges here are of inconsiderable height and though the snow line is at a comparatively high level (3300-4000 m) glaciations in the basin are insignificant. There are 251 glaciers in the Pskem river basin with a total area of 121.2 km^2.

The river is fed by snow and glaciers that predetermines discharge hydrograph (maximum volume in June-July. In the plain, the Chirchik river water is intensively used for irrigation and is supplied to the fields through an extensive network of canals.

3.1.3. Reservoirs

Reservoirs play a very important role in the operation of water management systems and support their sustainability. Currently, there are 51 operating reservoirs in the republic, which are mainly used for irrigation purposes. The total rated storage capacity of these reservoirs is 18.8 km^3, and the active storage capacity is 14.8 km^3. Reservoir water volume, stored for a given date, is considered as a state indicator.

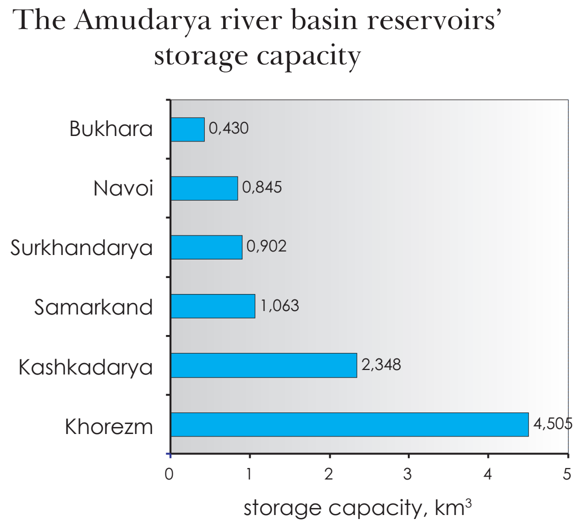
Initially, reservoirs were mainly constructed on the plains in close proximity to the irrigated lands. In the 1960's, construction of reservoirs was moved to the mountain areas, since mountain valleys, due to their morphological peculiarities, provided better possibilities for construction. Being located at considerable heights, they have proportionally larger commanded areas.

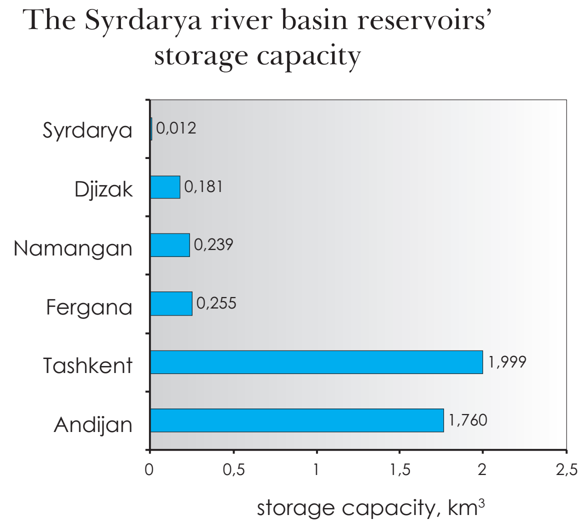
The largest reservoirs of Uzbekistan are in multipurpose use and intended mainly for irrigation, power engineering and industrial needs. Long-term reservoir operation and a change in their use resulted in their intensive silting and the necessity for the construction of compensating reservoirs. Reservoirs of Khorezm, Tashkent and Andijan regions are reported to have the largest active storage capacities (Fig.3.3).

There are approximately 500 lakes in Uzbekistan. They are mainly small water bodies with an area of less than 1 km^2. Only 32 lakes have an area exceeding 10 km^2. The Aydar-Arnasay lake system is the largest in Uzbekistan; its area is 3600 km^2 and its storage capacity is 42 km^3 and exceeds the water reserves of all other reservoirs.

Figure 3.3

Breakdown of reservoirs' active storage capacities by regions





Arnasay is one of the largest lake systems in Uzbekistan. In 2005, its cumulative volume was over 42 km^3 which exceeded the aggregate water volume of all the reservoirs of the republic. The lakes are used for fishing and have a high recreation potential. Their regime is governed by water releases from the Shardara water reservoir and discharges of collector-drainage waters. Recent changes in water management systems resulted in the deterioration of lake water quality.

3.1.4. Underground waters

As of January 1st 2007, approved reserves of fresh and brackish underground waters in Uzbekistan make up 23,642.64 thousand m^3/day (273.6 m^3/s). Approved reserves of underground fresh waters (salinity is up to 1g/l) make up 21,764.19 thousand m^3/day (251.9 m^3/s). Explored and approved reserves of underground waters are attributed to ecological indicators, which characterize state of environment, while underground water use volumes – to impact indicators.

Underground waters are mainly used for domestic and drinking water supplies (173.5 m^3/s), industrial and process water supplies (29.6 m^3/sec) and irrigation and stockwater development needs (70.5 m^3/sec) (Fig.3.4).

Fresh underground water salinity level varies within the range from deciles of gram per liter to 5 gram per liter, and even higher (Fig.3.5).

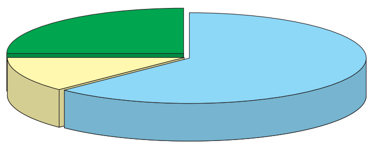
3.1.5. Water consumption pattern in the Aral Sea basin

Irrigation farming in the Aral Sea basin has centuries-old traditions. For the last 50 years irrigated lands area has increased from 4.5 millions of ha in 1960 to about 8 millions of ha. Population size in the region has also increased from 11 millions of people in 1950 to 40 millions of people in 1999.

Environmental conditions and sustainability of the national economy, in particular of the agricultural sector, greatly depends on water availability in a given region. Climatic peculiarities, namely strong continentality, high evaporating capacity (up to 1700 mm a year), insignificant and irregular seasonal patterns of precipitation (on average 150-200 mm), as well as high summer temperatures (up to 49°C) have led to the development of irrigated farming. The arid climate and high level of natural soil salinity has resulted in additional salt accumulation in the soil. Therefore, water in irrigated farming is used not only for irrigation of plants, but also for leaching.

Figure 3.4

Underground water use: breakdown by regions and industries



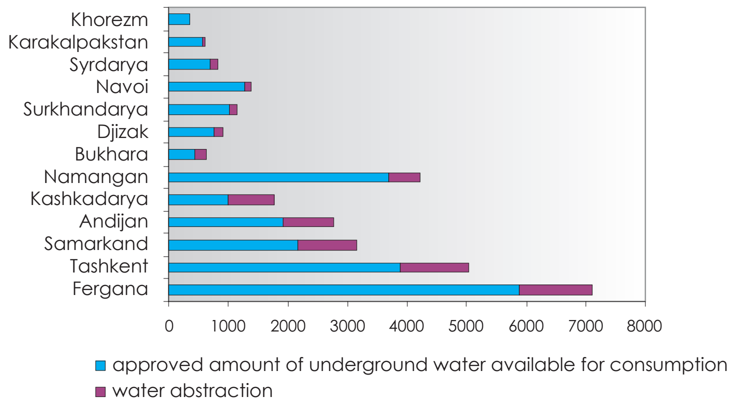
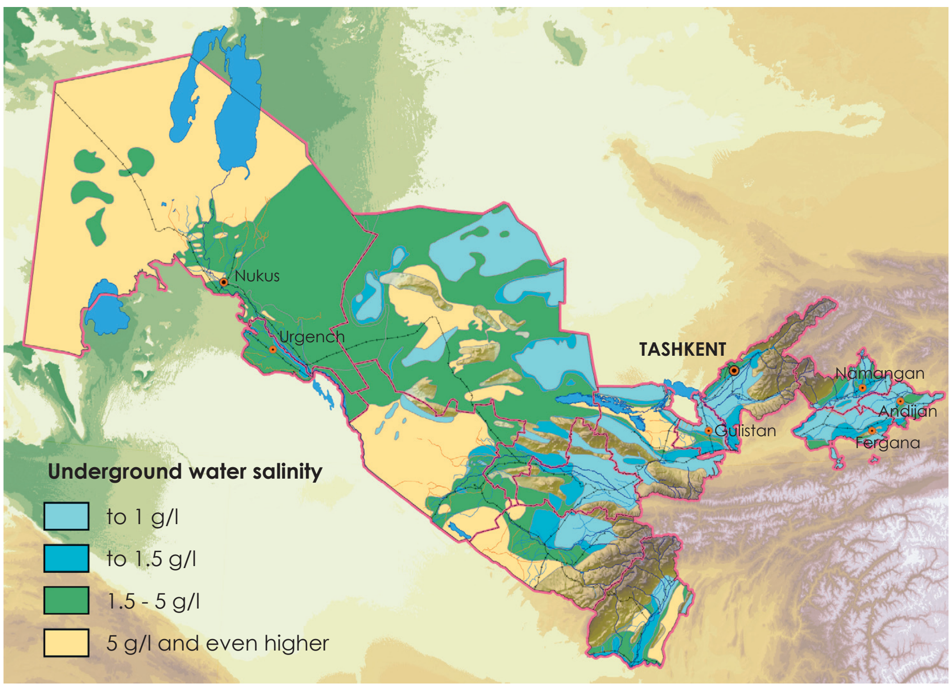


Figure 3.5

Dynamics of cropping pattern in irrigated lands of the Republic of Uzbekistan

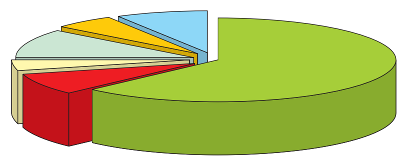


Irrigation farming in the Aral Sea basin is a centuries old tradition. For the last 50 years, irrigated land area has increased from 4.5 million ha in 1960 to about 8 million ha. Population size in the region has also considerably increased simultaneously.

The largest user of Aral Sea water resources is agriculture. The second largest water consumers are the industrial and public utility sectors. Water discharges to the irrigation collectors and the Aral Sea, as well as stream, canal and reservoir evaporation losses constitute a considerable part of the regional water balance (Fig.3.6).

Figure 3.6

Correlation of the main water consumption volumes in the Aral Sea basin



3.2. Water use

Water resources like other natural resources at the disposal of society are limited. Development of the economy and infrastructure, related to population increase, result in a steady increase of water consumption by the public utility, industrial and agricultural sectors of the economy. The ecological indicators relating to water use may be used to describe impacts and changes in the water sector.

3.2.1. General water resources use

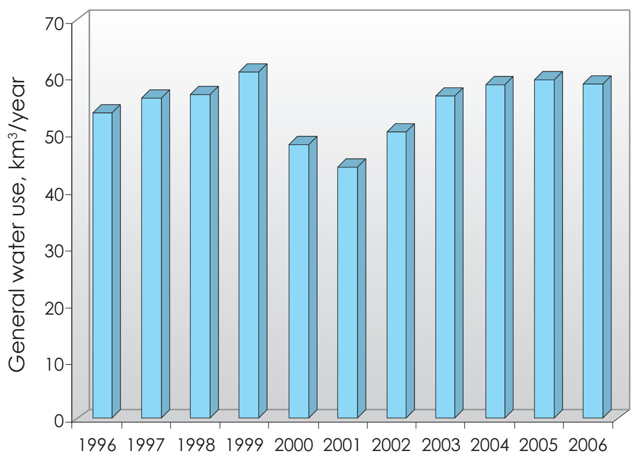
In Uzbekistan, general water use is based on a shared use of transboundary and internal water resources of the Aral Sea basin in accord with the allocated approved limit and varies (depending on the dryness of a year) within the limits of 45-62 km^3 per year (Fig.3.7). Over 90% of this volume is used in irrigated farming (Table 3.2).

After the droughts of 2000 and 2001, water use in Uzbekistan (breakdown by regions) has gradually increased during the next years.

Increased water use resulted in the increased disposal of collector-drainage waters (CDW). 10,854.64 million m^3 (46%) of CDW (or 46% of the total CDW volume) were dis-

Figure 3.7

Dynamics of general water use in Uzbekistan



According to the forecasts made by the State Committee for Nature Protection based on the data provided by the State Statistics Committee, water use limit will be reduced by 7% in 2008 as compared to the figures of 2008. At the same time, according to the forecasts, total recycled water usage will increase in 2008 by 10.4 million m^3 as compared to the volume of 2006, and by 1.2 million m^3 as compared to the volume of 2007.

Table 3.2

Current water resources use in the Republic of Uzbekistan (Average for the period of 2002 - 2006)

Water resources use	km^3	%
Total, including:	**55.1**	**100**
Irrigated farming	49.7	90.2
Non-irrigation users, including:	5.4	9.8
Domestic and drinking water supply	3.4	6.1
Industry	1.2	2.2
Fishery	0.8	1.5

posed into the streams in 2004. About 3% of the total CDW volume was used for irrigation, mainly in Samarkand, Tashkent and Syrdarya regions. The remaining CDW, approximately 50%, were disposed outside the regions to support CDW receiving lakes.

3.2.2. Domestic consumption

During 2002-2006, the total volume of water supply to public utility and rural sectors amounted to 3.4 km^3 per year. These values are the largest among the non-irrigation water users. The public utility sector annual irreversible water use amounts to 1.97 km^3. It should be mentioned that only a part of the public utility sector return waters undergo sufficient purification. In 2006, the volume of effluents treated to a standard quality made up 1057 million m^3. The discharge of pollutant effluents into the surface water bodies in 2006 amounted to 119 million m^3, i.e. compared to 2003 (140.9) it has decreased by 22 million m^3, thus resulting in a certain decrease of water bodies pollution load (Fig.3.8).

In the regions with a tight water balance, a considerable proportion of drinking water demand is provided by underground water supplies. Underground water intake for the municipal drinking water supply amounts to 1,142 km^3/year, and for the rural water supply, to 1,423 km^3/year.

3.2.3. Water recycling

In Uzbekistan, annual water intake for the industrial needs amounts to 1.2 km^3/year. The most effective large-scale industries are based on water recycling technologies. Recycled water volume amounted to 4106 million m^3 in 2006 against 3971.3 million m^3 in 2004. This indicator characterizes water saving technology introduction rates. In the 1990's, water recycling was reduced owing to a drop in industrial productivity, but in recent years the share of industrial water recycling has been increasing. The highest rate of water recycling is reported for the industrial enterprises of the Tashkent and Navoi regions (Fig.3.9).

Starting from 1990, the discharge of polluted industrial effluents has been gradually decreasing due to the decline in industrial capacities, and importantly to the activities of the environmental authorities.

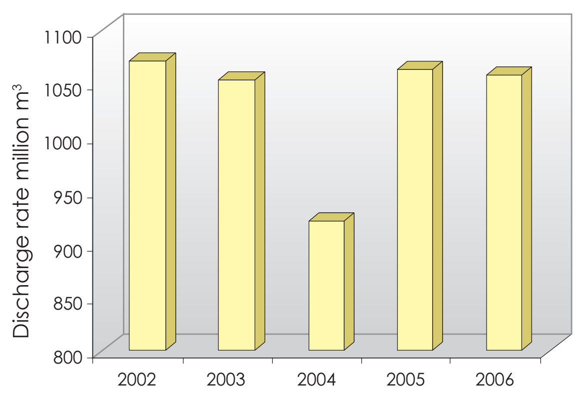
3.3. Water quality

From the ecological safety point of view, a deficit of water resources and their contamination is one of the most acute problems within the Republic of Uzbekistan. Water quality is an extremely important factor for all sectors of the economy and it plays a very important role in supporting ecological viability of water ecosystems and bio/hydro communities. Rivers, canals and reservoirs of the republic are ex-

Figure 3.8

Discharge rate of pollutant and treated to standard quality effluents

Discharge rate of treated to standard quality effluents



Discharge rate of pollutant effluents

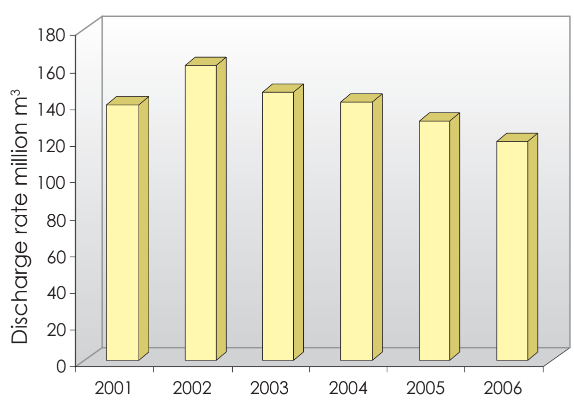
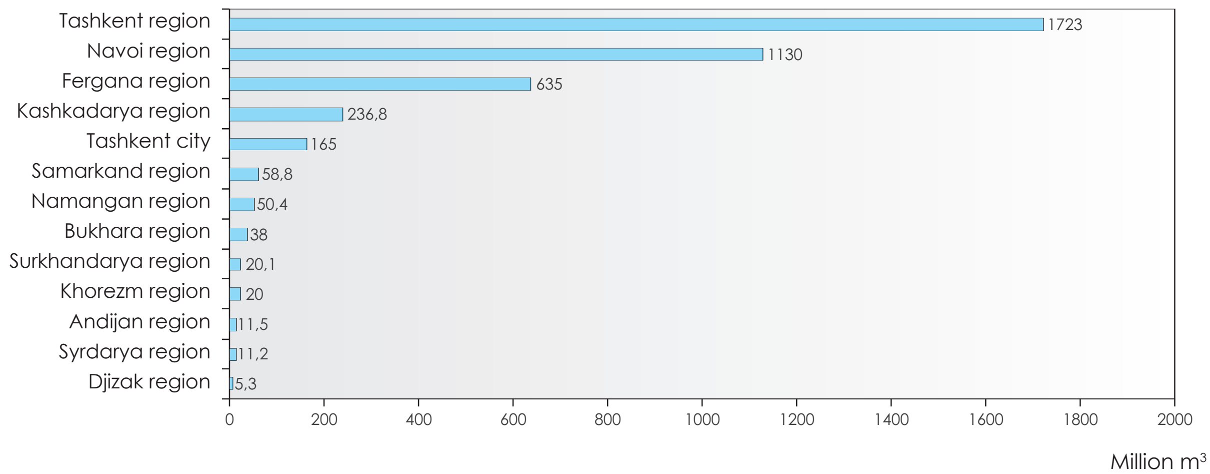


Figure 3.9

Recycled water use in industry



posed to the anthropogenic impact (including pollution), and its rate in many cases exceeds the self-purification capacities of natural water bodies.

In the mountain area, which is flow generation zone, water stream pollution sources are rare and all changes in physicochemical parameters of water and composition and the structure of biotic communities are of a natural character determined by orographic peculiarities and the general landscape.

Water streams located in flow generation zones are to a lesser extent exposed to the direct anthropogenic changes, however further downstream the situation is more difficult. An increase in the anthropogenic load on the river ecosystems results in a drastic decrease of water quality and leads to changes in the composition and structure of aquatic communities.

3.3.1. Water quality in flow generation zone

In Uzbekistan, river flow generation zones, in upstream branches, have relatively stable hydrological and hydrochemical regimes and satisfactory water and near-water ecosystems. However, it should be mentioned that climatic changes in the region have caused certain changes in balance of the natural environment even in that zones.

A reduction of glaciated area has been reported not only for the Uzbekistan mountain areas, but also for a large part of the mountain territory of the whole region. In many cases, this results in the formation of small lakes in the periglacial zone, which are characterized by an unstable hydrological regime. This in turn creates the need to establish a special monitoring system, since, first of all, mountain glaciation is the main regulating component of a rivers' hydrological regime and nourishment type, and secondly, some of these newly formed lakes could produce catastrophic floods and mud flows in the case of failure of their dams.

Depending on altitudinal zonality, geological and soil conditions, moisture content and direction of slopes, river water salinity varies within 60-200 mg/dm^3 limits and the concentration of biogenic and polluting substances is at the background level. Waters of the flow generation zone are characterized by a high dissolved oxygen level (DOL) that favors development of water biotic communities. Near channel forests are typical for river valley openings and low gradient river slopes.

3.3.2. Surface water pollution

The water pollution index (WPI) is used for integral water quality assessment. WPI is calculated as an arithmetic mean value of six hydrochemical factors: dissolved oxygen level

(DOL), biochemical oxygen demand (BOD) and the maximum permissible concentration (MPC) values of four pollutants. According to the official classification applicable in the republic, all surface water bodies are subdivided into the following 7 categories:

I - very clean (WPI - 0.3 or less)

II - clean (WPI - 0.31-1.0)

III - moderately polluted (WPI - 1.1-2.5)

IV - polluted (WPI - 2.51-4.0)

V - dirty (WPI - 4.1-6.0)

VI - very dirty (WPI - 6.1-10.0)

VII - extremely dirty (WPI – more than 10.0)

WPI increases downstream the rivers (from upper reaches to low reaches). Increased WPI values are typical for smaller streams (second and third order streams), which receive effluents from large localities and industrial-urban agglomerations such as Yangiyul, Tashkent, Samarkand. In certain periods, especially in summer months, WPI values in such streams (for example, Chirchik River, canals Salar and Bozsu, and collector Siab) may increase to 2.9-4.4 points, i.e. to IV and V categories.

According to water pollution index (WPI) classification, waters of the majority of high mountain zone rivers (Chatkal, Ugam, Aktashsay, Kyzylcha, etc.) are designated category II i.e. clean water (water quality classification categories). In the lower mountain zone, river waters are designated category III – moderately polluted.

In large rivers, water pollution increases downstream. In recent years, increased water pollution index was reported for the estuary sections of Syrdarya and Amudarya rivers, while in upper areas, where rivers escape from the mountain zone, the water pollution index has been decreasing during the last years (Fig.3.10, 3.11).

Water resources pollution caused by anthropogenic activities could be classified as follows:

- pollution caused by agricultural activity;
- pollution caused by industrial activity;
- pollution caused by disposal of household and municipal wastes in urban and rural areas.

Overuse of agrochemicals results in the intensive pollution of agricultural lands and water resources. It was reported that certain amounts of applied fertilizers (nitrates – up to 25%, phosphate – 5%, pesticides – up to 4%) are exported from the irrigated fields into collector waters. Their concentration in collector water exceeds the MPC values for domestic/drinking water supplies by 5 to 10 times.

Industrial production accounts for water pollution mainly by heavy metals, phenols and oil products. In-stream disposed industrial, household/municipal and collector-drainage waters contain from 8 to 15 polluting substances, whose concentration exceeds the MPC values for domestic/drinking water supplies and fishery waters by 2 to 10 times.

In-stream disposal of public utility waste water has been decreasing in recent years, but it should be mentioned that the purification rate is not sufficiently high. Low operating efficiency of waste water treatment plants (50-70% against rated capacity) results in increased concentration of pollutants in surface water streams and depression reservoirs. Treated waste waters are reported to contain increased concentrations of ammonium ions (10-15 MPC) and nitrites (2-6 MPC). In some instances, organic matter concentration in water supplied to the filtration fields is 6-10 times above MPC values. The situation is most difficult in the regions characterized by water deficit (Karakalpakstan, Khorezm, and Bukhara) and in areas with a high level of industrial agglomerations (Tashkent, Fergana, Samarkand and Navoi industrial areas). About 1-5% of industrial waters are disposed

Figure 3.10

Pollution index for the main Syrdarya river sections

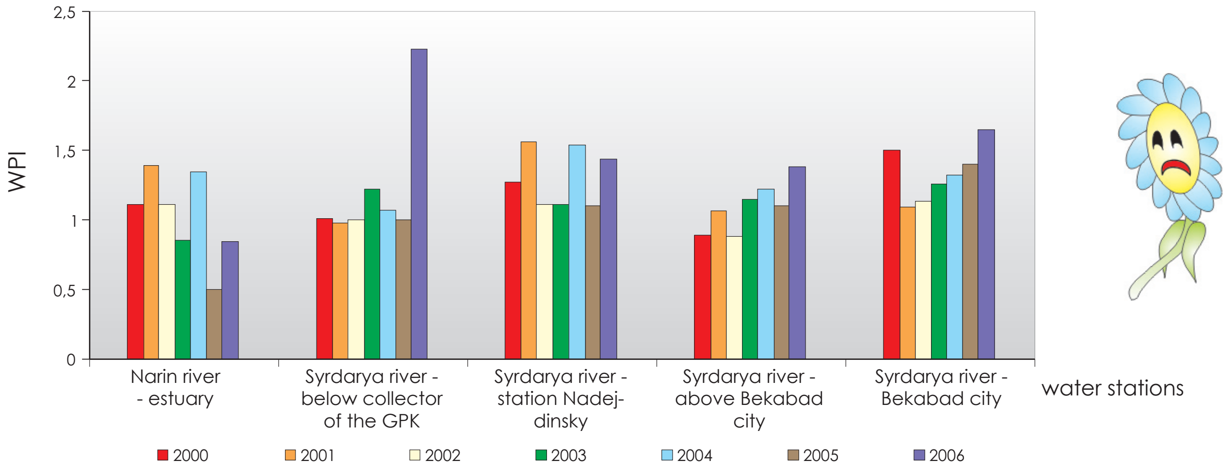
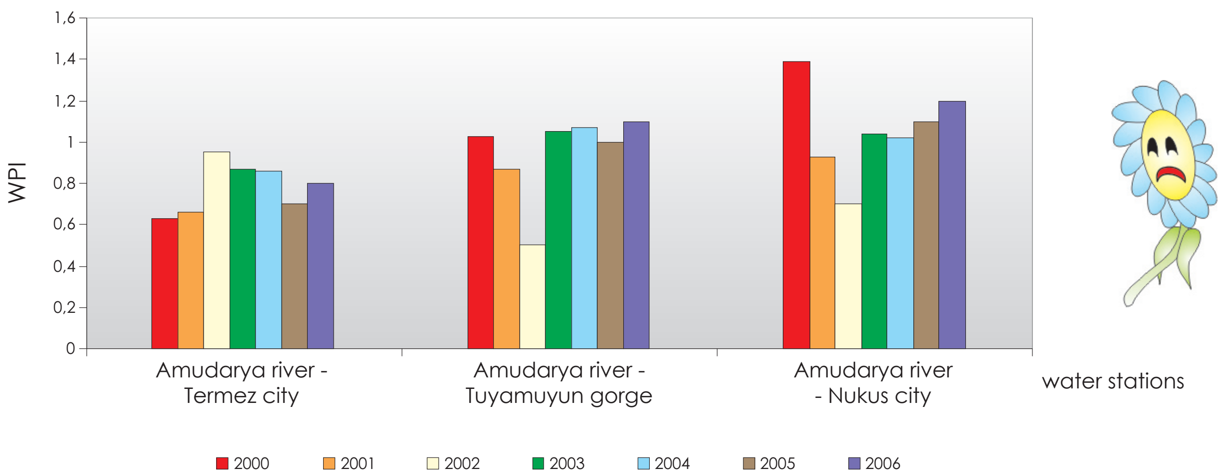


Figure 3.11

Pollution index for the main Amudarya river sections



into streams without treatment.

Therefore, middle and lower reaches of the majority of the regional rivers are characterized by increased water salinity: 1-1.5 g/l in the middle reaches and up to 2 g/l in the lower reaches. It is reported, that in Amudarya lower reaches water salinity and hardness, as well as sulfate, chloride, phenol and silicon concentrations regularly exceed MPC values. Fluorine and mercury concentration is approximating the MPC values.

Main water streams of the republic are no longer could be used as sources for drinking water supplies. This fact is conditioned by unavailability of fresh water releases and in-stream disposal of saline (polluted by pesticides and fertilizers) hutch waters from the irrigated fields. Adequate provision of population with a fresh drinking water of good quality is one of the most serious problems of the republic. Thus, in Karakalpakstan,

> The National Environmental Action Program of the Republic of Uzbekistan predetermines the policy of the state aimed to improve quality of the surface and ground waters.
>
> According to the forecasts made by the State Committee for Nature Protection based on the data provided by the State Statistics Committee, the discharge of pollutant effluents will reduce in 2008 by 0.679 million m^3 as compared to the volume of 2007.

drinking water availability rate amounts to (in average) 61.5%: in Beruni district it is 36.3%, in Shumanay district – 32.5%, and in Amudarya district – 28.7%. In total, over 1/3 of population of the country make use of drinking water not meeting the national quality standard requirements.

Chapter 4. AGRICULTURE

Expansion of agricultural production, which started in the 1960th, was conditioned by the extension of irrigated land area. In Uzbekistan, irrigated agriculture is the base of live activity of the most of population. These lands account for 95% of gross agricultural output.

4.1. Agricultural lands

The land funds, their use and change are considered to be the main indicators of the state of the environment. The total area of the territory of Uzbekistan is 44.89 million ha. As of January 1st 2007, 44.4 million ha or 96.9% of the total area are in the possession of various enterprises. Currently, agricultural land area makes up 22.3 million ha (Fig.4.1), including 4.2 million ha (or 9.4% of the total area) of irrigated lands, which account for 95% of gross agricultural output. Area under forest has increased by 1329.8 thousand ha. This has happened due to the correction of the forest resources record keeping system, which starting from 2003 comprised timberland and shrub pastures formerly attributed to the category of agricultural lands.

According to the different source data, the area of land available for irrigation varies within 7-10 million ha. These lands are represented by serozems meadow soils (16%), meadow soils (44%), serozems (30%), and takyr-like and meadow soils (10%).

During the last six years, the agricultural land structure actually has not changed (Fig. 4.2); grasslands and pastures prevail in this structure and only a very small portion of it is represented by perennial crops.

The largest irrigates land areas (over 400 thousand ha) are in Karakalpakstan and in the Kashkadarya region (Fig.4.3).

Area of small household farms (dekhan farms' lands), which are used for production of various agricultural crops (vegetables, cucurbits crops, cereals, feed crops, perennial crops, etc.), is not included in statistical reports into the category of agricultural lands.

At present, dekhan farms are considered to be one of the most effective agricultural management patterns and account for a considerable share of gross agricultural output. During the last ten years, irrigated household land area has increased by 20.3 thousand ha.

Figure 4.1

Lands resources structure of the Republic of Uzbekistan by land use categories (thousand ha)

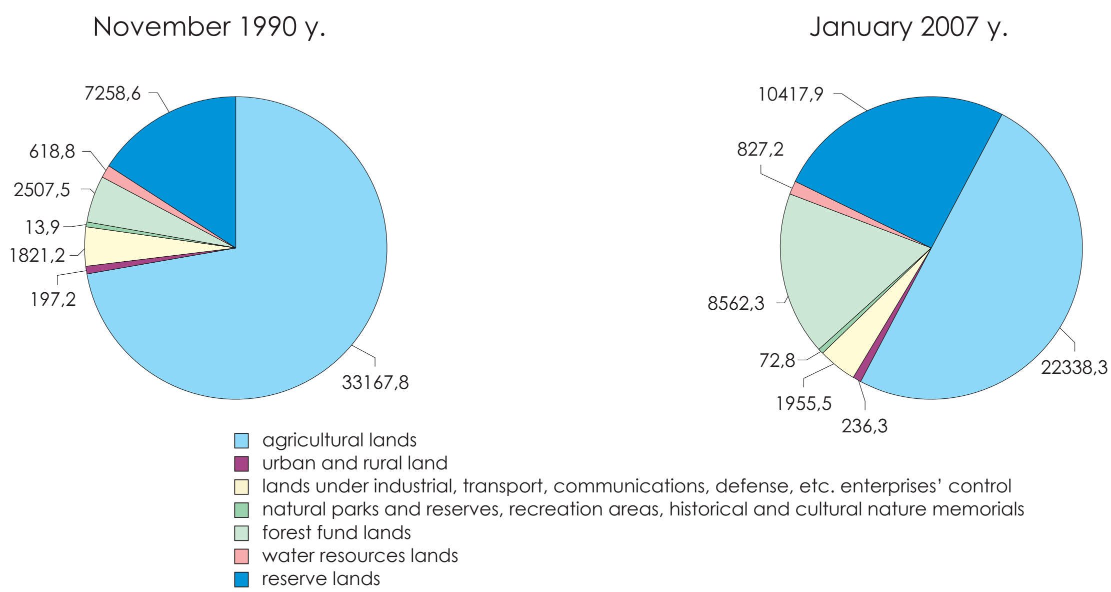


Figure 4.2

Agricultural land structure and dynamics (thousand km²)

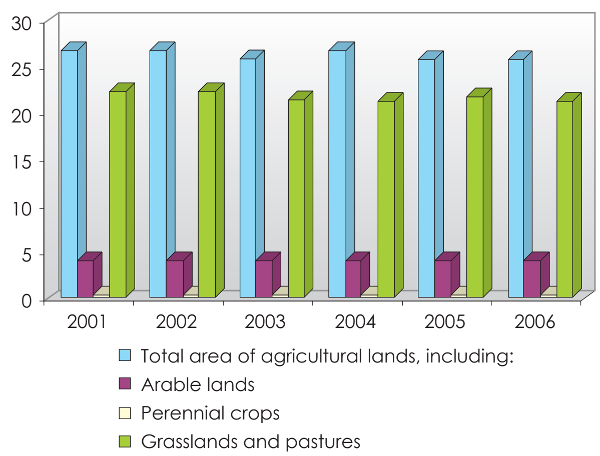
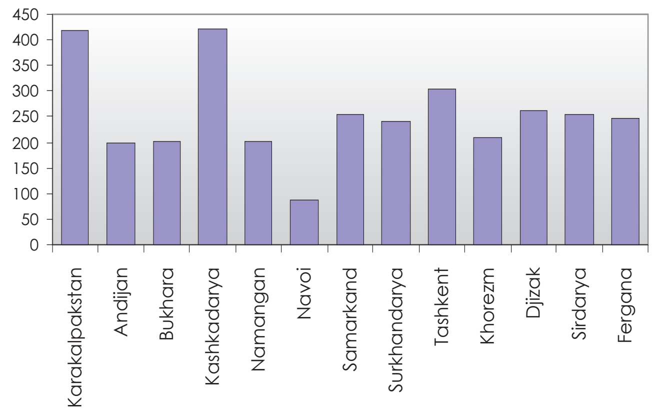


Figure 4.3

Allocation of irrigated arable lands over the regions of Uzbekistan (thousand ha)



4.2. Irrigated arable land quality

Irrigated arable lands are the most valuable agricultural lands, since they are of primary importance for development of the agriculture and of the economy as a whole. In the topsoil of irrigated light serozems and typical desert zone serozems the humus content amounts to 0.60-0.95%, in the old irrigated lands - to 0.85-1.1% and in meadow lands – to 1.25-1.60%.

Appraisal of fertility of different types of soils is based on degree of their quality (bonitet). Upon estimation of soil fertility degree the following main soil-formation factors are taken into account: soil texture, groundwater depth, soil salinity, cultivation level, humus content, etc. Fertility degree is estimated based on field and laboratory studies undertaken once in ten years.

Long-term single cropping of cotton results in degradation of lands; this is due to non-practicing of cotton/lucerne crop rotation and insufficient application of organic fertilizers. The above mentioned negative processes resulted in a considerable decrease in the fertility of irrigated land. Humus content in soil has decreased by 1.3-1.5 times compared to the values of 1980. In 2002, the irrigated land qual-ity average weighted point amounted to 55 which is 3 points less compared to 1991 (Table 4.1). The highest decrease of soil fertility level was observed in the Samarkand (10 points), Namangan (8 points) and Fergana (10 points) regions (Fig.4.4). The lowest soil fertility level was reported for irrigated lands of Karakalpakstan.

Wind and irrigation erosion considerably decreases soil fertility. Water and wind eroded land area is about 2 million ha or 50% of the total irrigated agricultural land area. In irrigated farming areas, soils are mainly polluted by nitrates and pesticides.

As a rule, heavy metal concentrations do not exceed MPC values, and only in several cases there were reported increased concentrations of strontium and zinc. Industrial enterprise waste is one of the main sources of heavy metal pollution of soils. High concentrations of heavy metals are observed in the Tashkent, Almalik, Bekabad and Chirchik areas.

4.3. Land salinity

In Uzbekistan, almost 50% of the irrigated lands are classified as saline. Saline lands are wide-spread in the Republic of Karakalpakstan and in the Bukhara, Navoi and

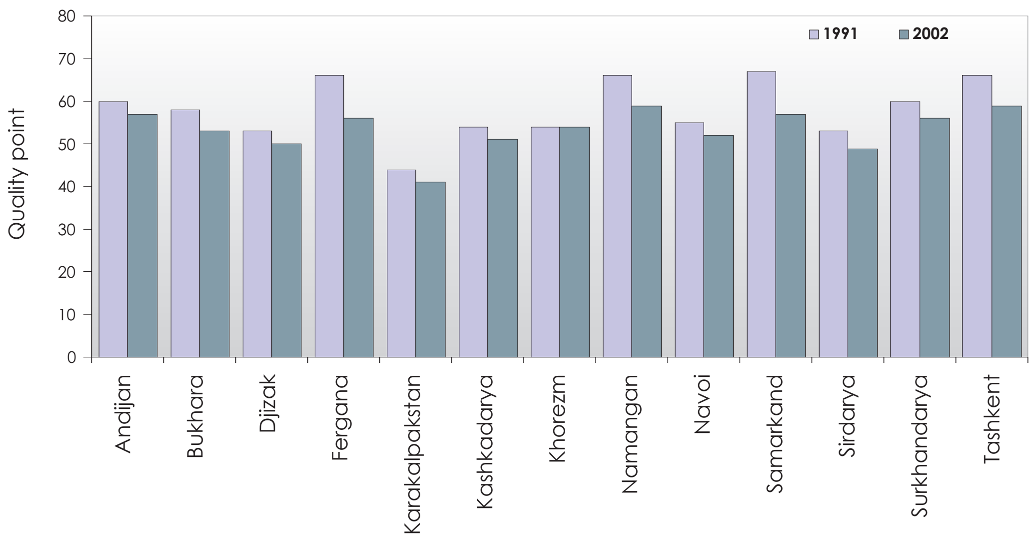
Table 4.1

Classification of irrigated arable lands of the Republic of Uzbekistan

Total	Including:										Average point 2002	Average point 1991
	The worst quality		Below average quality		Average quality		Good quality		The best quality			
	I class	II class	III class	IV class	V class	VI class	VII class	VIII class	IX class	X class		
	Fertility level											
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100		
	Area, thousand ha											
3697,33		8,60	125,75	739,61	971,66	704,55	608,83	314,27	88,180	3,137	55,00	58,00

Figure 4.4

Change in average fertility level of irrigated lands over the regions of Uzbekistan



Syrdarya regions. Almost 5% of the irrigated land area – 213.1 thousand ha is classified as severe salinity land (Fig. 4.5.).

Above 50% of land located in the alluvial plains suffer from salinity and waterlogging. Salinization of land is a consequence not only of irrigation activities; it is also a natural process common to all intermountain, alluvial and pro-alluvial areas of the arid zone. Drainage-free irrigation, huge infiltration losses, construction of unlined canals, exceeding of irrigation rates, uncontrolled water supply and usage of saline water for irrigation – all these factors contribute to the salinization of land.

In Karakalpakstan, for instance, annual increase in irrigated land salinity level is reported to be 10-30 tons/ha. Increase of irrigation water and soil salinity results in a decrease in agricultural crop capacity; for example, in the Khorezm region cotton yield has decreased from 39-41 centner/ha to 29-33 centner/ha during the last years, and in Karakalpakstan – from 30-34 to 14-24 centner/ha.

A downtrend in utilization of both, mineral and organic fertilizers was reported in the most of the regions (Fig.4.6.).

This satiation does not meet agronomic and environmental requirements and could result in further land degradation. Recently, agricultural reforms and long term leasing of land (for 50 years and more) are aimed to increase land users' responsibility that finally should result in stabilization of the situation and increase in irrigated land fertility.

According to the forecasts made by the State Committee for Nature Protection based on the data provided by the State Statistics Committee, in 2007-2008 area of recultivated lands will increase due to the development of the subsurface resources in some regions of Uzbekistan (for instance, in Kashkadarya region it will increase by 1741.2 ha).

Figure 4.5

Irrigated land salinity level (by regions)

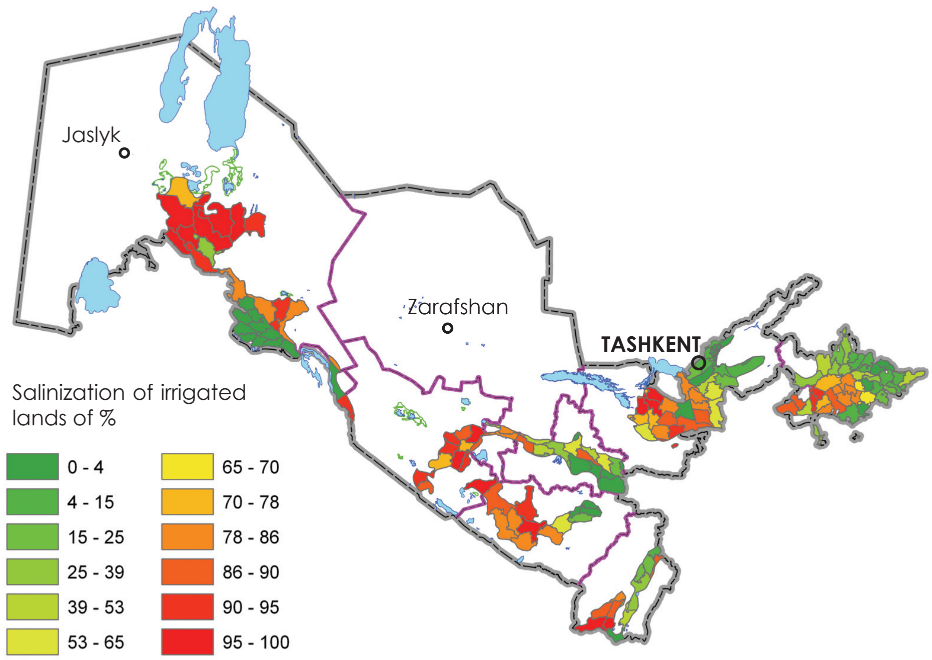
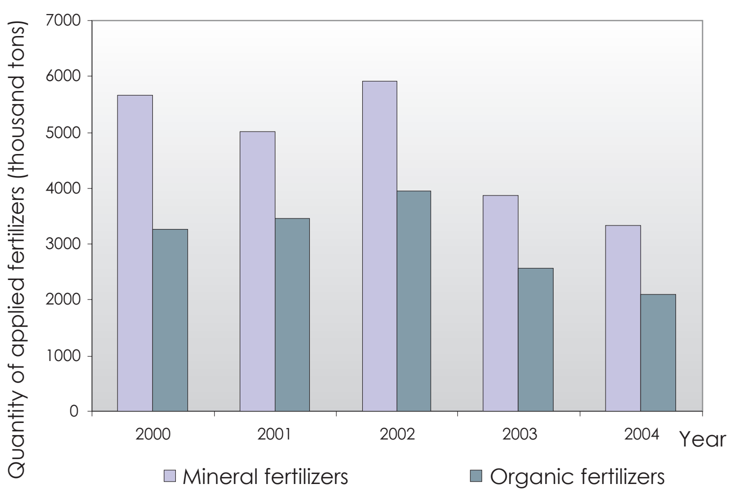
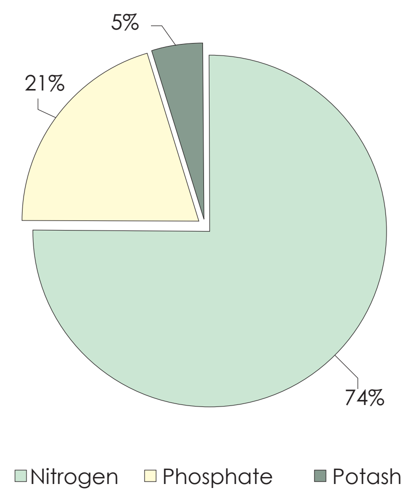


Figure 4.6

Fertilizer use





4.4. Sowing crop capacity

Technical crops and cereals prevail in the agricultural crop structure of Uzbekistan. Area under the cereals has increased by 1.9 times during the last decade. Wheat is the main cereal crop. Cotton still remains to be the main technical crop, though area under it has slightly decreased (Fig. 4.7). Forage land area reduction is another unfavorable trend: during the last decade it has decreased more than twofold.

Agricultural enterprises (mostly of non-state type) are the main cotton producers (94%); besides, they also produce grains (78%), fodders (76%), fruits and berries (47%), eggs (30%), wool (27%), cucurbits and potatoes (20%) and meat and milk (only 7-8% each).

During the period of 1994-2006, wheat crop capacity (wheat is the main cereal crop) has increased twofold (on average over the republic) from 20.8 to 42.7 centner/ha. Positive changes in crop capacity were reported for all regions (except for the Syrdarya region, where it was actually stable, and for the Surkhandarya region, where it dramatically dropped in 1999 due to infection by mildew). This increase mainly resulted from the improvement of cultivation technologies and the accumulation of practical experience in cropping of this culture. The highest wheat yielding capacity was reported in the Andijan region, the lowest ones – in the Syrdarya and Djizak regions, and in the Republic of Karakalpakstan (Fig. 4.8).

Drop in cotton crop capacity has been observed during the period of 1995-2003. Averaged for the re-public, it has decreased from some 26.4 centner/ha in 1995 to 20.6 centner/ha in 2003. Capacity drop was reported for all regions, but the highest values were reported for the Republic of Karakalpakstan – by 38%, the Syrdarya (by 35%), Namangan (by 30%), Tashkent (by 23%), and for the Fergana and Khorezm regions (by 26%). During the last years cotton crop capacity has been gradually increasing (Fig.4.9).

In order to maintain gross output at the current level, it is necessary to raise cotton crop capacity to 24 centner/ha (average value for the republic); though, it should be mentioned that in 2005 it was already 25 centner/ha.

Dekhan farms play a considerable role in agricultural production. The total area of their lands is just over 10% of the total cultivated area, but they account for 49% of the gross agricultural output, including 92% of meat, 91% of milk, 78% of vegetables, cucurbits and potatoes, 70% of eggs, 50% of fruits and berries, 16% of grain and 16% of fodders.

Figure 4.7

Dynamics of cropping pattern in irrigated lands of the Republic of Uzbekistan

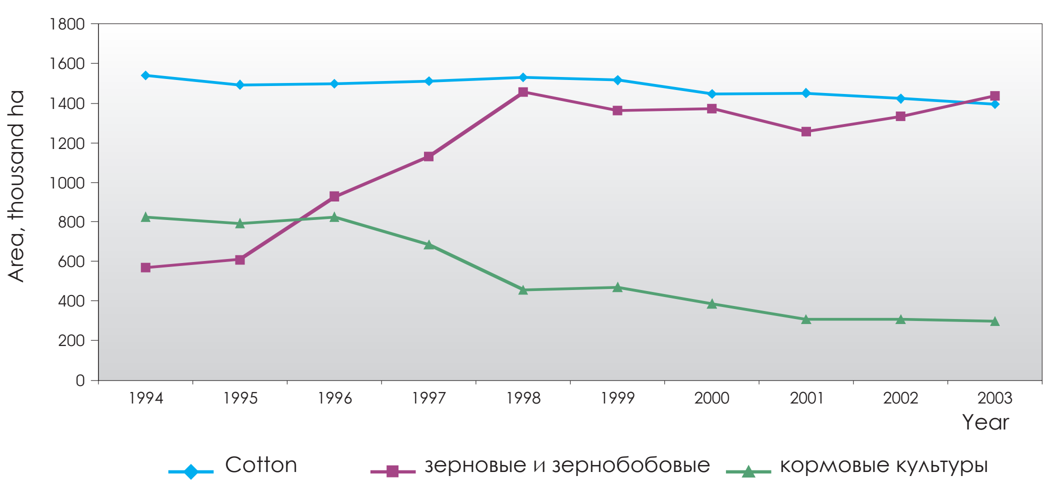


Figure 4.8

Wheat crop capacity on the irrigated lands

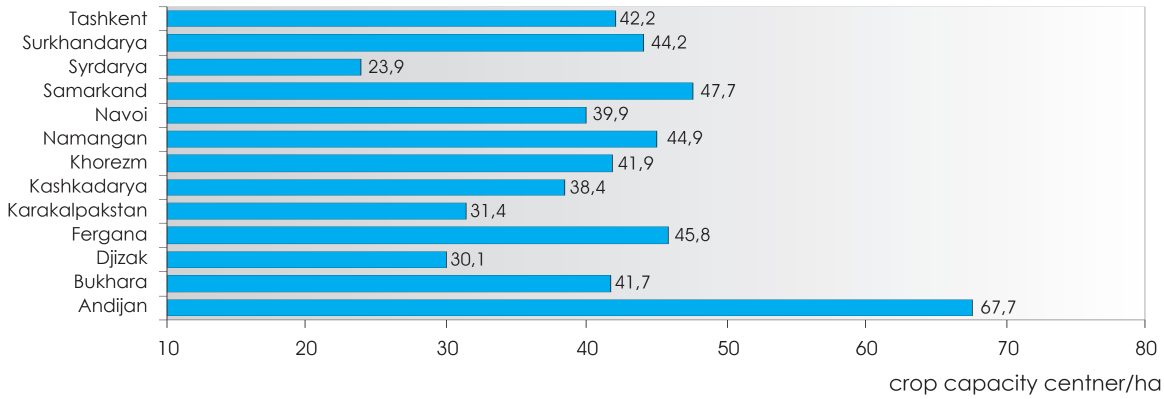
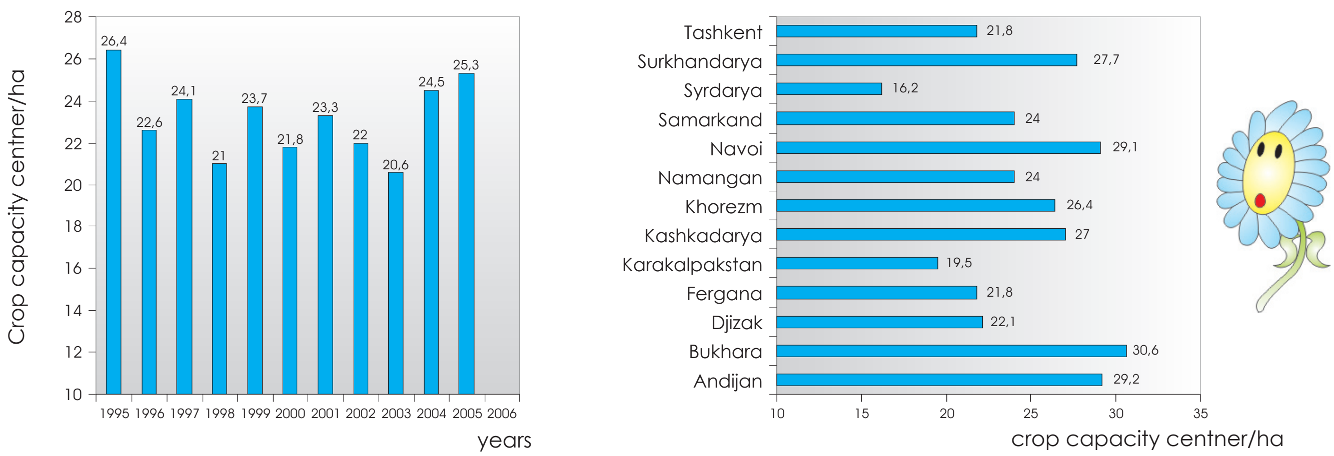


Figure 4.9

Dynamics of cotton crop capacity over the republic and over the regions



4.5. Land degradation

Land degradation is one the most serious desertification related problems. Land degradation results in decrease or loss of biological and economic productivity of arable lands and pastures, forests and forest areas due to the natural and anthropogenic factors, which are closely related with the large-scale development of lands in arid conditions. Decrease of sol fertility, as well as degradation and destruction of soil cover may be expressed in tens and hundreds of different local and zonal forms of appearance. The most typical of them is pasture digression and overgrazing, formation of shifting sand bar-chans and dunes, sheet wash and irrigation erosion, soil pollution by toxic substances and technogenic desertification, etc.

Over 400 thousand ha or over 10% of irrigated lands are in unsatisfactory state (Table 4.2).

In Uzbekistan, saline land makes up 65.9% of the irrigated area, including slight salinity (33.9%), moderate salinity (19.4%), and severe salinity lands (12.6%).

8% of the irrigated land area in Uzbekistan is exposed to the irrigation erosion, 2% of this area is rep-resented by moderately and severely eroded lands. From 20 to 40% of irrigated land areas are underflooded, 15% of the irrigated land areas are exposed to deflation (soil drifting).

Some 15.1 million ha are not used in agricultural production (slopes, rockslides, training ranges, sands, landfills, etc). Over 160 thou-

Table 4.2

State of irrigated lands of the Republic of Uzbekistan

Regions	Year	Area of irrigated lands	State of the lands					
			Good	Satisfac-tory	Unsatis-factory	Due to		
						High GWL*	Soil salinity	GWL + Soil salinity
Total for the Republic	2002	4207,0	1719,9	2184,7	407,9	156,3	115,2	77,2
	2003	4198,0	1719,2	2112,7	423,2	225,7	102,4	91,0

** GWL – ground water level*

sands ha suffer from technogenic impact.

4.6. Soil pollution by pesticides

Pesticides and mineral fertilizer use volumes have reduced 3-4 times over the last 10-15 years. Though the rate of agrochemicals used in agricultural production has considerably decreased in Uzbekistan), soil pollution by pesticides and fertilizer residues still remains a serious problem. Soil pollution by DDT residue aggregate has been decreasing during the period of 1999-2006 (Fig.4.10).

The number of cases, when their concentrations in samples were above the MPC values, has decreased from 39.2% to 21.1%, and the average pollution value has dropped below the MPC value and amounted to 0.85 MPC.

The increased level of soil pollution by DDT residue aggregate is still reported for the Andijan and Fegana regions and makes up 2.4-6.1 MPC (Fig.4.11). In all regions of the republic, concentrations of hexachlorocyclohexane residue aggregate, theflan, thiodan, phosphamide and fazalon in the soil were below MPC values. Former agricultural airfields (461) are considered as environmental pollution sources, since they are accountable for pesticide dispersion. Despite the earlier measures taken, there are still large quantities (1500 tons) of outdated, unused and prohibited pesticides in the republic that need to be destroyed or disposed.

Figure 4.10

Dynamics of soil pollution by DDT aggregate (in MPC values) in 2003-2005

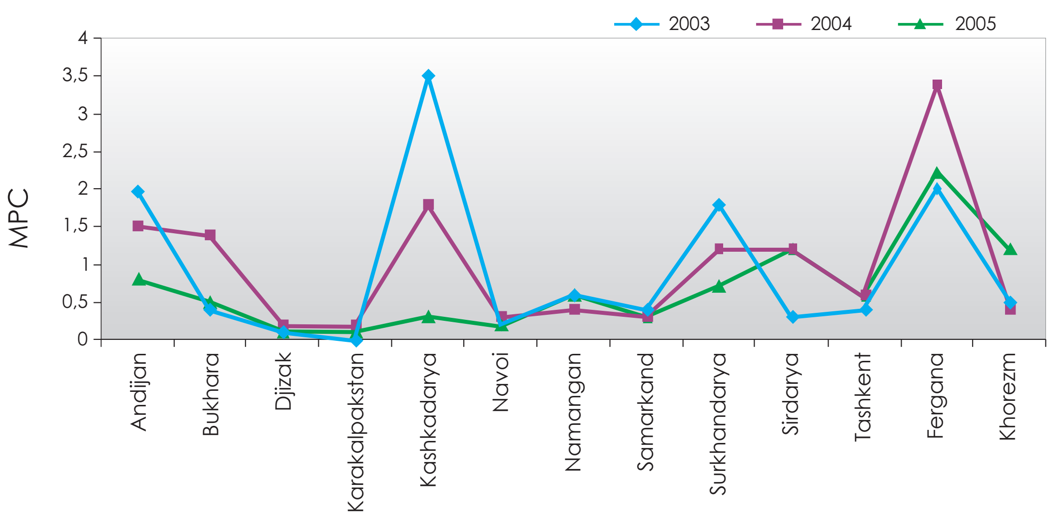
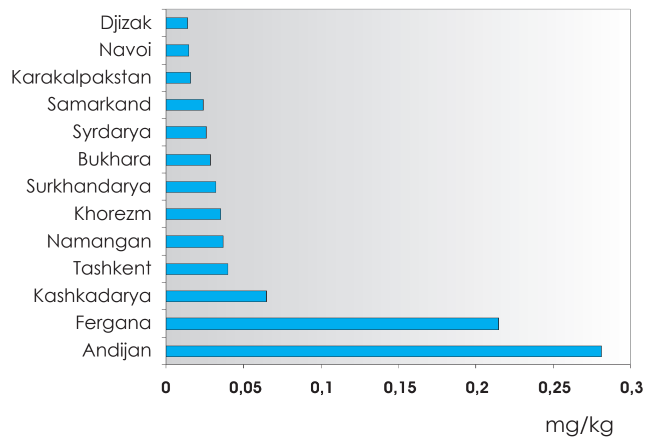


Figure 4.11

Soil pollution by DDT residue aggregate



4.7. Wind erosion

Sands, sandy and other light texture soils of deserts are easily broken up and become unstable due to their low water-bearing nature and the dryness of the desert climate. Non-practicing of anti-erosion agrotechnologies, as well as planning and tilling of large areas of sands and sandy soils resulted in unstableness, which subsequently spread out into the irrigation canals and roads.

Wind and pasture erosion are the most widespread types of erosion in the non-irrigated lands of Uzbekistan. Annual volumes of dust emission into the atmosphere from the dried Aral seabed area amount to 15-75 million tons which has adverse effect on irrigated farming.

In Uzbekistan, wind erosion on the irrigated lands is typical in the Fergana and Zarafshan valleys and Karshi steppe. The so called "Afgan" wind greatly affects yield productivity in the Kashkadarya and Surkhandarya regions. In 1965, 395.1 thousand ha of irrigated land suffered wind erodibility; in 2005 this figure had increased almost 1.5 times - to 628.4 thousand ha. This process is widely spread in the Tashkent (138.6 thousand ha), Samarkand (121.9 thousand ha), and Kashkadarya (159.7 thousand ha) regions (Fig.4.12). Antierosion measures need to be undertaken on these lands.

4.8. Waterlogging of lands

The spread and density of artificial hydrographic network constructed on irrigated lands exceed those of natural water streams (Table 4.3).

In Uzbekistan, most of the irrigated lands are exposed to waterlogging, which is conditioned by heavy infiltration losses (up to 40%) of irrigation water from the unlined irrigation ditches and canals. Irrigation canals efficiency is below 0.6. Waterlogging results from the rise of the groundwater level (1.0-1.5 m). In Uzbekistan, waterlogged areas cover over 20% of the territory, where reside some 5 million people. During the period of intensive irriga-

Figure 4.12

Share of agricultural lands suffering wind erodibility in 2004 (thousand ha)

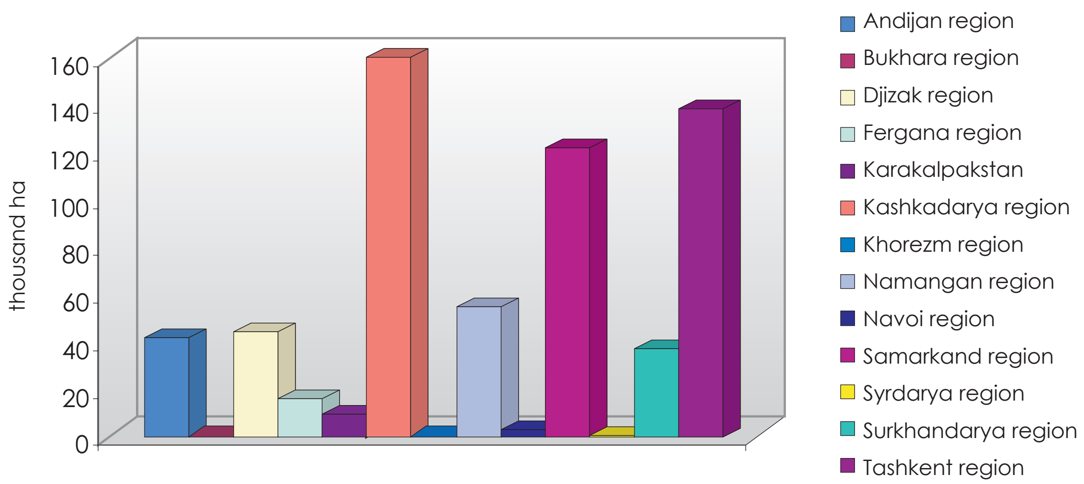


Table 4.3

General hydrographic characteristics of canals and collectors

	Canals, thousand km	Collectors, thousand km	Canals per 1 ha/m	Collectors per 1 ha/m
Total for the republic	185.91	271.46	44.3	64.7

tion, waterlogging is reported in over 40% of the irrigated land area in the Republic of Karakalpakstan and in the Khorezm and Navoi regions. In the Fergana valley and Samarkand region this figure amounts to 30-40% and more, in the Tashkent, Syrdarya, Djizak and Bukhara regions – to 20-30%.

Irrigated light and typical serozems in the piedmont area are mainly exposed to *irrigation erosion*. Some 50% of these lands are characterized by broken relief and considerable surface slope; therefore erosion development probability rate is higher in these lands than in the desert areas. In the old-irrigated-land area, the surface slope is below 3^0 and only in a few places does the gradient exceed 5^0. Percentage of area with heavy and moderate erosion level is higher in the Andijan, Samarkand, Surkhandarya, Namangan and Tashkent regions, where a considerable portion of the territory is occupied by piedmonts (Fig. 4.13).

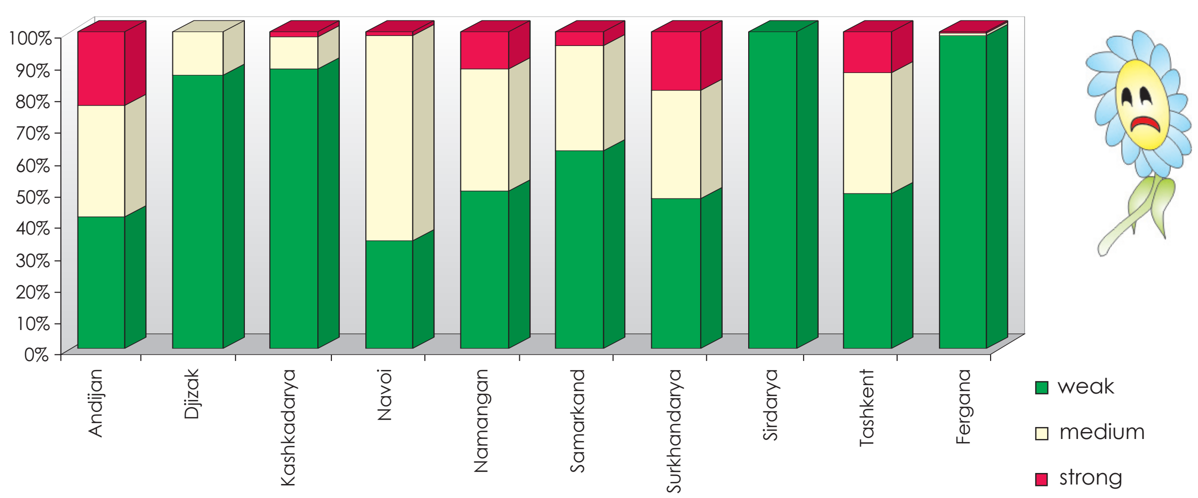
Ravine erosion is also widespread in the irrigated land area. Development of ravines is mainly conditioned by unregulated discharge of water from the irrigated fields and the breakthrough of irrigation ditches. River bank and river bed erosion is also widespread in the irrigated land area. Besides, erosive-karst funnels, "upkans" that promote the development of ravine erosion also occur in these areas.

Rain fed land under grain crops are exposed to erosion mainly in the serozems areas and to a lesser extent in the brown soil areas. The main type of erosion is a waterborne topsoil movement caused by rainfall.

Mudflows, characterized by a considerable destructive capacity, are a serious hazard to the national economy of the republic and to the land in particular. The most dangerous mudflow basins are situated on the mountain shoulders in the Fergana valley (mudflows are generated mainly in the territory of the Kyr-

Figure 4.13

Area of lands exposed to irrigation erosion categorized by eroded level, %



Eroded slopes, the consequence of cattle overgrazing

Eroded slopes

gyz Republic). Numerous mudflow sources are found in the mountain areas of the Kashkadarya, Samarkand and Tashkent regions. Uzbekistan accounts for about 75% of the total number of mudflows (2245) registered in Central Asia over the last 90 years.

4.9. Pasture degradation

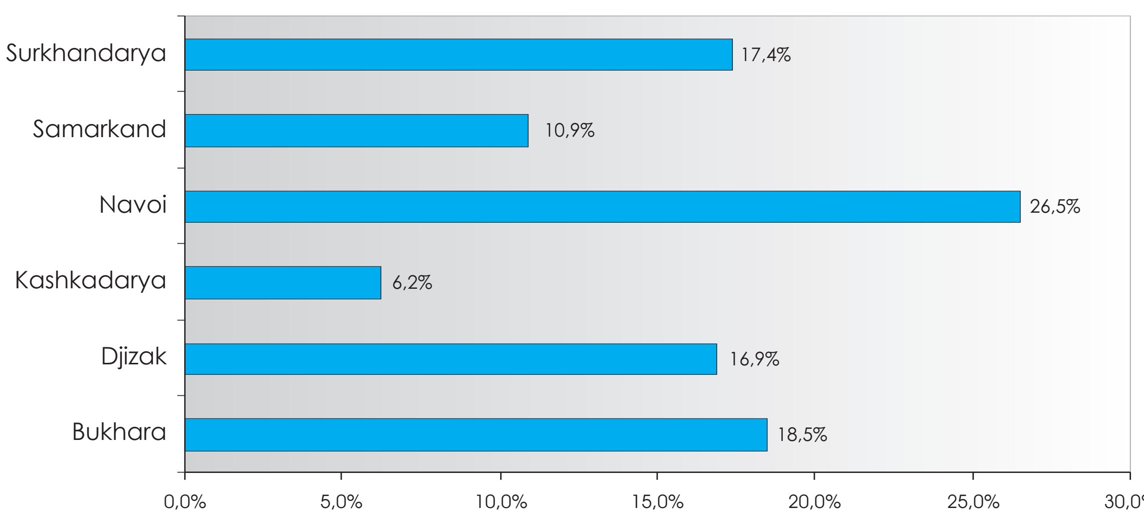
In Uzbekistan, pastures cover 21.2 million ha, or 50% of the total territory; this area includes 14.4 million ha of desert range lands, 5.7 million ha of piedmont pastures, and 1.1 million ha of mountain and high-mountain pastures. Pastures are mainly located in the Republic of Karakalpakstan and in the Bukhara, Navoi, Djizak, Surkhandarya and the Kashkadarya regions. About 19.4 million ha of pasture area is flooded, and 2.8 million ha of pastures need to be flooded. 16.4 million ha (77.3%) are exposed to digression; the situation is most serious in Karakalpakstan and in the Navoi, Bukhara and the Surkhandarya regions (Fig. 4.14). By their seasonal features, pastures are subdivided into the following categories: summer pastures (5.4 million ha), winter pastures (3.8 million ha) and year long pastures (3.5 million ha).

In Kyzyl Kum area, the main territories are covered by low-productivity and degraded pastures. Currently, large areas near to the wells and inhabited localities are degraded due to the extraction of vegetation for fuel needs that leads to desertification of the territory.

Depending on climatic conditions, the number

Figure 4.14

Pasture digression, (%)



of vegetation species on the desert range lands varies within 9-55 species, and cropping capacity is from 2 to 9 centners per ha. Average pasture cropping capacity (different source data) amounts to 2.4 - 2.7 centners per ha. Research data shows that when considering a 5 year period, 1 year of that period is reported as a low pasture cropping capacity year, another 2 years, as average pasture cropping capacity years and the remaining 2 years – as increased pasture cropping capacity years. This fact dictates the necessity not only for accumulating insurent fodder reserves, but also for improving vegetation species composition by seeding out of shrub and half-shrub vegetation.

The Bukhara and Navoi regions account for about 22% of the total republican sheep stock and 60.8% of camels, and desert vegetation is the main fodder base for them.

4.10. The dried Aral seabed area

For the last 35-40 years, the Aral Sea level has lowered by 24 m, the water table area has reduced more than 3.8 times, water volume has reduced from 1064 to 115 km^3, water salinity has risen to 100 g/l. Currently, the Aral Sea area and volume has reduced many times and it has actually turned into a "dead" sea. The dried Aral seabed area is about 4.0 million ha, and over 1.3 million ha of that area is in the Uzbekistan territory.

All these factors result in a gradual increase in the number and intensity of dust storms. Irrigated lands in the Amudarya and Syrdarya lower reaches are annually affected by over 80-100 million tons of salt and sand. This fact promotes the progress of desertification, loss of fauna and flora species, and the aggravation of sanitary conditions in the near Aral Sea area (Priaralye); it also results in increased morbidity rate (infection and other diseases), withdrawal of irrigated lands from crop rotation and the reduction of crop capacity.

The dried Aral seabed area

The Aral Sea shrinking process has had an adverse effect on the viability and health of vegetation in the Kyzyl Kum desert area (Bukhara and Navoi regions). Saxaul stands and other plants typical for this area are gradually dying out promoting desertification of the territory. The total area of shifting sand makes up over1 million ha.

One of the most effective measures of desertification and shifting sand control is the development of wetlands and protective forest plantations, which in 4 years completely arrest sand blowing and levita-tion of detrimental particles, thus promoting development of natural vegetation cover and desert range lands that later can be used for cattle breeding.

Dust storm in the near the Aral Sea area (Priaralye)

Chapter 5. WASTE

Environmental pollution control is closely related with the issues of multi-purpose use of natural resources and the introduction of more efficient clean technologies. Power engineering enterprises, non-ferrous and ferrous industries, as well as chemical and building industry enterprises are the main sources accountable for pollution of the environment by industrial wastes. However, it should be mentioned that in many cases the proportion of usable recoverable resources in the disposed industrial wastes is very high.

The population growth and conglomeration of large-scale industries within limited territories has resulted in damage to the environment, deterioration of living conditions and a decline in people's health. Urban areas are reported to have considerable accumulated quantities of solid domestic waste (SDW) and bulk waste (BW), which if not timely and properly disposed and treated could pose a threat to the environment and be accountable for its pollution. Numerous ill-structured and in some cases uncontrolled landfills around the urban areas are classified as dangerous environmental pollution sources.

The analysis of SDW treatment and disposal problems of developed countries has revealed new trends in this sphere of environmental protection: waste disposal land (landfills) is to a lesser extent used for in-ground SDW disposal and with every passing day larger volumes of waste are used as secondary resources for the processing industry.

5.1 Waste generation

Industrial waste

Annual industrial waste generation in Uzbekistan is reported to exceed 100 million tons, some 14% of which are attributed to the toxic waste category. The largest volumes of industrial waste are generated by mineral resources and ore mining and processing industries located in the Navoi, Tashkent and Fergana regions (Fig.5.1). In Uzbekistan, only 0.2% of generated solid industrial waste is used as a secondary resource, the remaining waste is stored at waste accumulation sites, whose area covers some 10 thousand ha.

The National Strategy and Waste Management Action Plan was developed in Uzbekistan with UNDP assistance. These documents will be used as the framework for determining the main strategic trends and coordination of works on solving waste disposal problems. The strategy is primarily aimed at the realization of state policy and the increase of waste management efficiency, and puts emphasis on such aspects, as waste reduction, reuse and retreatment.

Measures undertaken are aimed at the reduction of potential losses of waste that could be used as recoverable resources, prevention of further pollution of environment by toxic industrial and hospital/medical waste, and solving of SDW collection, storage and disposal problems. Stepwise realization of the tasks specified by the strategy will be based on the National Action Plan considering both, the international commitments of the country and its internal problems and interests.

According to the law, state control over waste generating enterprises is overseen by the State Committee of the Republic of Uzbekistan for Nature Protection, which keeps national records (cadastre) of waste disposal and burial sites and carries out national research activities and the development of technological designs and designing estimates.

The "environmental state indicators" database (developed by the State Committee for Nature Protection with the UNDP assistance) has revealed a downtrend in the rate of annual industrial solid waste generation.

Domestic waste

Data provided by the State Committee for Nature Protection shows, that in Uzbekistan annual SDW volumes amount to some 30 million

Figure 5.1

Allocation of solid industrial waste volumes by the regions, 2006

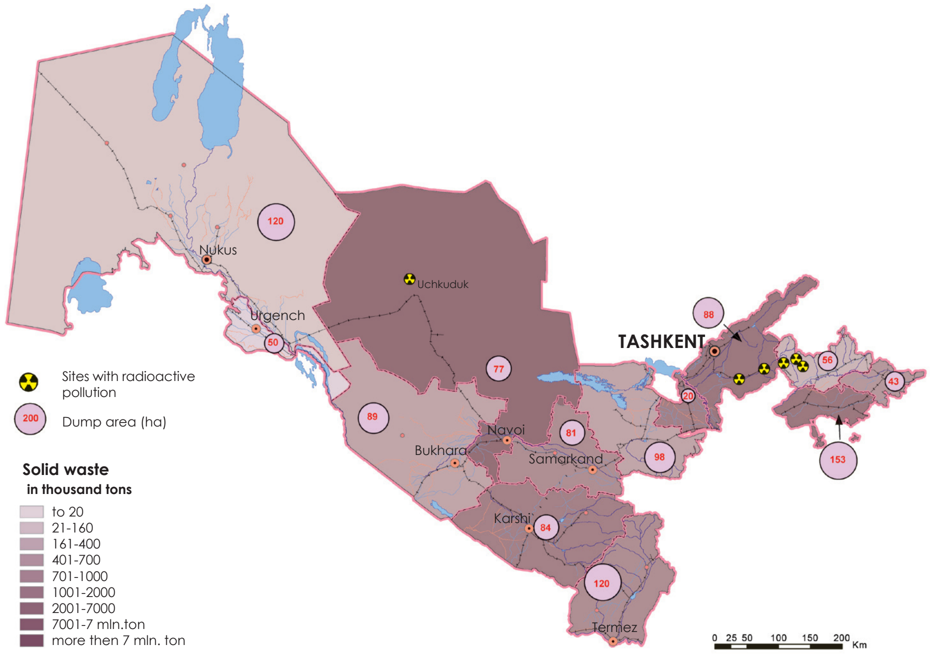
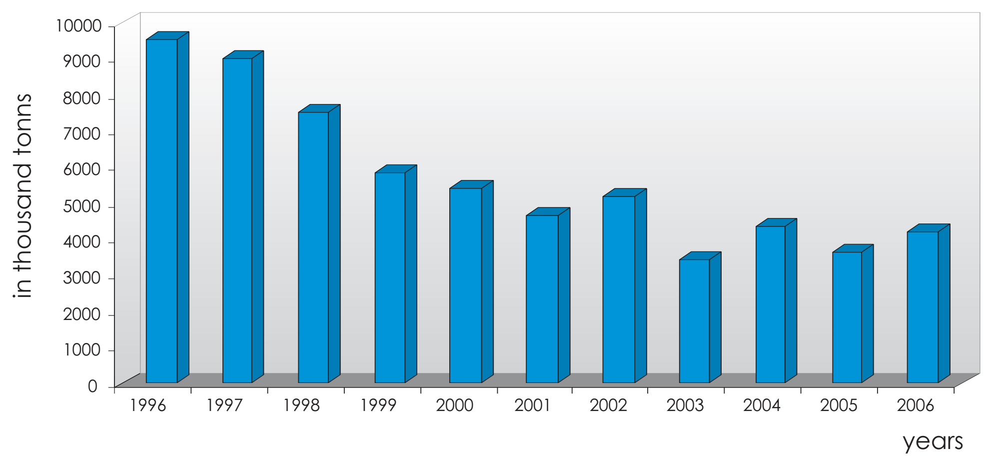


Figure 5.2

Long-term changes in solid industrial waste generation rates



cubic meters. This volume includes household waste, medical, educational, trading and office establishment waste, municipal (markets, streets, parks, etc.) waste, and a portion of industrial waste (class IV), which is mainly stored at the urban and rural landfills (total number of registered landfills in the republic amounts to 171). Each SDW million tons comprises 360 thousand tons of food waste, 160 thousand tons of paper and carton waste, some 55 thousand tons of textile waste and up to 45 thousand tons of plastic waste and other useful recoverable components. Long-term dynamics of SDW generation (in contrast to industrial waste) does not show a downtrend. Change in their annual volumes varies within the range 3437-5190 thousand cubic meters per year (Fig.5.3).

The largest volumes of SDW are generated in the Fergana and Samarkand regions, and in the city of Tashkent.

It has been reported, that by the beginning of 2007 the principal landfills sites have accumulated about 2 billion tons of industrial and domestic waste. The environmental impact and health effect have not been properly assessed for most of the regions. High air temperatures promote rapid destruction of organic matter and the accelerated development of microbial flora, including pathogens. All these factors dictate the necessity for the reduction of the SDW storage period. SDW transportation, disposal and processing issues still remain a serious problem for the region.

5.2. Waste disposal

The size of the urban population is one of the main factors predetermining the scope of work on SDW collection and disposal; it is also taken into account when selecting the best option for SDW treatment. Currently, the increase in urban population number is mainly caused by the migration of people from the rural areas resulting in an increased density of population in large industrial conglomerations. This fact dictates the necessity for the development in large urban areas of a chain of enterprises for centralized SDW collection, transportation, treatment and processing. This will require the availability of SDW transfer sites and heavy motor trucks.

SDW have multicomponent composition (Fig.5.4). In Uzbekistan, in-ground disposal of waste at sanitary and uncontrolled landfills is the most practicable method.

Landfills (the simplest and cheapest method of waste disposal) are organized at land sites with poor permeability and heavy clay loam soils. Lack of availability of such sites in the area, dictates the necessity for the construction of a special pervious foundation that requires considerable additional costs. Land plots for landfills are selected with the provision that they could be exploited for about 15-20 years. With every passing day it becomes more problematic to find such plots (40-200 ha) near to the urban areas, especially nearby large megalopolises. Only 26% of SDW total annual volume is collected, transported and disposed of at the landfills in a centralized manner. It should be mentioned that not all landfills meet sanitary requirements. Over 90% of 170 operating landfills, covering an area of about 2 thousand ha, are in an unsatisfactory state. They were organized without proper consideration of the environmental aspects and adequate engineering measures. Control over their environmental impact is insufficient. The pool of waste collection vehicles cannot meet current municipal demands, thus resulting in untimely and incomplete collection and transportation of waste.

Sanitary Regulations and Codes Standards No. 0068-96

SDW bulk weight in urban areas could vary within 355-406 kg/m^3; annual average value - 395-400 kg/m^3

Organic matter content - 58.3% (in autumn – 66.0%)

Thermal conductivity average annual - 1581 kcal/kg

SDW accumulation rates in urban areas per capita

Average value:

Per day	–	1.2 kg (0,0032m^3)
Per year	–	453 kg (1.1 m^3)
Maximum value (autumn):		1.6 kg/day
Minimum value (winter):		0.8 kg/day

Figure 5.3

Domestic waste generation, thousand cubic meters per year

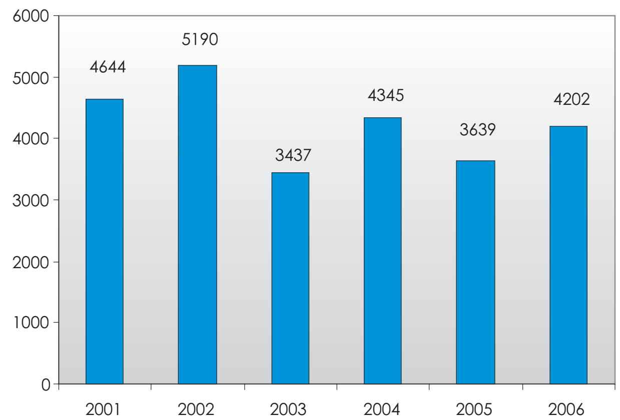
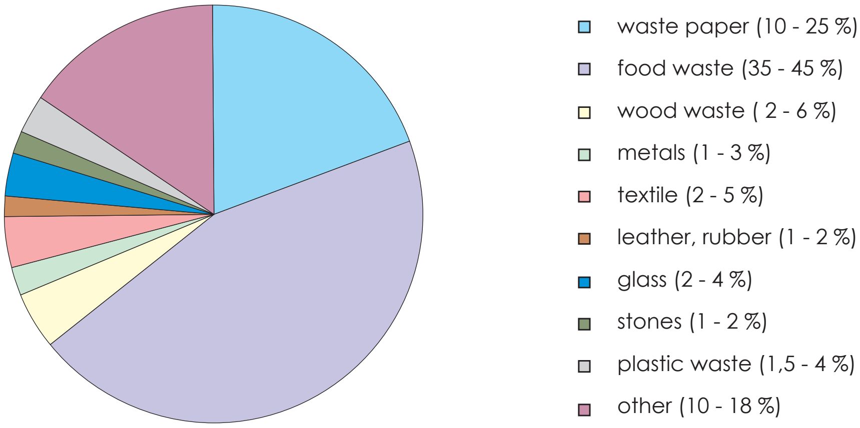


Figure 5.4

Solid waste composition



It should be mentioned that from the ecological point of view, burial of waste at landfills results in dust generation and an offensive smell. Apart from filtrate water generation resulting in water pollution, landfills also account for methane and other toxic gases emissions into the atmosphere causing air pollution in the near landfills areas. One of the main drawbacks of this method is that if buried at landfills, waste cannot be used as a source of potentially recoverable resources.

5.3. Toxic waste

Any used material hazardous for people's health or the environment (due to improper treatment and disposal) is considered a toxic waste. For example, arsenic, heavy metals, pesticides (that could cause acute or chronic diseases), highly inflammable matters (including organic and oil solvents and paint remnants), as well as waste containing corrosion agents ($2 > pH > 12.5$) that could cause destruction of metallic containers and human flesh are attributed to the toxic waste category. Expired date preparations and acids, which entering into a chemical reaction with substances presented in water and air could cause an explosion or release of chemical agents, are attributed to chemically active waste. Radioactive or pathogen containing hospital/medical wastes also pose a threat to people's health. Lately, these wastes are given special attention. In recent years, toxic waste treatment is considered as an ecological problem and one of the serious public concerns.

The database data shows regular increase in the main hazardous waste generation rates (Table 5.1), and only inconsiderable portion of these wastes is properly treated and reused (Fig.5.5).

The largest volumes of toxic waste are generated in the Navoi, Tashkent and Djizak regions, the major portion of which are transported to the controlled accumulation sites.

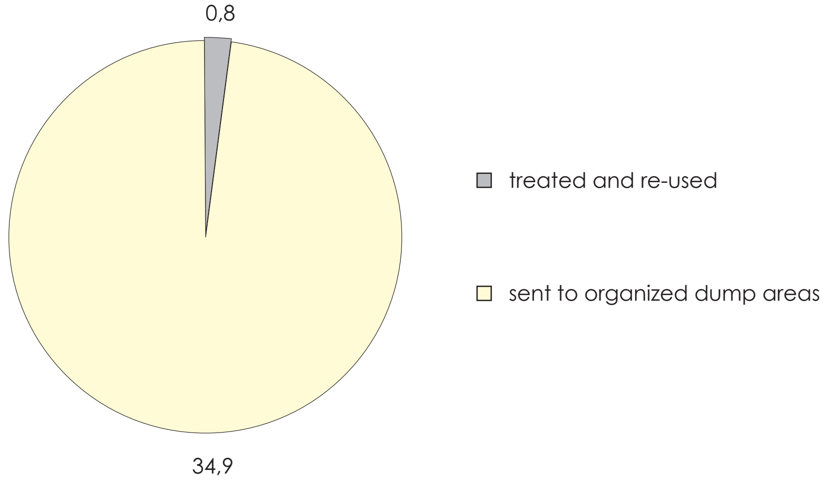
Table 5.1

Dynamics of hazardous waste generation, tons per year

	1998	1999	2000	2001	2002	2003	2004	2005	2006
1 class	0.345	0.154	0.169	1.697	1.063	4.925	1.545	0.244	0.09
2 class	6.004	5.245	5.723	5.68	8.451	7.579	2.828	4.051	3.476
3 class	67.806	706.747	371.895	693.791	689.567	806.2	1416.32	6871.9	37345.4
4 class	25764.7	26272.9	14068.9	27009.1	30666.2	32288.7	34306.8	33442.1	1222.4

Figure 5.5

Volumes of toxic waste generation, use and accumulation in Uzbekistan, tons per year (2004)



Chapter 6. BIOLOGICAL DIVERSITY

In Uzbekistan, biological diversity of ecosystems is represented by over 27,000 flora and fauna species. Fauna is represented by over 15,000 species; the largest fauna group is represented by the invertebrate arthropods (11300 species). The vertebrate fauna composition comprises 424 bird species, 97 mammal species, 58 reptile and 83 fish species. The territory of Uzbekistan is the habitat of many animal species attributed to the endemics of the Central Asian origin. There are 53 species and subspecies of vertebrates, which are endemics of Uzbekistan and Central Asia. Endemism level of different vertebrate groups varies within 1.8-51.7 % range.

Plant, mushroom and algae community is represented by almost 11,000 species, including 4800 species of flowers and vascular plants. Species diversity of endemics is not so large and is represented by some 400 species, 10-12% of which are the relict ones.

This biological diversity is mainly supported by the still existing wild natural ecosystems, formation of which was predetermined by natural and climatic conditions of the territory. The main types of ecosystems comprise desert ecosystems of plains, piedmont semi-deserts and steppes, river and coastal ecosystems, wetland and estuary ecosystems, mountain ecosystems, which in their turn is subdivided into smaller ecosystems.

A number of branches of national economy of Uzbekistan, such as agriculture, forestry, fishery, game husbandry, storage and primary processing of raw materials and processing industry directly connected with the biological

Desert ecosystems of plains occupy the larger part of the Turan depression and are widespread in the Kyzyl-Kum desert, Ustyurt plateau, the Karshi steppe, in the south of the republic and in the Fergana valley. Depending on the soil structure, the desert territory is subdivided into sandy deserts, saline deserts, clay deserts and stone (gypsum) deserts. The desert ecosystems are main habitats of the rare and endangered fauna species.

Piedmont semi-deserts and steppes are located in the piedmont zone at a height of 800 – 1200 meters below sea level and overtake mountain chains of 30-50 km width. Piedmont semi-deserts and steppes occupy about 2/3 of the mountain territory of the republic.

River and coastal ecosystems are widespread in plain areas of the Amudarya and Syrdarya valleys and in the Zarafshan and Surkhandarya river lower reaches. Environmental variety of these ecosystems preconditions their subdivision into 3 main types: tugai, reed, and river and open bank lands.

Narrow strips or islands of tugai stands are still preserved in the valley and estuary of the Amudarya river; they also can be found in the Syrdarya, Surkhandarya, Zarafshan and Chirchik river valleys. Separate tugai plant communities can be found in the Angren and Kashkadarya river lower reaches. Rivers and open bank lands are habitats of the rare and endangered fauna species.

Wetland and estuary ecosystems (internal wetland ecosystems) are subdivided into the natural and anthropogenic ecosystems. They are like river and coastal ecosystems, but unlike the latter they are characterized by a larger water area and a higher level of moisture content.

Natural wetlands are located in the Amudarya river estuary and occupy the area of about 700 thousand ha. Due to the reduction of water supply to the estuary and retreat of the Aral Sea shore, numerous fresh water lakes have evaporated during the last years, the tugai area has reduced twofold and area under reed has reduced 6 sixfold. A number of lakes have restored during the last few years owing to inflow of collector-drainage waters, but they are still very vulnerable due to the extremely unstable hydrological regime in the estuary.

Anthropogenic wetlands are mainly represented by artificial water bodies (reservoirs and drainage water receiving lakes), the largest of which is Aydar-Arnasay lake system, and lakes Dengizkul, Karakir and Solenoye.

Mountain ecosystems are spread depending on the vertical zonality of the territory, soil conditions and moisture content. The mountain steppes are located at a height of up to 2000-2600 meters above sea level. The mountain leafy forests cover small areas at a height of from 1000 to 2500-2800 meters. The largest leafy forest areas are located in the mountains of the Western Tien Shan (the Ugam, Pskem, Chatkal and Fergana ranges) and Pamir-Alay (the Gissar range). Relict forests comprise plantations of walnuts, plane trees and persimmon trees.

Juniper forest is the main type of the mountain forests, which grow at a height of 1400-3000 meters. Subalpine and alpine meadows are located at a height of from 2700-2800 to 3600-3700 meters.

diversity state.

6.1. Biological diversity threat

Currently, the problems of biological diversity conservation exist in all regions of Uzbekistan, but they are mostly pronounced in the areas with the highest density of population (Fergana valley), and in the areas located in the lower reaches of the rivers with the developed irrigated farming (Khorezm region and Karakalpakstan). In these regions biological diversity has greatly suffered from the anthropogenic activity: a number of wild natural ecosystems have been completely destroyed due to the direct extirpation of species.

The reduction and considerable changes in habitats represent the main threat for the biological diversity. Three groups of anthropogenic factors that greatly affect natural ecosystems include: land development with the subsequent redistribution of water resources, distant-pasture cattle tending, mineral resource industry and power engineering. All these factors (agricultural activities, overgrazing, irrigation, regulation and redistribution of river flows by numerous hydraulic structures, sand and gravel extraction, logging of mountain woods and destruction of flood plain forests, storage of vegetal resources, poaching, etc) promote desertification, salinization of lands and their withdrawal from agricultural production, disturbance of hydrological regime in water ecosystems and their pollution, destruction of vegetation cover, etc.

The experts estimate the biological diversity quality as *high* and *very high* only in 6.8 % of the territory, as *average* – in 50.5% of the territory (rainfed grass lands and pastures), as *low* and *very low* in 16% of the territory. Thus, the pristine environment has remained only in strictly protected natural reserves. But limited area and separateness of the reserve territories precondition vulnerability of their ecosystems and biological diversity in the long-term prospects. In majority of pastures that practice extensive cattle breeding, natural habitats and ecosystems have undergone considerable transformation, but still have some elements of the wild nature. Biological diversity quality is at extremely low level in all arable farming lands due to almost complete destruction of natural habitat.

6.2. Protected natural areas

The most effective conservation of biological diversity is observed in reserves. National parks, wildlife areas (zakazniks) and other strictly protected natural areas also play environmental protection role. In Uzbekistan, the system of strictly protected areas includes nine national reserves (220,760 ha), two national parks (598,700 ha), the ecological center "Jeyran" (5140 ha), nine national zakazniks (1,223,920 ha) and two national nature memorials (3480 ha), the total area of which makes up about 2,052,000 ha or approximately 4.6% of the total territory of the republic. According to the International Union for Conservation of Nature (IUCN), National reserves are attributed to the first classification category of the protected areas, National parks – to category II, Ecological center "Jeyran" – to category III, and zakazniks and nature memorials, to category IV (Table 6.1 of the Annex).

Works have been completed on the assignment of "protected natural area" status to 13 large scale deposits (underground fresh water generation zones of regional and republican im-

In the Republic of Uzbekistan, special attention is paid to biodiversity conservation issues. Key objectives and tasks of these activities are formulated in the National Environmental Action Plan (NEAP) of the Republic of Uzbekistan for 2006-2010 (MP-EAP, 2005, paragraph 2.1.2). The EAP is a part of the National Sustainable Development Strategy of the Republic of Uzbekistan (NSDS, 1999, section 3.4). Besides, a number of NSDS target tasks were specified in the following national plans and strategies: NSDS, National Desertification Control Program (NDCP, 1999), National Strategy and Action Plan on Sustainable Development of Mountain Areas (NSAPSDMA, 2001). All the above stated national planning documents specify not only main objectives, but also the corresponding strategic and operational objectives and tasks.

Development of the national reserves, multipurpose landscape protected areas, natural parks, wildlife reserves and nurseries. Area of the protected natural territories has increased during the last years: by 2006 it has increased by 907 thousand ha. In the next years it is planned to increase the area of protected natural territories by another 1.51 million ha.

portance with total area of 407,356 ha) (Table 6.2 of the Annex). All large rivers, such as the Amudarya, Syrdarya, Kashkadarya, Zeravshan, Chirchik, Surkhandarya, Narin and Karadarya within the territory of Uzbekistan also have water protected zones with total area of 155,416.5 ha, including 27,900.5 ha of riverside land (Fig.6.2).

Though these conservation areas are primarily intended for conservation of natural ground and surface water quality, later they can exercise larger ecological functions, in particular, maintenance and rehabilitation of biological diversity elements within their territories.

Figure 6.1

Protected areas

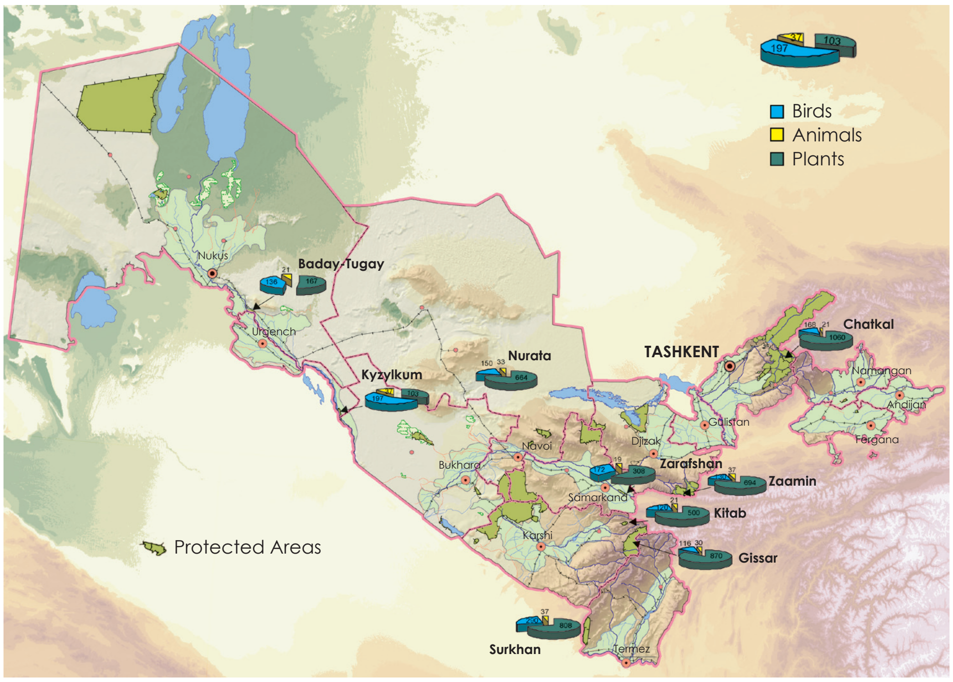
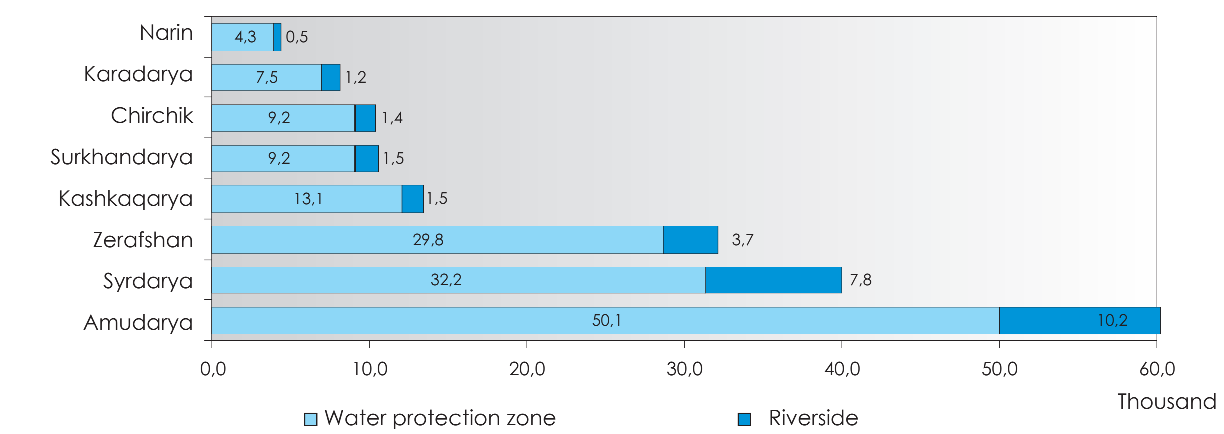


Figure 6.2

Areas of established water protection zones and riverside lands within territory of the Republic of Uzbekistan



6.3. Forests

The total area of the National Forest Fund (NFF) of the Republic of Uzbekistan makes up 8100 thousand ha or about 18% of the total area of the country. During the last few years forested territory area has increased from 2400 to 2800 thousand ha that makes up 6.2 % of the total area of the republic (Fig.6.3). That represents 0.1 ha of forested area per capita. 7000.1 thousand ha of forest fund lands are located in the desert and sandy zone, 831 thousand ha in the mountain areas, 113.7 thousand ha in the flood plains of the rivers, and the rest 164.3 thousand ha in the valley areas.

Structure of the National Forest Fund Lands of Uzbekistan is shown on the Fig.6.4.

Juniper forests on the northern slopes of the Chatkal Range

Forests play an important role in nature conservation and reclamation. In Uzbekistan, native forests cover 1.4 million ha (amount of forest – 3%). Even with regard to the forested and shrub desert range lands the area of forests does not exceed 5-6%. The major area of forest is located in the sandy zone and is represented by saxaul, calligonum, saltwort and other similar trees. Mountains and valleys account for about 0.3 million ha of forests and growing stock. Mountain juniper forests covering about 200 thousand ha are of particular value and importance.

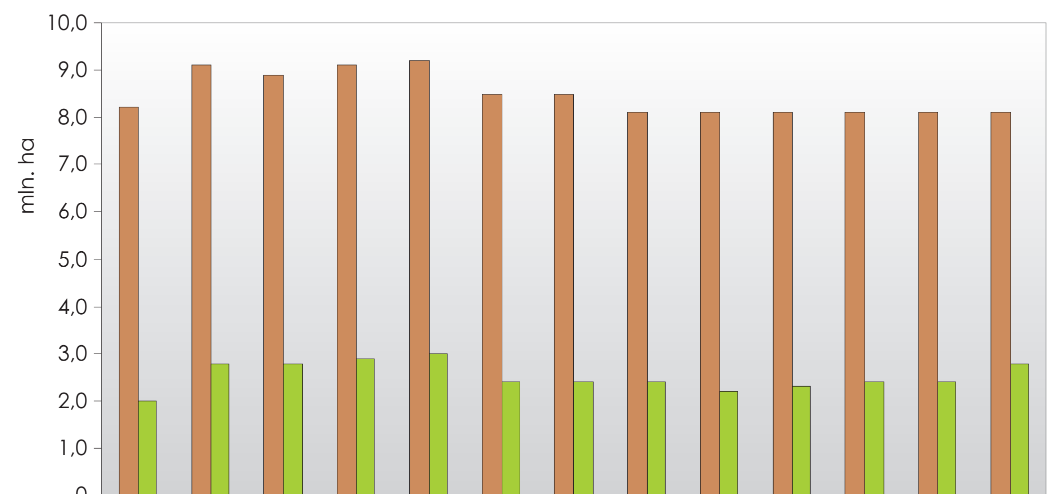
Juniper-bush – Juniperus sp.

In the mountains, juniper is the main forest constituting species of wood and it covers approximately 204 thousand ha.

Saxaul and other desert shrubs, which are

Figure 6.3

Dynamics of the forest fund lands state for the period of 1994-2006

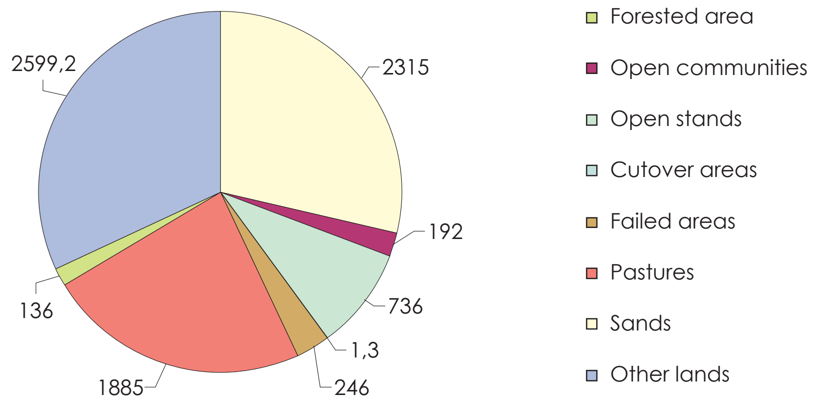


	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total areas	8,2	9,1	8,9	9,1	9,2	8,5	8,5	8,1	8,1	8,1	8,1	8,1	8,1
including forest areas	2,0	2,8	2,8	2,9	3,0	2,4	2,4	2,4	2,2	2,3	2,4	2,4	2,8

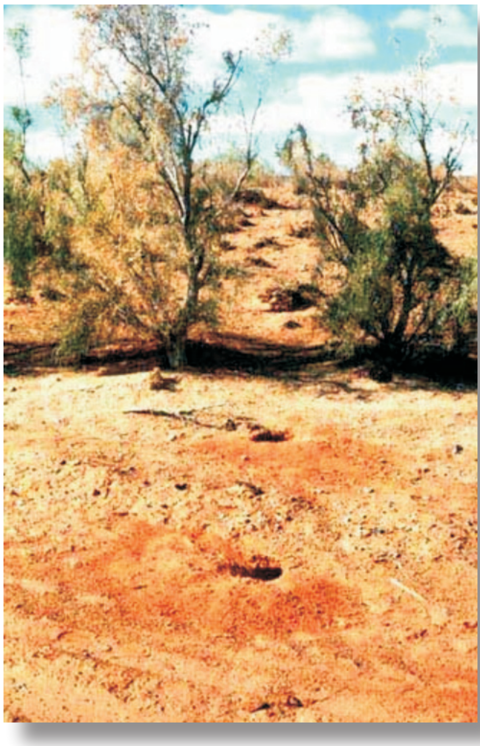
Note: In 1999 and 2001 the forest fund lands area has sharply decreased due to the transfer of Brichmula, Akhangaran, Parkent and Chirchik forest farm lands (Tashkent Region) at the disposal of Tashkent Region Khokimiyat.

Figure 6.4

Allocation of the National Forest Fund lands of Uzbekistan by categories (total area – 8110.5 thousands of ha)



typical on sandy soils, are very important for the protection of sands against wind erosion and for the softening of strongly continental climate of the desert.



The largest areas of the Forest Fund lands are located in the Republic of Karakalpakstan and in Bukhara and Navoi regions, while the smaller ones are in the Samarkand and Syrdarya regions and in the Fergana valley (Fig.6.5).

The forest territories of the republic are characterized by a rich variety of vegetation species, which is represented by 68 woodland species, 320 shrub species and 2953 species of grassland vegetation. The most popular woodland species are given in the below Table 6.1.

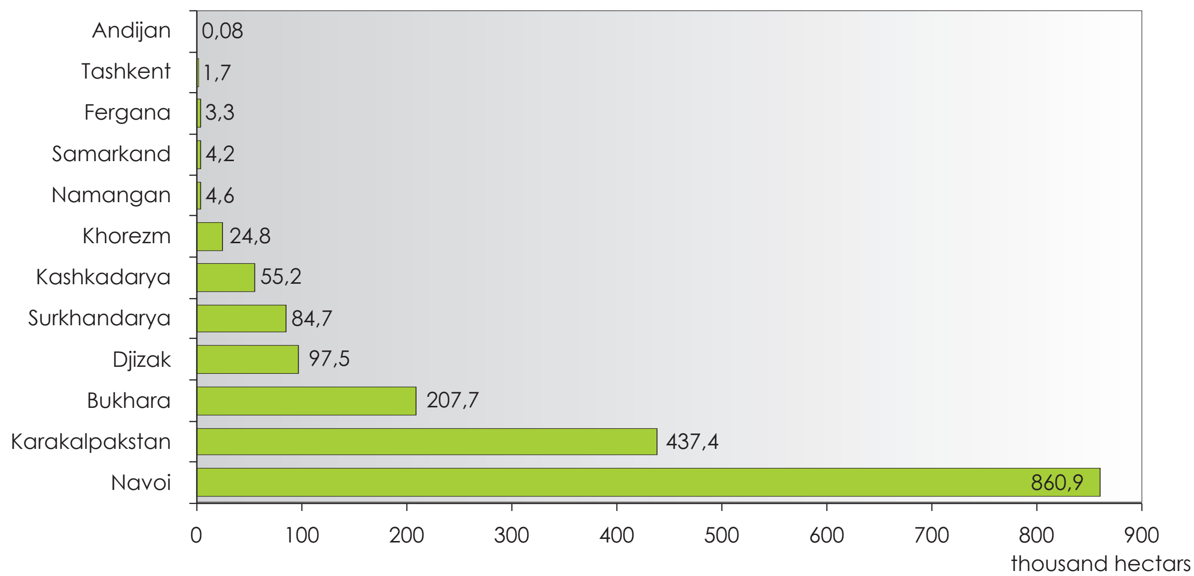
Table 6.1

Uzbekistan: Vegetation species variety

Total forested area, including areas under:	Thousand ha	2278.7	100%
Saxaul	-«»-	1385.5	60.8
Juniper	-«»-	225.6	9.9
Tamarisk	-«»-	207.3	9.1
Saltwort	-«»-	152.7	6.7
Asiatic poplar	-«»-	61.5	2.7
Nut trees	-«»-	52.4	2.3
Calligonum	-«»-	41.0	1.8
Other shrub species	-«»-	123.1	5.7
Other wood species	-«»-	29.6	1.3

Figure 6.5

Native forest systems of the Head Department of Forestry Management



There are 93 forestry enterprises in the republic, including 67 forest husbandries.

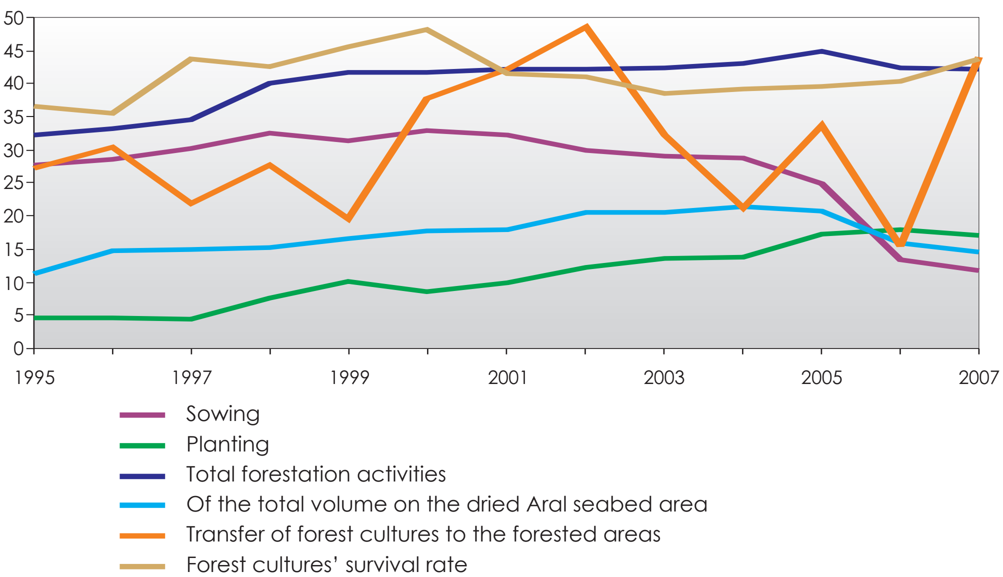
Forest husbandries every year undertake reforestation operations over an area of about 42 thousand ha, including sowing (dibbling-in) operations over an area of 27 thousand ha and planting operations over an area of 15 thousand ha. Recently, the proportion of forest planting operations compared with the overall volume of forestation activities has increased, since planting is a more effective method of forestation resulting in higher forest plant survival and establishment rates (Fig. 6.6).

Afforestation of the dried Aral seabed area

During the last 12 years, shelter forest (saxaul

Figure 6.6

Forestation activities in the Republic of Uzbekistan in 1995-2007



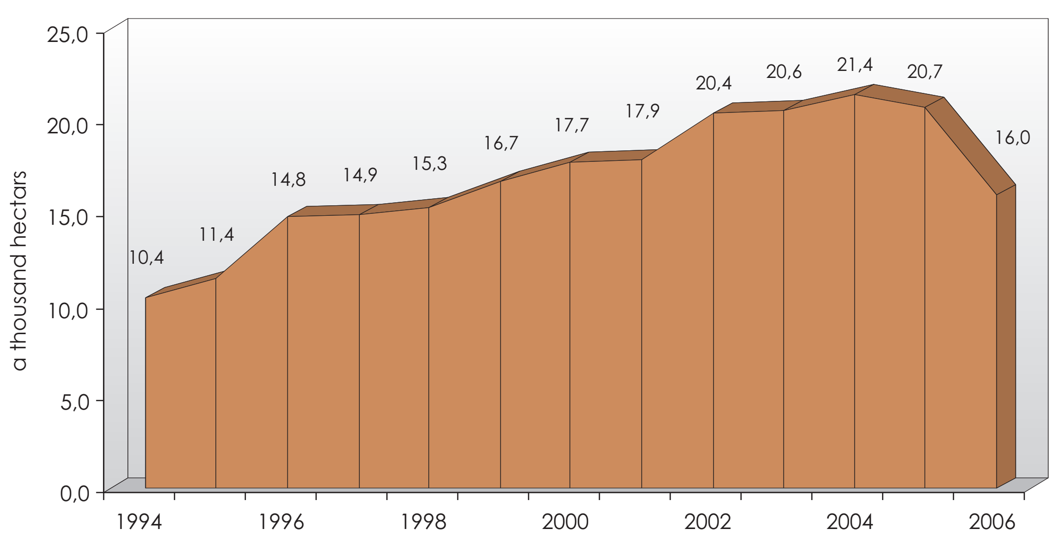
and other sandy soil type vegetation) development activities were undertaken in an area of more than 200 thousand ha of dried Aral seabed (20 thousand ha per annum). The wind speed is determined by the availability of forest shelters: on the 2nd year of planting out, wind speed decreased by 20 %, in the 5th year – by 80%, in the 6th year – by 90 %, and in the 7th year, wind speed reductions resulted in a sharp decrease of detrimental particles escaping from the land surface; saxaul and other shrub root systems anchor the soils promoting development of vegetation cover and increase in biocenotic diversity.

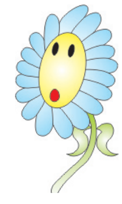
Currently, the Aral Sea problems are managed with the support of Germany, France and Turkey. A number of projects are aimed at the development of shelter forests on the dried Aral seabed area. Besides, there are numbers of problems requiring investment outlays, namely development of a shelter belt in the desert areas of the Bukhara and Navoi regions, which will protect the irrigated lands of the above regions against the detrimental effect of parching winds from the Kyzyl-Kum desert.

Phytomelioration works on the dried Aral seabed area

Figure 6.7

Afforestation of the dried Aral seabed area





6.4. Rare and endangered species

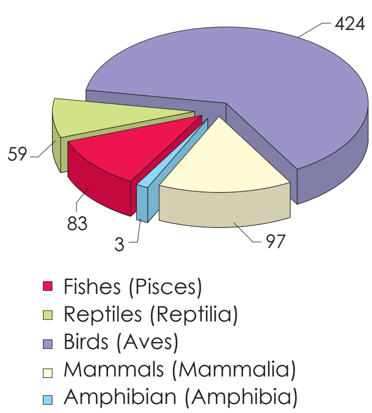
Rare and endangered species of animals listed in the Red Book

The largest number among the vertebrates is represented by birds (424 species), the lowest number is represented by amphibians (3 species). Fishes (43 species) and reptiles (30 species) dominate among the endemic species (Fig. 6.8).

Over 300 species of birds are under protection and 45 species and subspecies of them are considered to be rare and endangered. Though a number of measures on conservation of biological diversity were undertaken in Uzbekistan during the last few years, nevertheless the number of endangered species still continues to increase. The first edition of the Red Book of Uzbekistan (1983) comprised 63 species of vertebrates, while the last edition (2003) has already comprised 106 species or 16% of the total number of vertebrate fauna of the republic. The largest numbers of rare and endangered species are represented by invertebrates and birds (Fig. 6.9).

Figure 6.8

Species diversity (a) with endemism elements (b)



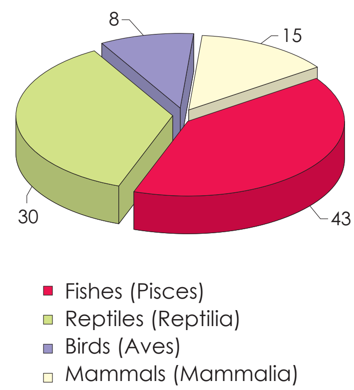
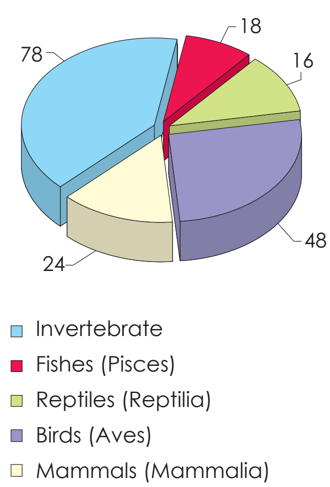


Figure 6.9

Endangered species as listed in the Red Book of Uzbekistan (2003), breakdown by main groups



According to the forecasts made by the State Committee for Nature Protection based on the data provided by the State Statistics Committee, it is planned to increase number of goitered gazelles up to 1200-125 of heads by 2008; in nursery "Saikhun" it is also planned to increase the number of wild ducks is planned to be increase up to 600-650 heads, gray gooses – up to 17-25 heads, pearl hens – up to 100-120 heads.

Desert monitor (Varanus griseus) is a rare inhabitant of Kyzyl-Kum desert. Listed in the Red Book of Uzbekistan

Rare and endangered species of plants listed in the Red Book

Over 1115 species of higher plants, including 66 species and subspecies of rare plants listed in the Red Book of Uzbekistan, are taken under control in the protected natural areas. However, it should be mentioned that due to the general transformation of natural ecosystems into man-made ecosystems the number of endangered plant species continues to increase. Thus, in 1984, 163 species of plants were included in the Red Book of Uzbekistan, while in 1998 this number increased to 301. A number of plant species were included in the Red Book due to an intensive stocking of plant raw materials or a massive plucking of flowers (tulips, peonies, Allium).

Kaufman tulip (Tulipa Kaufmanniana)

Little heron – is a rare species listed in the Red Book of Uzbekistan

Koopman wahoo (Euonimus koopmannii) Rare plant listed in the Red Book of Uzbekistan

Steppe peony (Paeonia hybrida)

Chapter 7. ENVIRONMENT AND HEALTH

In Uzbekistan, the distribution and density of population is uneven and varies considerably depending on landscape features (valleys, deserts, mountains). The Fergana valley regions are the most densely populated areas: in the Andijan region there are 522 people per 1 km^2 and in the Fergana and Namangan regions – from 200 to 400 people per 1 km^2.

Relatively high density of population is also reported for the Tashkent region (over 300 per 1 km^2 including the city of Tashkent), the Khorezm and Samarkand regions (over 200 per 1 km^2) and the Syrdarya region (128 per 1 km^2). Rural population makes up over 62% of the total number of population of the republic (Table 7.1).

The lowest population density is reported for the desert areas of the Navoi region - 7 people per km^2 and for the Republic of Karakalpakstan - 9 people per km^2.

7.1. Availability of safe drinking water

Groundwater resources provide 80% of the drinking water supply to the population of the republic which due to its uneven distribution requires the construction of water conduits of considerable length. In general, the available fresh groundwater resources meet the population's drinking water demands. However it should be mentioned that during the last few years, groundwater quality has been deteriorating resulting in a reduction of ground water reserves that can be used as drinking water sources. Groundwaters in the western territories of the republic are reported to have increased in salinity and hardness.

Urban population is better provided with drinking water. 93.1 % of the urban population is part of the drinking water supply network and in rural areas this figure amounts to 79.1% (Fig.7.1). Drinking water supply problems are very acute in the Bukhara and Navoi regions and in the Republic of Karakalpakstan.

It should be mentioned that the number of rural settlements having water conduits has slightly increased, but in general the problem of drinking water supply to the rural population has not been solved yet.

Available water conduit use efficiency is only 63% and in a number of regions it is even less – from 42 to 62% due to the various technical and organizational problems.

In 2004 number of settlements having water conduits composed followings: 120 towns; 112 urban type settlements; 9213 rural settlements.

According to Resolution # 278 of the Cabinet of Ministers of the Republic of Uzbekistan, 4508 rural settlements still need to be provided with drinking water; 903 of these settlements are located in hard to reach and distant areas.

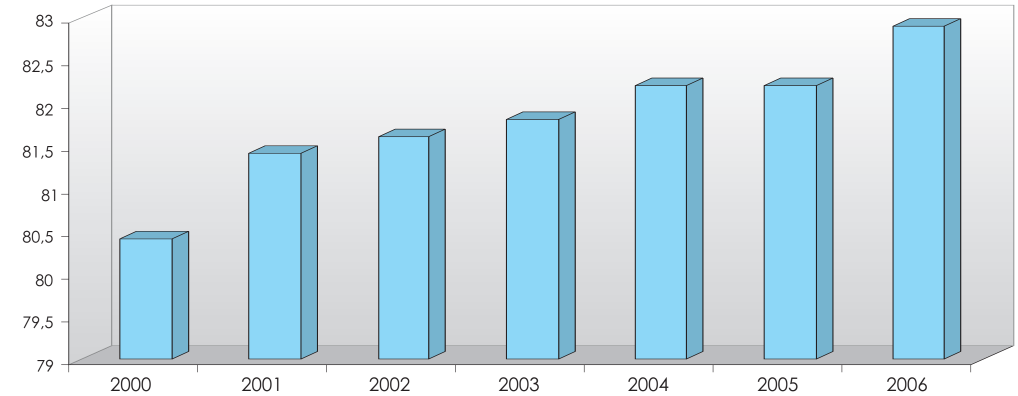
Table 7.1

Population size of the Republic of Uzbekistan (at the end of year), millions of people
(Data provided by the State Committee for Statistics of the Republic of Uzbekistan)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total for the Republic	23,22	23,66	24,05	24,41	24,74	25,06	25,37	25,66	25,96	9,57	9,68
Urban population	8,89	9,00	9,11	9,20	8,89	9,33	9,38	9,43	9,48	16,84	17,08
Rural population	14,34	14,65	14,94	15,21	15,48	15,73	15,98	16,23	16,48	26,41	26,77

Figure 7.1

Centralized water supply to population of the Republic of Uzbekistan, %



Many people have to use water from wells and irrigation canals. In most cases, this water does not meet sanitary requirements (especially in summer). Currently, about 1/3 of the population of the country consumes drinking water, which doesn't meet the national standard requirements. Tap water quality depends to a considerable extent on the sanitary conditions of water pipe-lines which may have been in use for 30-50 years. The monitoring data reveals nonconformance of tap water quality to the accepted standards by its chemical and bacteriological composition (11.7–18.9% and 5.1–7.5% respectively of the total number of samples (Table 7.2).

Specific water consumption (l/day per capita) in rural areas has decreased from 180.5 l/day in 1996 to 114.8 l/day in 2004, in urban areas – from 549 l/day to 325.7 l/day correspondingly (Fig.7.2); this decrease can be explained by the demographic factor.

The improvement of the sanitary living conditions of the population and prevention of the spread of dangerous intestinal diseases also greatly depends on the state of sanitary waste and sewage treatment system. Since less than 40% of sewage waters undergo treatment, pollution of water streams can occur which aggravates the problem of supplying drinking water to the rural population.

7.2. Air pollution impact to the public health

Air pollution may lead to a chain of adverse physical, chemical, behavioral and physiological processes. The first link of this chain is the emission and dissemination of hazardous matters (pollutants) in the air, where they undergo photochemical and other reactions resulting in the production of secondary pollutants, which in most cases are more toxic than the original ones.

In Uzbekistan, a number of hygienists have re-

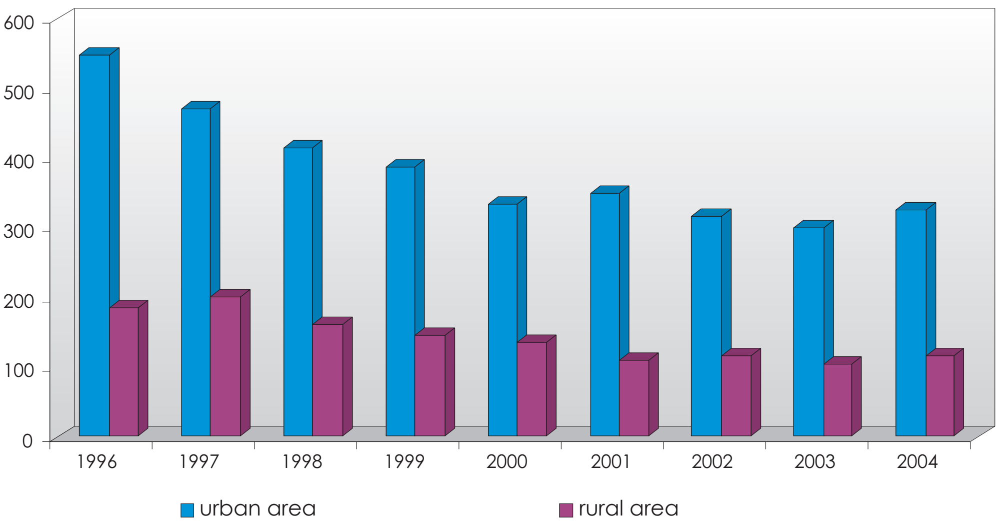
Table 7.2

Drinking water quality nonconforming to the standard requirements (samples were taken from municipal water conduits)

Year	2002	2003	2004	2005	2006
Number of samples nonconforming to the standards by chemical composition, %	16.3	15.9	16.3	18.9	11.7
Number of samples nonconforming to the standards by bacteriological composition, %	5.1	5.2	5.5	6.0	7.5

Figure 7.2

Water consumption: l/day per capita



ported in their works not only the increase in morbidity rate, but also changes in morbidity its structure, in particular, increase in the specific weight of such diseases as chronic bronchitis and pulmonary emphysema, bronchial allergy and malignant tumors. It also should be mentioned that people residing in polluted areas have a longer respiratory diseases duration period than people residing in less polluted areas.

1915 enterprises were registered in the Republic of Uzbekistan in 2006; these enterprises were reported to have 79,727 non-mobile pollution sources accountable for the emission of 159 pollutants into the air, 36 of which are the most harmful pollutants. The Tashkent, Almalik, Angren, Andijan, Bekabad, Chirchik and the Fergana urban areas account for 55% of all industrial emissions and for 60% of emissions from motor transport. The largest volumes of non-mobile source pollutant emissions are reported for the Almalik, Angren, Fergana and Navoi urban areas (Fig.7.3).

The highest specific load values of the industrial pollutant emissions are reported for the citizens of the Almalik, Angren, Navoi, Fergana, Gulistan and Bekabad urban areas (Table 7.3).

The monitoring data testifies that in many urban areas of Uzbekistan, air pollution levels are high enough to cause adverse health effects. The most serious air pollution after-effects for people's health are caused by heavy metals (being constituents of fine dust) and volatile organic compounds (phenol, formaldehyde, benzol, toluene, furfurol, acetone, benz-a-pyrene, sulfur dioxide and nitrogen oxides).

Over 2.6 million people reside in areas reported to have increased NO_2 concentration levels. 3 million people reside in urban areas reported to have increased phenol, ammonia and ozone concentration levels.

Increased air dustiness is reported for 10 large urban areas of Uzbekistan, where over 41% of the urban population reside. In industrial towns, the highest quantities of dust particles originate simultaneously with other pollutants, in particular with SO_2 and NO. Fine particles (PM 2,5) are the most dangerous, since they penetrate lungs leading to respiratory diseases. Continuous exposure to high concentrations of dust results in increased mortality rates and the number of medical referrals (respiratory and cardiovascular diseases). The coaction of dust and other pollutants causes high-toxic effects; for example, a) benzol + nickel + soot + benz(a)pyrene + formaldehyde results in a tumor response, b) hydrocarbons + heavy metals (plumb, copper, mercury) provoke the disfunction of reproductive organs and con-

Figure 7.3

Volumes and structure of pollutant emissions in urban areas (2005)

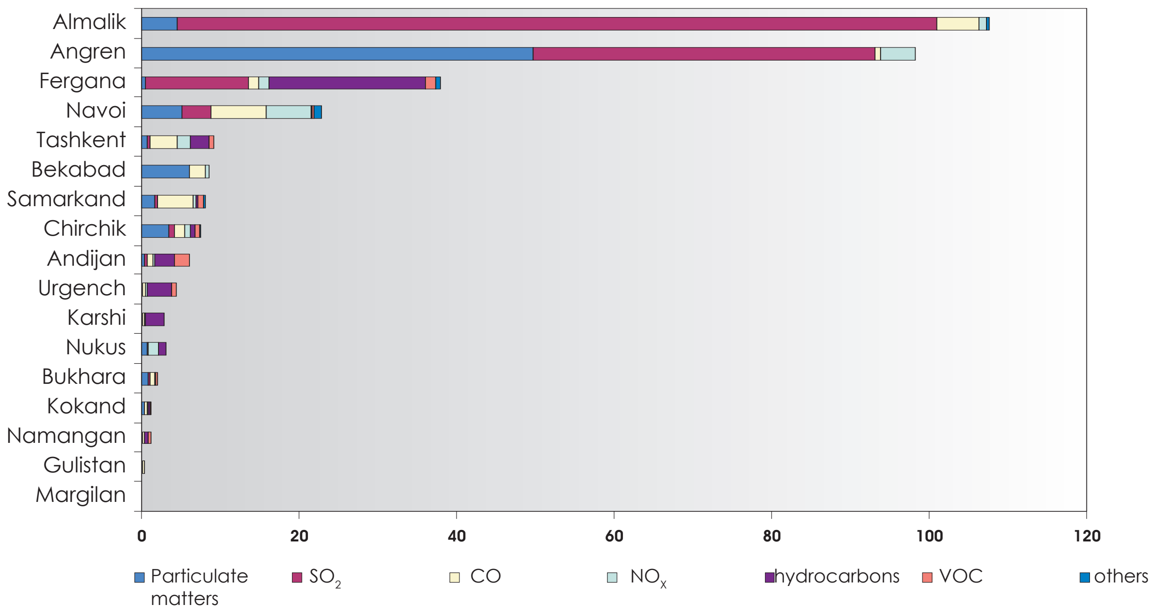


Table 7.3

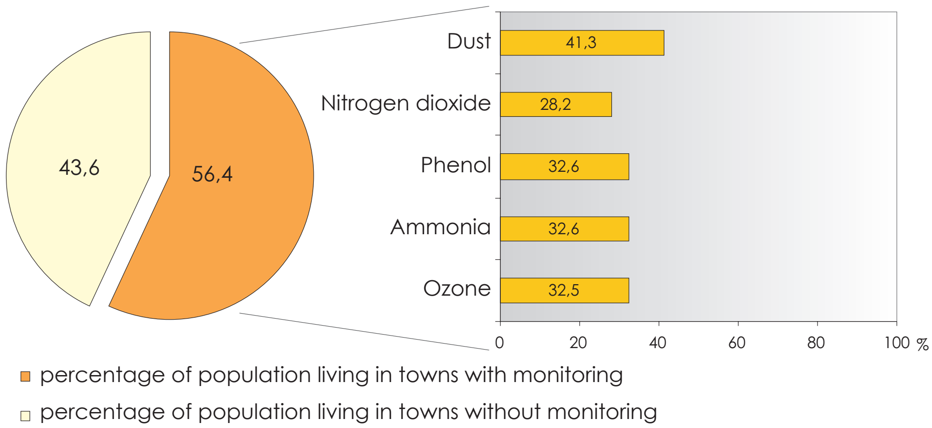
Specific rates of pollutant emissions into atmosphere from non-mobile sources in urban areas (kg per capita)

Name	SO_2		CO		NO_2		Hydro-carbons (without VOC)	Other gas and liquid matters	Total
	kg per capita	number of days *	kg per capita	number of days *	kg per capita	number of days *	kg per capita	kg per capita	kg per capita
Andijan	0,95	6	2,63	39	0,10	71	8,62	0,01	20,4
Bukhara	0,55	77	2,45	172	0,40	95	0,10	0,01	8,6
Nukus	0,01	0	1,25	147	6,70	5	5,46	0,00	18,9
Karshi	0,08	0	1,61	0	0,28	1	14,92	0,12	18,3
Navoi	29,64	0	55,78	0	44,45	285	2,07	7,40	189,2
Namangan	0,17	0	0,34	0	0,01		1,90	0,00	3,9
Samarkand	1,17	0	12,05	0	1,03	19	0,67	0,15	13,9
Gulistan	8,22	0	59,11	2	3,11	1	2,44	0,00	108,9
Tashkent	0,17	0	1,67	7	0,80	298	1,15	0,02	4,6
Angren	327,91	0	5,11	28	32,93	192	0,17	0,29	746,7
Bekabad	1,02	0	25,01	0	6,23	14	0,18	0,01	104,8
Chirchik	3,88	0	8,08	0	5,37	41	3,50	1,88	48,2
Almalik	828,45	226	45,85	105	7,61	4	0,16	3,20	925,4
Fergana	58,39	5	5,26	5	5,75	178	88,04	2,43	169,7
Kokand	0,38	0	2,04	20	0,53	245	1,17	0,17	6,9
Uzbekistan	**11,9**		**39,4**		**6,7**		**12,6**	**2,7**	**78,3**

Note: Number of days - maximum number of days when concentration is above the MPC values (2004-2006).*

Figure 7.4

Share of urban population residing in highly air polluted areas



genital pathologies.

Life expectancy being a standard composite life duration index is considered as one of the nonspecific factors reflecting environmental influence on the population health (Table 7.4).

Increase in life expectancy at birth is a composite index of population health.

Increase in life expectancy indicates a general improvement in population health, though this index varies over the different groups of population (for example, between the urban and rural population) due to the uneven anthropogenic environmental load. All health risk factors should be timely taken in consideration in order to ensure health maintenance at all ages.

Analysis of medical aid appealability data (number of referrals) for the last ten years has revealed that general morbidity structure varies over the regions. For instance, respiratory diseases are most widely spread in Tashkent city (27.3%), and in the Kashkadarya (26.7%), Navoi (27.4%), Fergana (29.1%), Namangan (31.7%) and Tashkent (29.1%) regions, whilst digestive system diseases prevail in the Khorezm region (20.5%). Blood and blood-forming organ diseases (anemia) are also reported to be widely spread in all regions of Uzbekistan, in particular in the Republic of Karakalpakstan (38.8%), and in the Namangan (24.1%), Navoi (26.1%), Andijan (21.4%), Bukhara (20.5%), and Djizak (24.8%) regions. According to the EBRD, WHO data, anemia is attributed to the 10 principal causes of people's unhealthy life (2.0 % of the total number, index DALYs).

During the last five years, overall the morbidity

Table 7.4

Life expectancy at birth (number of years)

Country	Years		
	1990	1995	The latest available data
Uzbekistan	69.7	67.88	70,54 (2005)
Russian Federation	69.3	64.7	65,37 (2005)
Kyrgyzstan	68.8	65.5	67,72(2005)
Kazakhstan	68.8	64.7	65,89 (2005)
Tajikistan	70.0	68.0	68,0 (2003)
Turkmenistan	66.6	65.24	66,1 (1998)

Data source: Report on health situation in Europe, 2005, EBRD, WHO.

rate has increased almost in all large cities and regions of the republic, but the most noticeable increase was reported for the Samarkand and Navoi regions. Only the Andijan region was reported to have a downtrend in morbidity rate. The highest morbidity rates were reported for the Navoi region, then for Tashkent city and the Bukhara, Khorezm, Namangan and Fergana regions. The lowest morbidity rates were reported for the Djizak, Syrdarya and Surkhandarya regions (Fig.7.5).

During the last five years, overall morbidity rate for children under the age of 14 has noticeably increased in the Samarkand, Navoi and Bukhara regions (Fig.7.6). In the Djizak region, the morbidity rate for this category of population has decreased slightly, while in other regions and in Tashkent city it has increased. It should be noted, that child morbidity rate values exceed those of the overall morbidity rate, thus testifying to the fact that children are more susceptible to diseases. Research data shows, that children residing in urban areas with increased air pollution levels are characterized as having less lung volume and they are to a greater extent susceptible to diseases. Besides, compared to adults, children spend more time outdoors, where air is polluted by exhaust gases and dust containing toxic contaminants and pathogenic germs. Tuberculosis, pneumonia, bronchitis, emphysema and asthma are the most common respiratory diseases among children.

The overall population mortality rate has decreased for the last five years in all regions, including the city of Tashkent. Maximum values were reported for the city of Tashkent and the Tashkent region, then for Karakalpakstan and the Syrdarya region. Minimum values were reported for the Djizak, Kashkadarya and Surkhandarya regions, which lack large industrial enterprises

7.3. Situation in the near Aral Sea area (Priaralye)

The Priaralye area covers territory of the Republic of Karakalpakstan and Khorezm region. This area is characterized by the varieties of landscapes and climatic zones, including upland Ustyurt, Aral Sea, present-day and far-back estuary of Amudarya and desert Kyzyl-Kum.

Southern location, remoteness from the oceans together with peculiarities of geological substates preconditioned strongly continental climate of that region characterized by considerable air temperature variations, long, dry and hot summers, wet springs and unstable severe winters. Natural and anthropogenic sources of

Figure 7.5

Dynamics of overall morbidity rate

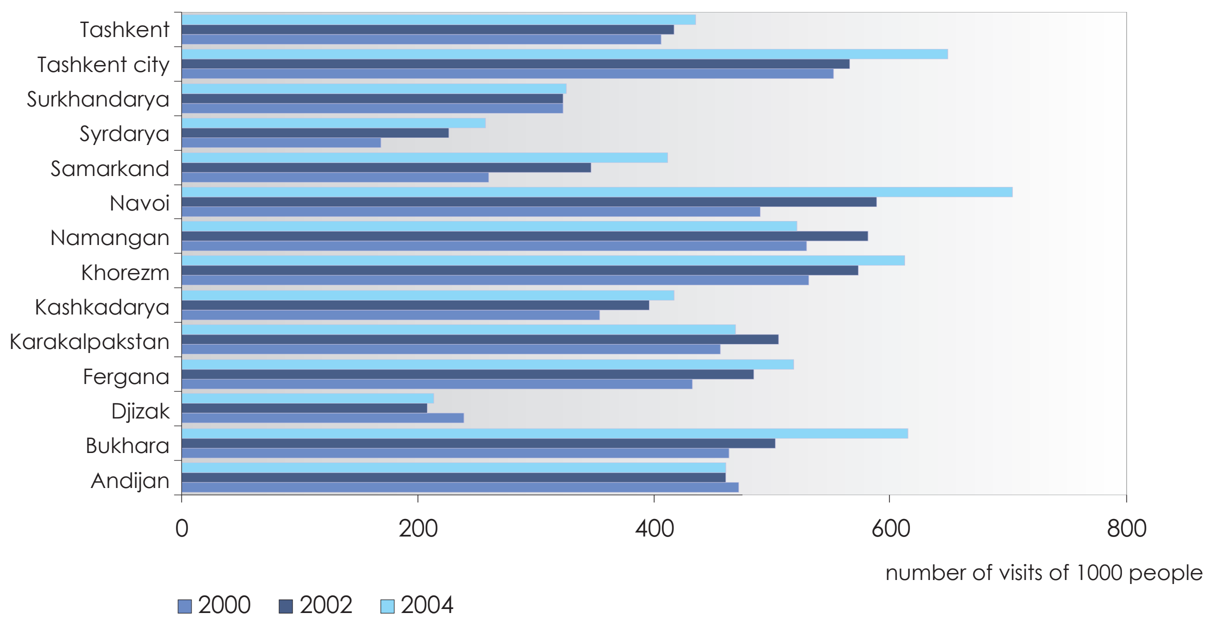
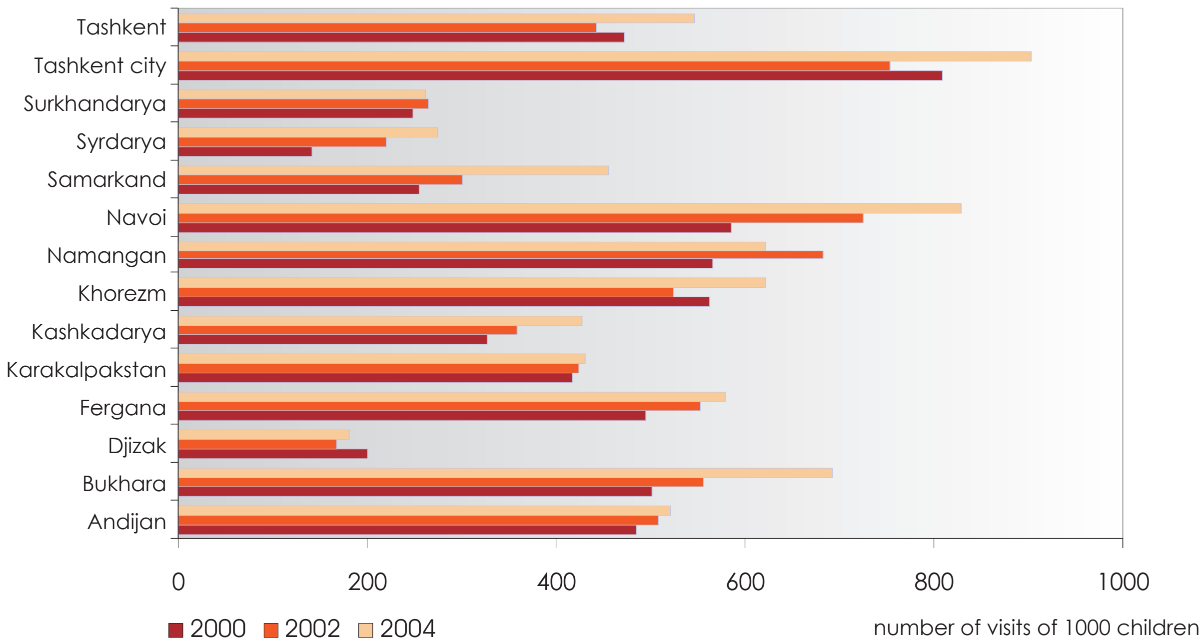


Figure 7.6

Dynamics of overall morbidity rate for children under the age of 14



pollution play important role in formation of qualitative and quantitative composition of atmospheric air.

Sharp degradation of environmental situation in Priaralye caused by Aral Sea degradation and reduction of water availability in the region affected all spheres of the life, including population health. Over 1.5 million people living in Karakalpakstan and Khorezm region suffer from pollution of atmospheric air, which contains dust from the dried Aral seabed area. Considerable large areas of irrigated lands are exposed to salinization and desertification. Heavy deficit of drinking water is one of the most serious problems of the region. Recurrent droughts are another serious problem. Health survey data has shown, that various health pathologies were reported for 60-70% of the examined people residing in that area.

Sanitary-hygienic situation in the Republic of Karakalpakstan is rather serious. In 2006, 41.1% of the tested water samples from the surface water bodies did not meet the national standards by their chemical composition. Bacterial pollution of water in the surface water bodies in the Republic of Karakalpakstan amounted to 19.5%. Acute pollution of surface water bodies results in piped water quality impairment. Thus, in 2006, 24.5% of the tested water samples did not the nationals standards by their chemical composition and 1.9% of samples by their microbiological composition.

Surface water bodies' pollution is of total character and results in considerably pollution of ground waters, including water in the wells. Well water does not meet hygienic requirements by its chemical composition in 69.6% of the tested samples, in 6% by its microbiological composition.

Water pollution plays essential role in the increase of morbidity rate, resulting in the increased adult and child mortality rate. In 2006, general morbidity rate of population of the Republic of Karakalpakstan exceeded the analogues figure for the Republic of Uzbekistan by 18%. Child mortality rate is 12.8% higher and maternal mortality rate is 16.8% higher. These figures result specifically from the increased occurrence of kidney diseases, cholelithiasis, oncologic and acute infectious diseases.

In the Republic of Karakalpakstan tuberculosis morbidity rate is by 70% higher than mean morbidity rate for Uzbekistan. In 2006, the intensive morbidity rate in the Republic of Karakalpakstan made up 120.9 per 100 thousands of population; in Muynak district this figure amounted to 186.6, in Nukus district to 203.5, in Chimbay – to 189.8, in Karauzyak – to 227.5, and in Takhtakupir – to 211.3.

Anthropogenic impact also results in soil pollution (salinity, toxic pollution, pesticide and heavy metal pollution) and affects public health.

The Southern Priaralye area is a large agricultural region: people residing in the area consume crop products which are grown on polluted soils. Pollutants migrate in soil solution; pass into plants, then into animal tissue and further to people by food chain. Pesticides, heavy metals and residual quantities of fertilizers are major pollutants. In 2006, specific weight of foodstuff samples that did not meet hygienic requirements by their chemical composition have made up 8.5% in the northern areas of the Republic of Karakalpakstan located most closely to the Aral Sea.

Analysis of public health dependence on pesticide load, especially during the period of maximum use of pesticides (1980-1995), has revealed steady increase in morbidity rate of such diseases as chronic bronchitis, bronchial asthma, congenital cardio malformation, cervical erosion, nephritis, peptic ulcer diseases, cholelithiasis, ischemic heart disease, hypertensive disease, anemia, chronic otitis, and oncologic diseases during that period.

All these factors preconditioned the necessity for the development, and what is more important, for implementation of the prompt, realistic and effective social, medical and sanitary/hygienic measures with due account of people's interests. All these measures were called to ensure environmental health care, to create appropriate social and sanitary conditions for people's life, to ensure provision of good-quality drinking water and ecologically acceptable foodstuff, medical services and pharmaceuticals.

7.4. Radioactive pollution

Uranium ore production in Uzbekistan and adjoining border areas has resulted in radioactive pollution of the territory. Apart from uranium ore production enterprises, there are numbers of other enterprises in Uzbekistan involved in mining and processing of mineral resources, which contain increased amounts of radioactive elements, for example, coal and phosphate mining and processing enterprises. The phosphate ores always contain minor amounts of natural radionuclides, such as uranium, thorium, radium and potassium. It should be mentioned, that processing of ore results in its concentra-

"Agreement on cooperation in solving the Aral Sea and Priaralye zone problems, ecological rehabilitation and socioeconomic development of the Aral Sea region" was signed by the Heads of five Central Asian states (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) in 1993 in Kyzyl-Orda. This Agreement was followed by the establishment of the Interstate Council on the Aral Sea Basin Problems (ICASBP), the Interstate Sustainable Development Commission (ISDC) and the Interstate Commission for Water Coordination (ICWC – 1992).

In 1994 Heads of the Central Asian states have established the International Fund for saving the Aral Sea (IFAS).

The Aral Sea Basin Program (ASBP) comprising formulation of the Strategy, priority measures, pilot projects and large-scale researches was approved by the second session of the ICASBP and meeting of the presidents of the Central Asian states in 1994. Many projects of this Program called to improve ecological and socioeconomic situation in Priaralye have been and are being successfully implemented with the assistance of donor community.

Nowadays, a number of international projects on improvement of environmental situation in Priaralye are being implemented.

A number of laws on mitigation of consequences of environmental crisis in Priaralye zone have been passed in the Republic of Uzbekistan.

Special Committee on environmental issues and environmental protection was established within the Oliy Majlis structure; Environmental protection public prosecutions department was established in the Priaralye zone.

Charity Fund aimed at conservation of the Priaralye zone gene pool and called to realize a number of programs and projects on public health and environmental protection, conservation and restoration of biological diversity and protection of the Priaralye zone gene pool as main condition for ensuring sustainable development of the region was founded in 2004 according to the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan.

tion, therefore regular application of phosphate fertilizers to the soil in agricultural fields results in soil pollution by radionuclides, which partially pass into plants.

Analysis of the results shows, that radiation levels in public accommodation is within acceptable limits. Natural background Gamma-radiation changes within 10-30 microroentgen/hour limits (maximum permissible limit is 50 microroentgen/hour) and is formed mainly by natural radionuclides: uranium, thorium and potassium.

Local technogenic pollution by radionuclides is caused by the operation of exhausted and exploitable uranium deposits in the territory of the republic and in the transborder areas; utilization of other mineral resources containing increased concentrations of natural radionuclides also contributes to radioactive pollution.

Radionuclides of technogenic origin (cesium-137, strontium-90, etc) in amounts exceeding permissible rates have not been discovered in the territory of Uzbekistan so far.

Productive mines, located in the territory of Kyrgyzstan and Tajikistan close to the border of the Republic of Uzbekistan, are considered as transborder sources of radioactive and other hazardous wastes. In Kyrgyzstan, they are exhausted uranium deposits Mayluu-suu and Shakontar, lead deposit Sumsar, mercury-stibium-flokrit deposit Khaydarkam, and stibium deposit Kadamdjay; in Tadjikistan – radioactive waste tailing storage in the village of Degmata Gafuruva in close vicinity to the Syrdarya river, industrial effluents of the Anzob mining and processing and the Tajik gold-mining integrated plants located at the Zarafshan river confluence. Tailing storages and off-balance ore refuse dumps, polluted by radionuclides and heavy metals, are washed out by floodwaters and pose a potential pollution threat to the Republic of Uzbekistan.

Tailing storage of ore mining and chemical industrial wastes are of primary concern. Cancer morbidity rate is reported to be very high in the nearby areas and the percentage of newborns with evident pathologies has also increased. Many inhabitants of the surrounding areas probably have genetic changes that could affect future generations. Unfortunately, accurate health risk data is not available due to the confidentiality of information regarding pollution levels and specific disease morbidity rates in the areas of uranium-mining and processing.

CONCLUSION

Uzbekistan is located in the center of the Eurasian continent and plays the key role in securing ecological safety in the Central Asian region. The scale of natural-resources, intellectual and economic potential of Uzbekistan predetermines the importance of its role in solving the global and regional ecological problems with a view to ensure conservation of the environment for the next generations.

Environmental indicator based assessment of the consequences of the global and regional climatic changes in Uzbekistan have shown that yearly average temperature in the northern part of the republic may increase by 2-3% by 2030, in the southern part by 1%. Increase in the amount of precipitation is expected throughout the country: in the Fergana valley it may increase by 15-20%, in the northern regions of the republic by 15-20%.

A downtrend in air pollution level was reported in many towns and industrial agglomeration

The problem of disposal and treatment of industrial and domestic wastes is also still needed to be solved.

In conditions of arid climate the anthropogenic pressure increases with the growth of population (need for water and other resources for living). This creates additional environmental, economic and social pressures on the high-dense territories of the state.

In terms of availability of water resources Uzbekistan is located in a quite unfavorable natural conditions. (Situation with water resources availability in Uzbekistan is characterized as a rather unfavorable one.) The hydrographic network of Central Asia has a very uneven distribution of water bodies and resources. In dry years, the most serious water management is observed in the lower reaches and estuaries of the rivers. Utilization of water resources without taking into account the environmental capacity has also resulted in water quality deterioration and tight situation with drinking water supply.

The Aral Sea shrinking has also resulted in the uprising of numerous social and economic problems whose intensity and consequences are of the international character and significance. Hydrometeorological state of the Aral Sea itself has not stabilized yet, and great efforts are made to stabilize the surface of the dried seabed area.

Desertification processes occur in large territories of the Republic of Uzbekistan. Desertification of natural landscapes results in decrease of biological productivity, and consequently, causes ecological discomfort of population and changes in the flora and fauna species composition. According to these indicators the area of new deserts in Central Asia has increased for almost 100 thousand square km and the biological productivity in some districts has decreased by 50%. In most cases it creates a socio-economic tension (decrease of cattle productivity). Desertification processes are mostly pronounced in the near Aral Sea area (Priaralye), in Ustyurt tableland, in Kara-Kum and Kyzyl-Kum deserts, and in the Tien Shan and Pamir foothills.

Irrigated lands and natural landscapes are exposed to the different types of erosion, namely: 2790 thousand ha suffer from water erosion (339 thousand ha of the irrigated lands), 20478 thousand ha suffer from wind erosion (2262 thousand ha of the irrigated lands); 2005 thousand ha are exposed both to the wind and water erosion (341 thousand ha of irrigated lands).

Heavy exploitation of biological resources has led to worsening of the living conditions of plants and animals, to declining of their species and loss of biodiversity. During the last decade the list of rare and endangered plant species inscribed in the Red Book of Uzbekistan has increased from 163 up to 301 species (8% of all flora of the state). The current system of protected area does not cover all diversity of animal and plant species of Uzbekistan. There are no protected areas in the territory of the Ustyurt tableland, in the Kyzylkum deserts and in the low-mountain areas.

The information provided in this review is based on the number of indicators and allows evaluating the state of the environment and its changes and also revealing the most important trends of its components and related problems; therefore, this information is the basis for undertaking the measures and developing the strategic policies aimed to ensure sustainable development of the country and wellbeing of its population.

However, it should be mentioned that the republic has essentially significant potential of renewable energy sources being a very important precondition for the successful and ecologically safe development of the energetic sector, which is actually not developed for the date.

In agricultural sector, poor practicing of cotton-lucerne crop rotations and insufficient application of mineral and organic fertilizers has resulted in the decrease of irrigated soil fertility. Humus content in soil has reduced 1.3-15 times compared to 1980. In 2002, average weighted factor of irrigated soil quality (bonitet) made up 55 points, that is 3 points less compared to the figures of 1991.

Over 50% of lands located in the alluvial plains suffer from salinity and overwatering. Salinization of lands is a natural process typical for all intermountain, alluvial and proluvial areas of the arid zone. However, the main reasons of soil salinization include drainage-free irrigation, huge infiltration losses, construction of unlined canals, exceeding of irrigation rates, uncontrolled water supply and usage of saline water for irrigation. In Karakalpakstan, for instance, annual increase in irrigated land salinity level is reported to be 10-30 ton/ha.

Forage land area reduction is another unfavorable trend: it has decreased more than twofold during the last decade.

Analysis of the current state of environment has revealed that rational natural resources use issues are becoming more important with every passing day.

In general, the results of social survey carried out by the CARNet experts among the different age, social and educational groups, are in line with the unbiased environmental assessment results derived based on the environmental indicators. The survey results have shown that majority of respondents (59.4%) in Tashkent, Samarkand and Bukhara have rated the state of environment in Uzbekistan as "satisfactory", while in Nukus the respondents (56.7%) have rated it as "bad" and "very bad".

From the experts' point of view, the following ecological problems are the most pressing ones in Uzbekistan for the date:

- Irrational use and pollution of water resources (74.7%);
- Imperfect waste management practices (58.2%);
- Air pollution (54.5%);
- Biodiversity conservation (50.3%);

- Climate change (44.2%);
- Desertification and land degradation (43.6%);

Most of the experts, almost half of the respondents (47.7%) believe that Parliament and Cabinet of Ministers of the Republic are among those who are greatly concerned about environmental conservation and the effect of environment upon the people's health. Many of the respondents (23.5%) have stressed that local authorities (khokimiyats, makhallya committees) pay less attention to the ecological aspects and not always consider them while taking decisions.

The majority of the experts also believe that "waste management sector" (21.8%) and "energy sector" (20%) are fields, where environmental concerns are either "not taken" or "almost not taken" into consideration. Other fields where environmental concerns are almost not taken into consideration are climate changes (16.4%), biodiversity conservation (15.1%) and the Aral Sea conservation problem (13.9%).

Absolute majority of the respondents have demonstrated that they are "very" or "greatly interested" in receiving additional information on the state of environment and other aspects of environmental conservation. Almost half of the respondents (44.2%) have displayed their concern about water resources irrational use and pollution problems, and have stated that they would like to receive the accurate and reliable information about these problems. Second priority – the information about the climate change (40.6%) and the third priority – imperfect waste management practices (38.2%).

Majority of respondents suppose that the main reason of their poor awareness about environmental problems, environmental protection, conservation and sustainable development tasks is due to a poor information support, resulting from inadequacy of the technical base required for implementing these activities (39.4%). The second reason (to the respondents' opinion) is lack of qualified specialists required for these activities (33.9%), and finally – unavailability of proper strategy on collection, storage and dissemination of nature conservation data and inefficiency of the existing information system providing information to the specialists.

The State Committee for Nature Protection of the Republic of Uzbekistan has prioritized strategic tasks aimed at securing the ecological safety:

- Integrated and rational use of natural resources, including water, land, mineral, raw material and biological resources;
- Decrease of environmental pollution level throughout the republic to the ecological, hygienic and sanitary standards;
- Adoption of the integrated measures on localization, rehabilitation and improvement of ecological situation in the ecological catastrophe zone – Priaralye (near the Aral Sea area), as well as in other environmentally neglected regions of the country;
- Provision of the population of the republic with the good quality drinking water, food stuffs, pharmaceuticals;
- Introduction of environmentally friendly and resource saving technologies;
- Development of scientific and technical potential and utilization of scientific and technical achievements in the field of ecology;

- Improvement and further introduction of economic mechanism on regulation of cooperation between the different state agencies and natural resources users, inclusion of ecological requirements in the procedure on the assessment of social and economic efficiency of the adopted managerial decisions;
- Creation of the experimental sustainable development ecological zones;
- Creation of the integrated ecological monitoring, forecast and information system;
- Improvement of the transboundary pollution control and contamination prevention services;
- Prevention and elimination of the ecological catastrophe, disaster, emergency and accident's aftereffects;
- Creation of the Central Asian regional ecological safety system;
- Development and improvement of the ecological education, culture and training system for the population;
- Strengthening of cooperation with the world community in solving the ecological problems.

Further development and improvement of the environmental indicators database will promote efficient monitoring of solving of these and other defined tasks.

ANNEXES

ANNEX 1 (Chapter 2)

Chemical composition of atmosphere

Atmosphere composition	Background atmosphere composition, %	Atmosphere composition in region, %
Oxygen	20,85	20,85
Nitrogen	78,00	78,00
Argon	0,80	0,80
Carbonic gas	0,30	0,35
Hydrogen	0,01	0,01
Water vapor	from 0,10 to 4	to 4
Aerosols marks	0,02	0,04
Pollutants (SO_2, NOx, CO, dust, organic components, heavy metalls)	marks	0,20

ANNEX 2 (Chapter 3)

Reservoirs of Uzbekistan

Region	Number	Active storage capacity, km^3	Region	Number	Active storage capacity, km^3
Amudarya river basin			Syrdarya river basin		
Khorezm	1	4,505	Andijan	3	1,760
Kashkadarya	14	2,348	Tashkent	5	1,999
Samarkand	7	1,063	Fergana	4	0,255
Surkhandarya	4	0,902	Namangan	7	0,239
Navoi	2	0,845	Djizak	4	0,181
Bukhara	2	0,430	Syrdarya	2	0,012
		10,093			**4,446**

ANNEX 3 (Chapter 4)

Areas of agricultural lands (thousand ha)

Total area		Arable lands			Perennial crops		Fallow lands		Grasslands and pastures	
Total	irri-gated	Total	including:		Total	irri-gated	Total	irri-gated	Total	irri-gated
			irrigated	rainfed						
444103	4303	4064	3308		339	325	82	48	20858	43

Total area of agricultural lands		Household lands, communal gardens and servants' orchards		Lands at melioration development stage	Forests		Shrubs	Lands not used in agricultural production
total	irrigated	total	irrigated		total	irrigated		
25344	3725	692	521		3404	49	115	15147

ANNEX 4 (Chapter 6)

List of the protected natural areas of the Republic of Uzbekistan

Name (foundation year, regulatory body)	Location		Area, thousands of ha
	Administrative	Geographical	
I. National Reserves (Corresponds to the IUCN category – Ia)			
1. Zaamin (1928, 1960, Ministry of agriculture and water resource - MAWR)	Djizak region Zaamin district	Pamir-Alay, Turkestan Range	26,840
2.Chatkal (1947, Tashkent Region Khokimiyat)	Tashkent region Parkent and Bostalik districts	Western Tien Shan, Chatkal Range	35,724
3. “Baday-Tugay” (1971, MAWR)	Karakalpakstan Beruniy district	Amudarya river flood plain	6,462
4. Kyzyl-Kum (1971, MAWR)	Bukhara, Khorezm region Romitan district	Amudarya river flood plain	10,311
5. Zarafshan (1975, MAWR)	Samarkand region Djambay district	Zarafshan river flood plain	2,352
6. Kitab (1979, SCGMR)	Kashkadarya region Kitab district	Pamir-Alay, Zarafshan Range	3,938
7. Nuratin (1975, MAWR)	Djizak region Forish district	Pamir-Alay, Nuratau Range	17,752
8. Gissar (1983, SCNP)	Kashkadarya region Yakkobat district	Pamir-Alay, Gissar Range	80,986
9. Surkhan (1987, MAWR)	Surkhandarya region	Pamir-Alay, Kugitang Range	24,554
Total area			**208,176**
% of the total territory of the republic			**0.46 %**

II. Natural Parks (Corresponds to the IUCN category – II)			
1. Zaamin National (1976, MAWR)	Djizak region. Zaamin district	Pamir-Alay, Turkestan Range	24,110
2. Ugam-Chatkal National (1990, Tashkent Region Khokimiyat)	Tashkent region. Bostalik, Parkent and Akhangaran districts	Western Tien Shan, Chatkal Range	574,590
Total area			**598,700**
III. National Nature Memorials (Corresponds to the IUCN category – III)			
1. "Vardanzi" (1975, 1983, SCNP)	Bukhara region	Central Kyzyl-Kum	0,3
2. "Yazyavan" (1991, SCNP)	Fergana region	Fergana valley	1,842
3. Minbulak (1993, SCNP)	Namangan region	Fergana valley	1,000
4. Chust (1994, SCNP)	Namangan region	Fergana valley	0,96
5. "Central Fergana" (1995, SCNP)	Fergana region	Fergana valley	0,1425
Total area			**3,3805**

IV. Areas for conservation, reproduction and restoration of separate natural bodies and complexes (Corresponds to the IUCN category – IV) Zakazniks (wildlife areas)			
1. Arnasay (1983, SCNP)	Djizak region	Central Kyzyl-Kum	66,300
2. "Aktau" (1992, SCNP)	Samarkand region	Pamir-Alay, Aktau Range	15,420
3. "Dengizkul" (1973, 1992, SCNP)	Bukhara region	Southern Kyzyl-Kum	8,6225
4. "Karakir" (1992, SCNP)	Bukhara region	Southern Kyzyl-Kum	30,000
5. Karnabchul (1992, SCNP)	Samarkand region	Southern Kyzyl-Kum	40,000
6. Koshrabat (1992, SCNP)	Samarkand region	Pamir-Alay, Aktau Range	16,300
Mubarek (1998, SCNP)	Kashkadarya region	Southern Kyzyl-Kum	236,846
7. "Saygachiy" (1991, SCNP)	Karakalpakstan	Ustyurt tableland	1000
8. "Sarmish" (1991, SCNP)	Navoi region	Pamir-Alay, Aktau Range	2,520
9. "Sechankul" (1992, SCNP)	Kashkadarya region	Southern Kyzyl-Kum	7,0375
"Sudochye" (1991, SCNP)	Karakalpakstan	Amudarya river estuary	50,000
10. "Drofiniy" (1998, SCNP)	Navoi region	Southern Kyzyl-Kum	25,000
Total area			**1498,050**

Natural Nurseries			
1. Ecological Center "Jeyran" (1976, SCNP)	Bukhara region	South-west Kyzyl-Kum	7,122
TOTAL AREA OF PROTECTED NATIONAL TERRITORIES SECURING SUSTAINED LONG-TERM CONSERVATION OF BIOLOGICAL DIVERSITY			239.3
% OF THE TOTAL TERRITORY OF THE REPUBLIC			0.53 %
VI. Separate Natural Resources Management Areas (Corresponds to the IUCN category - VI) Forestry Enterprises			
1. Forestry Enterprises (number-12, MAWR)	Republic of Karakalpakstan	-	1342,835
2. Forestry Enterprises (number-2, MAWR)	Andijan egion	-	1,975
3. Forestry Enterprises (number-10, MAWR)	Bukhara region		572,010
4. Forestry Enterprises (number-7, MAWR)	Djizak region	-	190,484
5. Forestry Enterprises (number-12, MAWR)	Kashkadarya region	-	217,184
6. Forestry Enterprises (number-7, MAWR)	Navoi region	-	2093,255
7. Forestry Enterprises (number-3, MAWR)	Namangan region	-	58,934
8. Forestry Enterprises (number-7, MAWR)	Samarkand region	-	27,227
9. Forestry Enterprises (number-2, MAWR)	Syrdarya region	-	7,528
10. Forestry Enterprises (number-6, MAWR)	Surkhandarya region	-	246,800
11. Forestry Enterprises (number-3, MAWR)	Tashkent region.	-	6,249
12. Forestry Enterprises (number-1, MAWR)	Fergana region	-	12,254
13. Forestry Enterprises (number-1, MAWR)	Khorezm region	-	78,412
Total area			**4855,147**
Game Husbandries			
1. Kazakhdarya game husbandry, MAWR	Republic of Karakalpakstan	Amudarya river estuary	402,970
2. Kungrad game husbandry, MAWR	Republic of Karakalpakstan	Ustyurt tableland	2606,515
3. "Dalverzin" forestry-game husbandry, MAWR	Tashkent region	Right-bank sections in the middle reach of Syrdarya river	5,360
4. Arnasay game husbandry, MAWR	Djizak region	North-east section of Aydarkul lake and adjacent dry land territories	16,500
5. Karakul game husbandry, MAWR	Bukhara region	Dry land territories adjacent to the western side of Dengizkul lake	8,275
Total area			**3039.62**

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