National State of the Environment Report

Uzbekistan

MINISTRY OF ECOLOGY, ENVIRONMENTAL PROTECTION AND CLIMATE CHANGE OF THE REPUBLIC OF UZBEKISTAN

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National State of the Environment Report: Uzbekistan

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Written by Khaniya Asilbekova, Zulfiya Yarullina, Marina Plocen, Khalilulla Sherimbetov, Tatiana Li, Jakhongir Talipov, Umarjon Abdullayev, Bobur Makhmudov, Numonjon Shokirov, Javokhir Abdukhalikov, Anvar Tursunaliyev, Shahnoza Usmanova, and Olga Mirshina.

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Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: iisd.org
Twitter: @IISD_news

Foreword

Aziz Abdukhakimov

Minister of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan

In our modern world, we are confronted with complex environmental challenges at global, regional, and local levels. It is essential that we use our natural resources wisely and seek sustainable solutions to environmental issues. To accomplish this, we need reliable and up-to-date information that establishes the link between environmental factors and socio-economic development. This information can be a powerful tool in facilitating informed policy and decision-making.

It is crucial to acknowledge that the National State of the Environment Report is intended to fill more than a decade-long gap in the development of such an important and in-demand information resource in the field of ecology and environmental protection. The need for it is relevant for the general public, decision-makers, and experts in various fields of activity. It is a known fact that any human activity inevitably affects the environment, which is a prerequisite for the socio-economic development of any state.

Environmental policy issues have taken a prominent position on the agenda of Uzbekistan's new government. President Shavkat Mirziyoyev's Yashil Makon initiative, which aims to plant 1 billion trees and seedlings, has become a national project and has received international recognition. The government has taken measures to impose a moratorium on tree felling, the introduction of clean and green energy, proper solid waste management, the development of green transport infrastructure, the expansion of the network of protected natural areas, and the restoration of ecosystems to conserve biodiversity. Additionally, the government is taking steps to combat desertification and drought, align environmental legislation with international standards, and support the introduction of modern information technologies. Furthermore, the Ministry of Ecology, Environmental Protection and Climate Change was established with an extended mandate and framework. All of these actions show positive trends in the country's efforts to protect the environment.

The Aral Sea crisis is another environmental challenge that has a severe impact on the livelihood of people in the region. Under the leadership of President Shavkat Mirziyoyev, massive afforestation activities were carried out at the Aral Sea dried bottom, aimed at combating dust storms and stabilizing the socio-ecological situation in the region. The President initiated the adoption of the UN General Assembly resolution to declare the Aral Sea region a zone of environmental innovations and technologies. This aims to promote green transformational changes in the Aral Sea region.

Considering the transboundary nature of environmental issues, with the initiative of the President of the Republic of Uzbekistan, in December 2023, the UN General Assembly unanimously adopted the resolution Central Asia in the Face of Environmental Challenges: Strengthening Regional Solidarity for the Sake of Sustainable Development and Prosperity.

Today, more than ever, it is important to find the fastest ways to effectively implement fundamental and applied scientific research. This involves not only acquiring new knowledge but also putting it into practical use to address socio-economic, scientific, technical, and environmental issues. In recognition of this, the Central Asian University of Environmental Studies and Climate Change "Green University" was established by Presidential Decree.

We are committed to continuing our efforts in effectively mobilizing resources, attracting green investments, and expanding global cooperation. It is crucial that every citizen participates in the protection of natural resources and environmental safety to ensure sustainable development for future generations.

To conclude, I would like to express my gratitude to the UN Economic Commission for Europe, UN Environment Programme, the FAO Representative Office in Uzbekistan, the International Institute for Sustainable Development, and the team of international and national experts who contributed to the preparation of this report.

Executive Summary

A healthy environment and its sustainable management are critical for citizens' well-being and supporting Uzbekistan's growing economy. The National State of the Environment Report (NSoER) is a comprehensive document that provides a snapshot of current environmental trends in Uzbekistan's socio-economic development for citizens, experts, and policy-makers in the country. This document also reviews relevant policy priorities, strategies, and other documents to outline responses to address environmental challenges. It also presents international commitments outlined in the United Nations' Sustainable Development Goals, multilateral environmental agreements, and other international frameworks to address the linkages and challenges facing environmental health and human well-being.

The analyzed environmental trends need to inform decision making and improve citizen engagement in natural resource management and environmental protection. This report thus aims to connect actions creating drivers and pressures influencing the state of the environment and relevant responses to address environmental challenges. Our approach uses the Drivers–Pressures–State–Impacts–Responses Framework (DPSIR) to draw connections between the state of the environment and the drivers and pressures on the environment. The framework brings together five critical elements of development in a connected framework to integrate causes of environmental degradation (as well as environmental improvements) into a chain of causes and consequences. The DPSIR framework provides a suitable model for describing the interaction between human activities and the environment. Based on the application of the DPSIR framework, the NSoER team, with the participation of stakeholders, identified the specific drivers, pressures, and components of the environment, such as atmospheric air, water resources, land, and specific ecosystems:

- Uzbekistan is a country significantly affected by climate change. Average annual temperatures in the country have been increasing and are forecast to grow further. Climate change and extreme weather events have led to an increase in the dry heat period, reduced snow accumulation and glacier degradation, increased evaporation across the plains and foothills, and increased frequency of droughts and extreme low-water events. Weather conditions in the country are expected to become hotter and drier. More frequent and intense periods of abnormal heatwaves and droughts, along with changes in precipitation patterns, will lead to an increase in extreme weather events associated with these changes, such as heavy rainfall, floods, and mudflows. Climate change is intensifying land degradation and desertification, thus affecting agricultural production and biodiversity.
- Uzbekistan's considerable population and economic growth is a major driver of socio-economic and environmental change. Energy infrastructure development has not kept pace with the speed of industrialization and urbanization resulting from population growth.
- Average annual water consumption in agriculture and industry (cotton, textiles, light, food, chemicals, metallurgy, etc.) remains high—and water scarcity is exacerbated by climate change, resulting in increased frequency and duration of droughts. Population growth is expected to increase demand for quality drinking water. Groundwater and surface water resources are polluted due to inefficient operations of wastewater treatment installations. The main polluters are industrial, agricultural, and municipal enterprises.

There are efforts made to introduce technologies to reduce water, use renewable energy sources and recycling, and promote sustainable solutions for urban and rural populations.

- Atmospheric air pollution from stationary and mobile sources is exacerbated by unfavourable climatic conditions. It is largely driven by certain key sectors: the energy, oil, and gas industries; metallurgy; chemical industry; the construction industry; and public utilities, as well as the growing number of vehicles. At the same time, the average annual concentrations of the main pollutants in most of the monitored cities remain below their maximum permissible concentrations. There has been a decrease in emissions of carbon monoxide (CO) and hydrocarbons but an increase in the emissions of NO_x and particulate matter. The sectors that contribute the most to the emissions are energy (76%) and agriculture (18%).
- Both negative and positive trends in land resource management have been observed in Uzbekistan. Negative trends include the development of desertification processes caused by both natural/climatic factors and anthropogenic activities. Positive trends include adopting responses to increase green space, the reduction in the area producing cotton and an increase in the area of grain crops, vegetables, fruit and fodder crops, and increased state support for the introduction of water-saving irrigation technologies.
- One of the causes of land degradation and desertification is the overuse of water resources. Unsustainable irrigation practices and an aging water supply infrastructure that requires extensive rehabilitation have resulted in rapid desertification, with the Aral Sea drying out. The Aral Sea, once one of the world's largest inland seas, has shrunk drastically due to extensive irrigation projects diverting water from its tributaries. This ecological disaster has led to the loss of biodiversity, declining fish stocks, and adverse impacts on local communities' well-being.
- Water issues in Uzbekistan are multifaceted and stem from a combination of geographical, climatic, economic, and management factors. The country's arid and semi-arid climate, coupled with limited water resources, presents significant challenges to sustainable water management. Uzbekistan faces chronic water scarcity due to its location in the arid region of Central Asia. The limited water supply is exacerbated by the presence of vast desert areas and the fact that the country shares water resources with neighbouring countries in the region.
- Agriculture is a major contributor to the national economy, but it relies heavily on irrigation. The use of inefficient irrigation practices, including outdated infrastructure and techniques, leads to excessive water consumption, resulting in wastage and depletion of water resources. The absence of integrated water management practices contributes to uneven distribution and overexploitation of water.
- Industrial discharges, agricultural runoff, and inadequate wastewater treatment have led to water pollution, affecting both surface water and groundwater. This pollution poses risks to human health and the environment.
- Uzbekistan is vulnerable to the impacts of climate change, including shifts in precipitation patterns, increased temperatures, and the melting of glaciers in upstream regions. These changes can further strain water availability and exacerbate existing water challenges.

- An analysis of the current state of protected areas in Uzbekistan and current trends in this area shows that the number and area of protected natural areas in the country has grown in recent years. Reforms in the forestry sector are underway, and they have resulted in a marked increase in the amount of forest land in the country. However, the negative impact on floral and faunal diversity of anthropogenic factors, such as agricultural land development and redistribution of surface runoff, distant pastoralism, energy and mining development and, in mountainous areas, infrastructure and human settlement growth, remains constant or is increasing.
- Uzbekistan submitted its Intended Nationally Determined Contribution in 2017. It is aimed at addressing the impacts and drivers of climate change given the country's economic and development context and in line with the Enhanced Transparency Framework. The country's long-term socio-economic priorities are reflected, among others, in the "Adaptation" component of the Nationally Determined Contribution.
- The country resubmitted its Intended Nationally Determined Contribution in 2021. According to this document, Uzbekistan's greenhouse gas (GHG) emissions have decreased by 0.6% since 2013. In 2017, the emissions amounted to 189.2 million tonnes, and the country has committed to reducing GHG emissions per unit of GDP by 35% by 2030 from the 2010 level by promoting energy-saving and environmentally sound technologies and dedicating resources for climate financing.
- The Aral Sea region has international significance. In the last half of the 20th century, the Aral Sea entered a period of instability. Spurred by anthropogenic impacts, this period is characterized by a decreased water volume and flow, increased salinity, reduced fish biodiversity, and other negative processes. A shrinking Aral Sea has a significant impact on the ecosystems of all neighbouring countries: its critical situation extends directly to Turkmenistan, Kazakhstan and Uzbekistan, in particular to the Republic of Karakalpakstan, Khorezm, Bukhara, and Navoi regions, and indirectly to Tajikistan and Kyrgyzstan. If the current trends in the salinization of water bodies and soil continue, in a few decades, most of the agricultural land in the Syr Darya basin will become unsuitable for irrigated agriculture (a similar situation will occur in the Amu Darya basin), and river pollution may cause irreparable damage to the ecological and socio-economic development of the territory.
- Population growth and development in Uzbekistan have resulted in increased waste generation and the amount of waste per capita. However, there is an opportunity to improve waste management practices and recycling and promote overall waste reduction. Investments have recently been made to promote the dynamic development of solid waste management infrastructure with increasing levels of waste collection. However, there is a low level of implementation of waste recycling and utilization technologies, resulting in waste being mainly disposed of in landfills. While improvements have been made to manage municipal waste and improve both collection and recycling, there are challenges in managing industrial waste. There is also a lack of a unified system for storage, transport, and disposal of medical waste. In addition, there are challenges in ensuring proper collection and neutralization of e-waste and batteries.
- As for public health, there are both positive and negative trends. There has been a clear improvement in the health of the population of Uzbekistan (e.g., reduction in child mortality or the number of underweight children) and improvement in nutrition through structural

changes in food consumption. At the same time, the probability of dying prematurely from four major groups of noncommunicable diseases—cardiovascular diseases, diabetes, chronic respiratory diseases, or cancer—for an Uzbek citizen is higher than 1 in 4 (26.9%), with a much higher probability for men (32.9%) than for women (21.4%).

As noted above, in Uzbekistan, specific provisions and relevant activities have been implemented to address the dual stress on the environment and well-being resulting from human activities and climate change. Uzbekistan is an active participant in international environmental protection and human development mechanisms. The country is party to 14 international conventions, as well as over 20 protocols, agreements, and memoranda of understanding in environmental protection and sustainable development. Uzbekistan has updated and strengthened its commitments on GHG emissions under the Paris Agreement for the period up to 2030. At the 26th UN Climate Change Conference (COP 26) in Glasgow, Uzbekistan announced its new climate mitigation target to reduce specific GHG emissions per unit of GDP by 35% by 2030 compared to 2010 levels and reaffirmed its adaptive capacity development goals.

The Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan has effectively developed multilateral co-operation with the United Nations and its specialized agencies, as well as with other international platforms such as the International Union for Conservation of Nature, Fauna & Flora, Organisation for Security and Co-operation in Europe, Deutsche Gesellschaft für Internationale Zusammenarbeit, European Union (EU), Regional Environmental Centre for Central Asia, International Fund for Saving the Aral Sea, Scientific Information Centre of the Interstate Commission for Sustainable Development, Korea Environmental Industry & Technology Institute. Various initiatives are being implemented on biodiversity conservation, ecosystem restoration in the Aral Sea region, ozone layer protection, climate change mitigation, and waste management. There are also strategies and programs to ensure access to healthy nutrition and clean water for the population.

Uzbekistan cooperates with the EU and its environmental and sustainable development bodies, as well as with individual states such as Germany, Finland, Türkiye, and South Korea. Regional cooperation is also in focus, as Uzbekistan, together with other Central Asian countries, voices a unified position of the region on the climate agenda and is working to expand mutually beneficial bilateral and regional co-operation on the use and introduction of modern energy- and resource-efficient technologies and low-GHG-emission technologies, as well as biodiversity monitoring and preservation programs, for example, through the Regional Environmental Centre of Central Asia and various platforms to protect and support sustainable development in the Aral Sea region.

There are significant opportunities for Uzbekistan to encourage sustainable development choices and priorities that promote citizens' well-being, engagement, and participation. Global frameworks such as the Sustainable Development Goals and the Paris Agreement on Climate Change, as well as national and regional processes and collaborations, provide an impetus to inspire the future sustainability of the country.

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Abbreviations and Acronyms

ASBP	Aral Sea Basin Programme of Action
DPSIR	Drivers-Pressures-State-Impacts-Responses Framework
EBRD	European Bank for Reconstruction and Development
EDB	Eurasian Development Bank
EPR	Environmental Performance Review
FAO	Food and Agriculture Organization of the United Nations
GHG	greenhouse gases
IFAS	International Fund for Saving the Aral Sea
KEITI	Korea Environmental Industry & Technology Institute
Ministry of Ecology	Ministry of Ecology, Environmental Protection, and Climate Change of the Republic of Uzbekistan
MPC	maximum permissible concentrations
NSoER	National State of the Environment Report
SDGs	Sustainable Development Goals
Statistics Agency	Statistical Agency under the President of the Republic of Uzbekistan
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	UN Environment Programme
UNFCCC	UN Framework Convention on Climate Change
Uzhydromet	Hydrometeorological Service Agency at the Ministry of Ecology of the Republic of Uzbekistan
UZS	Uzbek soums
WHO	World Health Organization
WPI	Water Pollution index
WRI	World Resources Institute
WWF	World Wildlife Fund

1.0 Introduction

A healthy environment and its sustainable management are critical for citizens' well-being and supporting Uzbekistan's growing economy. The National State of the Environment Report (NSoER) is a comprehensive document that provides a snapshot of current environmental trends in Uzbekistan's socio-economic development for citizens, experts, and policy-makers. This document also reviews relevant policy priorities, strategies, and other documents to outline responses to address environmental challenges. It also presents international commitments outlined in the United Nations' Sustainable Development Goals, multilateral environmental agreements, and other international frameworks to address the linkages and challenges facing environmental health and human well-being.

This report has been prepared in accordance with activities to implement the Concept of Environmental Protection of the Republic of Uzbekistan Until 2030, which is tasked with publishing an annual national report on the state of the environment and use of natural resources, along with a roadmap to deepen reforms in environmental policy and protection of natural resources and transform the system's activities. The last edition of Uzbekistan's NSoER was published in 2013, covering the period 2008–2011. It should be noted that in October 2020, the UN Economic Commission for Europe (UNECE) published the 3rd Environmental Performance Review (EPR) of Uzbekistan. The new edition of the NSoER for Uzbekistan is oriented toward providing updated environmental data and indicators and aims to raise awareness about the state of the environment in the country. By making the data on the environment available, we are hoping that the NSoER will also support informed decisions related to the management of natural resources, more active public participation in environmental decision making, and regular reporting on the status of the environment.

In addition to suggesting policy responses and measures, it is important to consider the institutional setting and capacities, including financial resources, for implementation and enforcement of policies. Suggested responses could, therefore, include changes in institutional configuration and alignment across different agencies and stakeholders. In this context, the NSoER can offer opportunities to improve policy and institutional linkages using the comprehensive Drivers–Pressures–State–Impacts–Responses (DPSIR) Framework and engaging a range of experts.

This report is a collaborative effort of experts from diverse ministries, including the Ministry of Ecology, Environmental Protection and Climate Change and its structural agencies: Agency Uzhydromet, Agency of Forest Resources, the Centre for Specialized Analytic Control of Environmental Protection, the Ministry of Health, and the Ministry of Water Resources. It builds on their knowledge and measurement capacity. This collaborative effort brings together key trends and indicators to provide an overview of environmental changes in Uzbekistan. The experts also aimed to outline the most relevant responses being implemented.

Finally, we hope this report will suggest capacity-building and learning opportunities, creating media outreach and interest from students, experts, and other stakeholders.

2.0 Our Approach

This report is a comprehensive document that reviews the state of the environment, taking account of Uzbekistan's socio-economic development and policy and decision-making responses, including efforts made mostly at the national and global levels. The document summarizes the state of the environment in Uzbekistan, as well as the necessary context to identify major drivers and pressures to help guide the way forward in the short and medium terms.

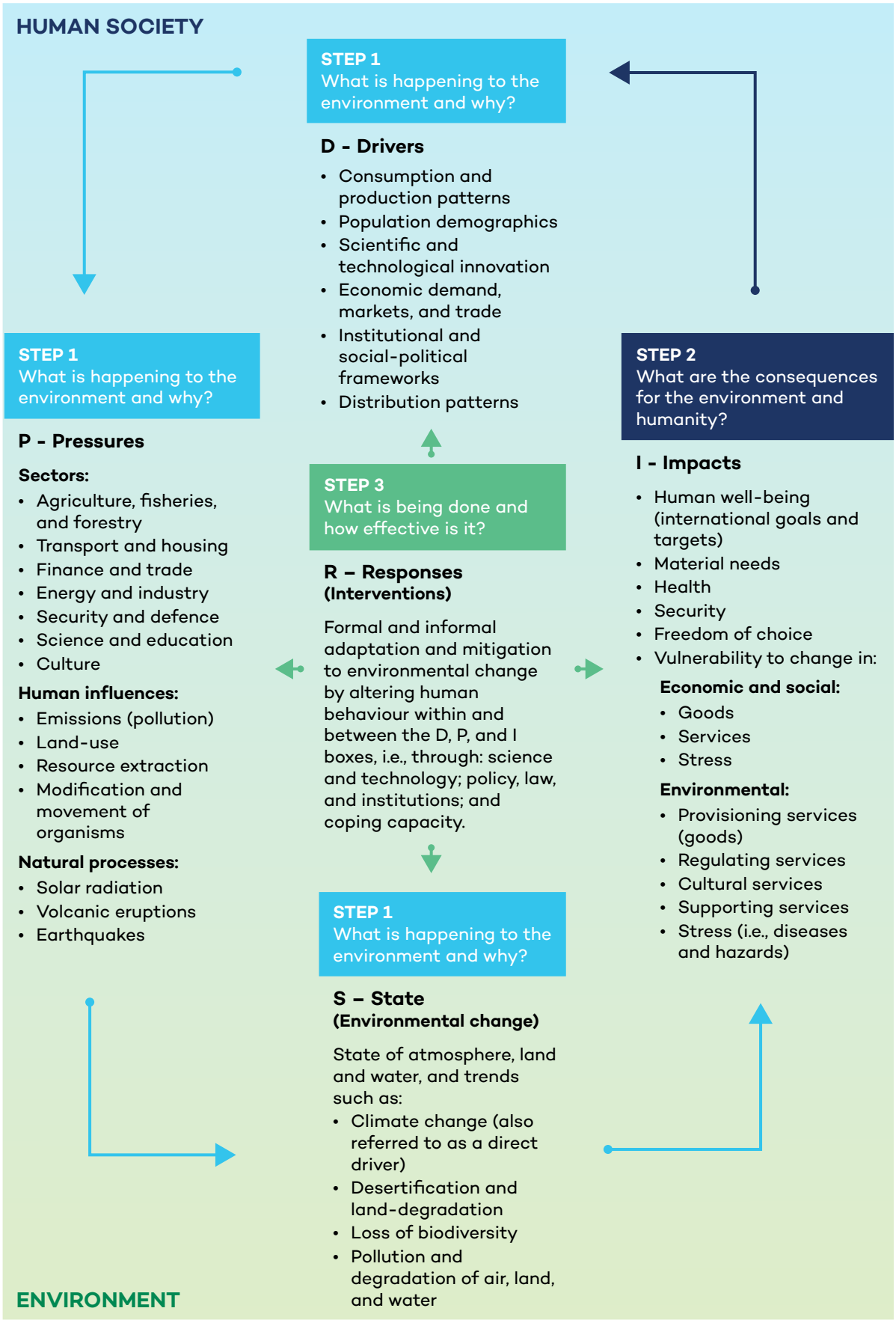
The field of environmental analysis and assessment mainly monitors the state and development of individual components of the environment, such as air, water, land, and biodiversity and how they change over time. In this context, this report seeks to bring together high-quality, relevant environmental data and indicators (and their interpretation), and different types of responses, including policies and measures.

The report's approach aims to connect actions creating drivers and pressures affecting the environment with relevant responses to address environmental challenges. It is intended to inform decision making and improve citizen engagement in natural resource management and environmental protection by outlining environmental trends. It uses the DPSIR framework to identify such linkages.

The DPSIR analytical framework was conceived by the European Environment Agency and established by the Organisation for Economic Co-operation and Development (European Environment Agency, 1998). The framework is now a standard way to describe the state of the environment in a country in terms of its development and policy context (Figure 1). The framework is being used in numerous global, national, and subnational reports, including the United Nations Environmental Programme's (UNEP's) Global Environmental Outlook and national and provincial/subnational state of the environment reports (Commonwealth of Australia, 2021; Government of the Northwest Territories, 2022; Ministry of the Environment of the Czech Republic, n.d.; Republic of Turkey Ministry of Environment and Urbanisation, 2020). The framework combines five critical elements of development in a connected framework to integrate the causes of environmental degradation (as well as environmental improvements) into a chain of causes and consequences. The DPSIR framework provides a suitable model for describing the interaction between human activities and the environment.

Based on the application of the DPSIR framework, the NSoER team, with the participation of stakeholders, identified the specific drivers/pressures on the environment and measures being taken to improve the environmental situation. Environmental components include atmospheric air, water and land resources, biodiversity, and, more generally, ecosystems.

Figure 1. Overview of the DPSIR Framework and its elements



Source: UNEP & IISD, 2007.

Beyond understanding the linkages between the country's development, status, and impacts on the environment and responses, the DPSIR framework provides opportunities to **identify indicators** for the report. For example, if the country's population, economic, and income growth is identified as a driver, then potential indicators could include total population, rural and urban population, and income changes. For potential examples of indicators in the context of the DPSIR framework, we prioritized indicators in quantitative terms; however, it is also important to keep in mind that sometimes quantitative indicators are not available, and a qualitative description of trends should be considered (Table 1). The report presents an opportunity to highlight indicator and data gaps and can serve as a vehicle for improving the country's monitoring efforts.

Elements of the DPSIR framework can be described as follows (see also Figure 1):

- Drivers (D): Describes the overall drivers of development that cover both the needs of the population as well as those of industry. Potential drivers could, for example, include population changes, consumption and production patterns, and waste production and handling.
- Pressure (P): Describes the consequences of development drivers of the population and industry that create pressures on the environment. These could, for example, include extensive use of natural resources, changes in land use, land cover, and water use, as well as pollution and emissions.
- State (S): Pressures, including changes in air and water quality, soil, and ecosystem characteristics, affect the state of the environment.
- Impact (I): Changes in the state of the components of the environment affect their ability to support a country's development, including its well-being. This is also the space to identify vulnerabilities and risks that are created because of the changes in the state of the environment.
- Responses (R): Summarizes the responses by society, often in the form of policy measures, but can also refer to actions by citizen groups, stakeholders, and industrial organizations to support/complement policy efforts.

Table 1. Overview of the time horizons and trends considered in this report

Categories	Description
Time horizons	
Long term (10 years)	Trends cover mostly the 2012 to 2022 period; end of 2021 is considered in some cases.
Medium term (3 years)	This period covers the recent changes in the indicator; mostly focusing on the years 2019–2022 depending on data availability. When trends are assessed, changes in the trends in 2021 due to COVID-19 are taken into account.
Type of indicator trends	

Categories	Description
Positive	Trend for the indicator is positive in terms of improving the environment: for example, reduction in air pollution or water withdrawals, or improved water-use efficiency.
Stable	There is no significant trend change over the studied timeframe; the trend for the listed issue is stable.
Negative	Trend for the environment is negative: for example, increased levels of pollution, reduction in habitat, or increase in disease occurrence.

Source: Authors.

Finally, this report considers the covered **geographic boundary and timeline** through the application of the DPSIR framework and indicator selection. The chosen timeline covers roughly 10 years (2012–2022), and, where relevant, regional and subnational trends are considered as well.

3.0 International Context

Table 2. Trends in international rankings of Uzbekistan

Ranking	Long term (10 years)	Medium term (3 years)	Details
Environmental Performance Index	+1.90	NA	In 2022, Uzbekistan ranked 107 out of 180 countries on its national efforts to protect environmental health, enhance ecosystem vitality, and mitigate climate change; the long-term trend is positive (Wolf et al., 2022).
Sustainable Development Report	+9%	+3%	In 2023, Uzbekistan ranked 69 out of 166 countries on overall progress toward achieving all 17 Sustainable Development Goals [SDGs]; the long- and mid-term trends are positive (Sachs et al., 2023).
Human Development Index	+1%	+7%	In 2021, Uzbekistan ranked 101 out of 191 countries for long-term progress in human development, including healthy life expectancy, knowledge access, and quality of life; long- and mid-term trends are positive (United Nations Development Programme [UNDP], 2022).

Source: Authors.

3.1 International Frameworks

Uzbekistan is a party to 14 international conventions, as well as protocols, agreements, and memoranda of understanding in the field of environmental protection and sustainable development. Uzbekistan supports the principles of the Rio Declaration and the Global Agenda 21 and has adopted 16 SDGs through to 2030, having defined providing its population with good quality drinking water as one of its main goals. As shown in Table 1, Uzbekistan's status in the global environment performance and human development rankings has been improving.

Uzbekistan has updated and strengthened its commitments on GHG emissions under the Paris Agreement for the period up to 2030. At COP 26 in Glasgow, United Kingdom, Uzbekistan announced its new climate mitigation target to reduce specific greenhouse gas emissions per unit of GDP by 35% by 2030 compared to 2010 levels and reaffirmed its adaptive capacity development goals. In May 2022, Uzbekistan joined a global initiative (the Global Methane Pledge) for countries to achieve the collective goal of reducing methane emissions by at least 30% by 2030 compared to 2020. Cross-sectoral work is under way for the country to accede to international conventions:

these include the Convention on Long-Range Transboundary Air Pollution; the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; and the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters. Drafts of the Environmental Code and Health Code have been prepared.

In 1999, Uzbekistan submitted its first Intended National Communication (INC) to the UN Framework Convention on Climate Change (UNFCCC) in October 1999, followed by two more communications (also National Inventory Reports). In 2021, the First Biennial Update Report showcased mitigation efforts to reduce GHG emissions and promote efficiency in various economic sectors. According to INC, key adaptation efforts for Uzbekistan include optimizing water use and implementing water-saving techniques in various sectors, as well as flexible agricultural planning.

The upcoming fourth INC will address mitigation and adaptation. Identified gaps in mitigation involve decision making, cross-sector communication and coordination, progress tracking of nationally determined contributions, and Enhanced Transparency Framework compliance. One gap in adaptation is the lack of an integrated approach using science and technology for reduced climate vulnerability in society and the economy.

Currently, the Ministry of Ecology is implementing 31 international grant projects for a total amount of USD 106.547 million. In the period 2023–2024 eight more international projects totalling USD 39.8 million (Table A3) are planned. A number of international projects in the field of biodiversity conservation, management of hazardous chemicals and waste, and introduction of smart technologies are promising (Table A2).

3.2 United Nations Mechanisms

The Ministry of Ecology has effectively developed multilateral co-operation with the UN and its specialized agencies. Various initiatives are being implemented in cooperation with UNDP, along with a number of grant projects on biodiversity conservation, ecosystem restoration in the Aral Sea region, ozone layer protection, and climate change mitigation. In particular, the Biodiversity Finance Initiative in Uzbekistan aims to create an effective dialogue between government agencies and other biodiversity finance stakeholders, to better understand the current situation and determine a baseline of biodiversity costs, as well as to identify the financial needs and instruments to protect and resurrect the Aral Sea.

In 1993, the Republic of Uzbekistan became a party to the UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage. In 2016, the UNESCO World Heritage Committee added the Western Tien Shan transnational serial site, nominated collectively by Kazakhstan, Kyrgyzstan, and Uzbekistan, to the World Cultural and Natural Heritage List.

The nomination of Tien Shan to the UNESCO World Heritage List is based on its role in conserving biological diversity. The region is home to many rare and endangered species, such as the Menzbir marmot, snow leopard, Tianshan mountain sheep, and others.

The transboundary natural site Turanian Temperate Deserts was added to the UNESCO World Natural Heritage List at the 45th session of the UNESCO World Heritage Committee held from September 10 to 25, 2023 in Riyadh, Saudi Arabia. The Turanian Deserts are the first site to be

included in the category of temperate deserts on UNESCO's list. The inscribed sites are located in three countries in the territories of desert reserves, national parks, and landscape reserves in Uzbekistan, Kazakhstan, and Turkmenistan. Inclusion of the Turanian Temperate Deserts in the list of World Natural Heritage is also important for the preservation of unique biological diversity; in particular, it will bring to the international level the protection of 41 species of mammals, 167 species of birds, 42 species of reptiles, among which the kulan, saiga, gazelle, urial, and many globally threatened species of animals and plants are of special value.

To improve and strengthen inter-agency coordination and cooperation along with legislative and regulatory frameworks (as well as support implementation, monitoring, and reporting on chemicals and hazardous waste), UNEP is supporting the implementation of the project Strengthening the Institutional Capacity of the Republic of Uzbekistan in the Implementation of the Basel and Stockholm Conventions and GHS, as well as Facilitate the Accession to the Rotterdam and Minamata Conventions.

In order to accelerate hydrochlorofluorocarbons (HCFC) phase-out to achieve the targets set under the Montreal Protocol and sustainable reduction of HCFC dependency in the service sector, the project Complete Phase-out of HCFC Consumption in Uzbekistan Through Promotion of Energy-Efficient Technologies With Zero Ozone Depletion and Low Global Warming Potential is being implemented jointly with UNDP. The project consists of four interrelated and mutually reinforcing components: Assistance in Implementation of National Legislation and Capacity Building of Customs and Law Enforcement Officials to Control HCFC Import/Export and ODS Alternatives; Strengthening HCFC Reuse System and Implementation of HCFC Replacement Demonstration Projects; Outreach and Resource Mobilisation; and Gender Mainstreaming, Monitoring, and Evaluation.

In co-operation with UNDP and UNECE, a new joint project called Master Planning and Innovative Financial Solutions to Support the Yashil Makon Initiative was initiated in 2022. This project supports the country in building climate resilience, combating desertification and dust storms, and adapting to climate impacts by offering innovative long-term financing, coordination, and capacity building.

Uzbekistan has adopted and implemented a framework and a set of measures to ensure healthy nutrition for its population for the period 2015–2020 and continues to work to provide the population with good-quality and safe food products, cooperating with international organizations, such as the Food and Agriculture Organization of the United Nations (FAO), World Health Organization (WHO) and others. Some other projects implemented jointly with FAO include Land Use and Restoration of Degraded Ecosystems and Biodiversity in Uzbekistan; Sustainable Management of Forests in Mountain and Valley Regions; Restoration of Arid Regions, Conservation of Central Asian Deserts; Sustainable Management of Desert Forests and Pastures; and Integrated Management of Natural Resources in Agricultural Production Systems Exposed to Drought and Salinity in Central Asia and Türkiye. National water supply and other projects are implemented with the support of international finance institutions and organizations, such as the Asian Development Bank (ADB), World Bank, UNDP, UNICEF, and individual states.

Finally, cooperation on the development of environmental education has been established with the United Nations Economic Commission for Europe Steering Committee on Education for Sustainable Development (UNECE-ESD).

3.3 Other International Mechanisms

The Republic of Uzbekistan is a party to 14 conventions on cooperation in the field of environmental protection, including four conventions directly related to biodiversity conservation issues: the Convention on Biological Diversity (1995); Convention on International Trade in Species of Wild Fauna and Flora (CITES) (1997); Convention on the Conservation of Migratory Species of Wild Animals - Bonn Convention (1998); and the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the Ramsar Convention) (2001). In 2023, Lake Sudochie was included in the Ramsar List of Wetlands of International Importance. It became the fourth site in Uzbekistan officially included in the list of the Ramsar Convention. Previously, the list included Lake Dengizkul (2001), the Aidar-Arnasai lake system (2008), and Tudakul and Kuimazar reservoirs (2020). The Republic of Uzbekistan has identified and described 52 important bird areas (IBAs) of international importance for the conservation of globally threatened bird species and all biodiversity. These territories have been confirmed by the BirdLife International secretariat and are included in the IBA international network (BirdLife International, 2007).

In 2022, a representative office of the Global Green Growth Institute in Central Asia was opened in Tashkent. Work is underway to open representative offices in Uzbekistan of the International Union for Conservation of Nature (IUCN) and the Korea Environmental Industry & Technology Institute (KEITI). In October 2021, a formal ceremony was held to recognize Uzbekistan's membership status in the IUCN. Thus, Uzbekistan became the 92nd country to join the IUCN and the first Central Asian country. Together with IUCN, the Increasing Landscape Resilience to Zoonotic Diseases Through Consolidation of Conservation Systems in Central Asia project is being implemented.

In 2020, Uzbekistan became a member of the Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services, and established cooperation in various environmental areas. A pan-European and Central Asian network of national platforms linked to this organization was established to exchange information and consolidate capacity building efforts between them. On November 18, 2020, Uzbekistan became the first member of the Pan-European and Central Asian Network among Central Asian countries in the Commonwealth of Independent States.

3.4 Cooperation With UNECE, the EU, FAO, and Other Actors

Uzbekistan has established extensive co-operation with the UNECE Committee on Environmental Policy in the field of air-quality improvement, environmental policy and management, environmental monitoring and assessment and environmental education. The Third Environmental Performance Review of the Republic of Uzbekistan has been developed with the participation of UNECE and national experts.

Active co-operation with the EU within the framework of the Environment, Climate Change, and Water Resources project is being developed. Based on the agreements reached with the EU

side, cooperation with that project is aimed at implementing EU air quality standards and other related basic requirements, air quality analyses (including air-quality management systems), in accordance with international—and particularly EU—approaches. The 6th EU-Central Asia High-Level Conference on Environment and Water Co-operation was held in Tashkent in January 2019.

Uzbekistan cooperates with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) to improve ecological knowledge and provide material and technical support for inclusion of the Lower Amu Darya State Biosphere Reserve in the UNESCO program Man and the Biosphere (which is a part of the framework of the joint project Ecosystem-Based Land Use and Preservation of Ecosystems in the Lower Section of the Amu Darya). In 2021, the Lower Amudarya State Biosphere Reserve was included in the UNESCO Man and the Biosphere program. Within the framework of GIZ's Green Central Asia initiative, there is ongoing work to support environmental innovations and technologies focused on reducing the impacts of anthropogenic factors on nature. Other GIZ projects being implemented include one titled Integrated Land Resources Management in Central Asia and another on Environmentally Oriented Regional Development of the Aral Sea Region.

Other examples of partnerships with EU and other states include the projects Rehabilitation of Tugai Forests and Strengthening of Material and Technical Base of Forestry Farms (in partnership with Turkish Cooperation and Coordination Agency, TIKA) and the Construction of Solid Domestic Waste Landfills (SDW) in Jizzakh Region project in partnership with KEITI. There are also projects in the field of environmental monitoring, development of hydrometeorological services, and climate sustainability, in cooperation with the Ministry of Foreign Affairs of Finland and the Finnish Meteorological Institute.

The project Development of Joint Measures to Prevent And Respond to Pollution of the Syr Darya River in Emergency Situations (Phase I), carried out under the Convention on Protection and Use of Transboundary Watercourses and International Lakes and the Convention on the Transboundary Effects of Industrial Accidents, in the framework of the EU Water Initiative National Policy Dialogues on Integrated Water Resources Management (June 2021–February 2023) revealed (among other issues) that risks in several areas of the Syr Darya River basin are particularly high.

It is also important to stress FAO's support in addressing food system transformation, including the social and environmental challenges it raises. FAO provides technical expertise and knowledge sharing on a wide range of agricultural and rural development issues. This includes sustainable land management, water resource management, crop diversification, and livestock production. Given Uzbekistan's vulnerability to climate change, FAO supports the country in developing climate-resilient agricultural practices. This involves promoting drought-resistant crops, efficient irrigation techniques, and climate-smart agricultural methods to enhance productivity while reducing environmental impact. FAO collaborates with Uzbekistan to address environmental challenges that include desertification, deforestation, and water scarcity. FAO also facilitates the exchange of innovative agricultural practices, technologies, and research findings among countries in the region.

3.5 Regional Cooperation

Within the framework of COP 26, the governments of Central Asian countries issued a regional statement voicing the region's unified position on the climate agenda. One of the most significant regional-level events was the adoption of the regional Green Agenda program for Central Asia at the Fourth Consultative Meeting of Heads of State in Cholpon-Ata. Under this document, the countries of the region agreed to expand mutually beneficial bilateral and regional co-operation on the use and introduction of modern energy and resource-efficient technologies and low greenhouse gas emission technologies. This document provides for strengthening co-operation in the field of adaptation and mitigation of climate change, environmental protection and rational use of natural resources, prevention and elimination of natural and human-made emergencies, and reduction of their risks.

Regional projects in the fields of environmental monitoring, biodiversity, and climate change are being implemented. They include the following: Capacity Development and Technology Transfer to Improve the Use of Data and Information for Environmental Monitoring in Central Asia (Uzbekistan, Tajikistan, and Kyrgyzstan in collaboration with UNEP); Support for the Implementation and Review of the Progress of the Global Framework Programme on Biodiversity Beyond 2020 (Pan-European region) (Uzbekistan, Ukraine, and Moldova); Combating Wildlife Trafficking in Central Asia (Uzbekistan, Kyrgyzstan, Tajikistan, and Kazakhstan); Strengthening Responses to Security Risks Related to Climate Change (Uzbekistan, Kyrgyzstan, Tajikistan, and Kazakhstan); Combating Wildlife Trafficking in Central Asia (Uzbekistan, Kyrgyzstan, Tajikistan, and Kazakhstan); Strengthening Responses to Climate Change-Related Security Risks in South-Eastern Europe, Eastern Europe, the South Caucasus and Central Asia; and Climate Risk Management in Central Asia (Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, and Kazakhstan).

A memorandum of understanding between the Ministry of Ecology of Uzbekistan and the Regional Environmental Centre of Central Asia is being implemented. In 2020, under the SAMR4ASB project (in cooperation with the World Bank and the Regional Environmental Centre of Central Asia), modern mobile environmental laboratories of Mercedes-Benz Sprinter 519 CDI models were provided to the Centre for Specialized Analytical Control in the Field of Environmental Protection, the Tashkent City Department of Ecology, Environmental Protection and Climate Change, and Hydrometeorological Service Agency at the Ministry of Ecology of the Republic of Uzbekistan.

3.6 Aral Sea Region

The Aral Sea basin is attracting increased attention from the international community and a forum for international cooperation to address the Aral Sea crisis. The environmental situation in the region associated with the drying up of the Aral Sea is an internationally significant issue, and its preservation and sustainable development are of paramount importance, both globally and regionally. In 2021, the President of Uzbekistan, Sh. M. Mirziyoyev, signed the Decree on Measures to Implement the United Nations General Assembly Special Resolution of 18 May 2021 on Declaring the Aral Sea Region a Zone of Environmental Innovation and Technology, 29 July 2021, No. PP-5202.

In order to eliminate the negative consequences of the Aral Sea drying up, an investment project of green rehabilitation of the territories of the Republic of Karakalpakstan in order to address

the consequences of the Aral Sea crisis (2021–2024) is being implemented jointly with Global Green Growth Institute. The project's implementation will address the complex Aral Sea problems at a systemic level, offering a viable pathway to redirect the development trajectory of Karakalpakstan into a green growth model. It will also take concrete measures to restore the livelihoods of communities with increased resilience to environmental disasters and the ability to generate sustainable businesses. To this end, measures are being taken to adapt and ensure disaster-resilient livelihoods of 113,000 people in the most heavily affected districts; 1,587 farmers and entrepreneurs will be provided with agribusiness models; and 500 farmers, micro, small, and medium-sized business enterprises will be established.

The project Conservation and Sustainable Use of Wetland, Lake and Floodplain Ecosystems of Priaralie aims to support five newly created protected areas on an area of more than 2.4 million hectares in the Republic of Karakalpakstan and thus to provide a territorial form of protection of all species of fauna and flora.

Finally, together with UNDP, a crowdfunded initiative called Green Aral Sea on greening the Aral Sea floor was launched in 2020. A memorandum of understanding was signed between the UNDP and a number of ministries and agencies of the republic. Within the framework of this initiative, more than 34,000 seedlings were planted on the dried up Aral Sea floor.

4.0 Overview of the Country's Development Progress, Drivers, and Pressures

Table 3. Key trends and indicators — development progress

Indicator	Long term (10 years)	Medium term (3 years)	Details
GDP growth	Positive	Positive	Growth over 5% was achieved for most of the time frame
Employment (registered)	Positive	Positive	Improved trend for the numbers for employees and self-employment
Production change (%)	Positive	Positive	Significant improvements in production over the time frame
Primary fuel and energy production	Stable	Positive	The indicator indicates improved energy efficiency
Water demand by industry	Negative	Negative	With growing production, the water intensity stays high
Energy from renewable sources	Negative	Slightly positive	In 2021–2023, solar and hydro power is being developed

Source: Authors.

- Uzbekistan has experienced considerable population and economic growth; this growth is a major driver of socio-economic and environmental change. The demand of a growing population for quality food, water, energy, clean air, and other natural resources is increasing. At the same time, economic growth implies growing production of goods and services, increased incomes, and overall larger contributions to regional and global development.
- The development of industry and the energy sector in recent years has resulted in annual demand increases for water. The total annual water consumption of these sectors will increase from 1.9 billion m^3 to 3.5 billion m^3 (1.8 times) by 2030. In addition, energy infrastructure development has not kept pace with the speed of industrialization and urbanization resulting from population growth.
- Average annual water consumption in agriculture remains high. Before 2015, the total water deficit in Uzbekistan was more than 3 billion m^3—by 2030 it could reach 7 billion m^3 and by 2050, 15 billion m^3. In addition, the demand for access to good quality water is expected to grow, which would lead to an increase in water demand from the public utilities sector. At the same time, climate change will further exacerbate water scarcity in Uzbekistan and may increase the duration and frequency of droughts (as occurred in 2000, 2008, 2011, 2014, and 2018), causing serious problems in meeting the water needs of the economy.

- Finally, there are significant development prospects for many industries, such as cotton, textiles, light industry, food, chemicals, and others, that directly depend on agriculture and energy. There are efforts made to introduce technologies to reduce water intensity, use renewable energy sources and recycling, and promote sustainable solutions for urban and rural populations.

4.1 Main Development Achievements and Challenges Faced by Uzbekistan

There has been an increase recently in the social development and well-being of Uzbekistan's population. The country has experienced significant population and economic growth, which has become the major driver of socio-economic and environmental change. Specifically, Uzbekistan's population is increasing by an average of 650,000–700,000 people per year; by 2030, it is expected to increase to 39 million people. The growing population is resulting in increased demand for access to good-quality and reliable water, energy, and other natural resources.

The economy has also experienced considerable growth and an increase in the production of goods and services, as well as growth in incomes and contributions to regional and global development. In 2022, Uzbekistan's GDP at current prices was UZS 888.3417 trillion, a 5.7% increase compared to 2021. The European Bank for Reconstruction and Development (EBRD) projects 6.5% GDP growth in 2023, while the Central Bank of Uzbekistan projects growth of 4.5%–5% (Table 4).

Table 4. GDP growth dynamics in Uzbekistan (2013–2022)

Years	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
GDP growth (%)	7.3	6.9	7.2	5.9	4.4	5.5	6.0	2.0	7.4	5.7

Source: Statistics Agency, 2023.

This growth was followed by slight changes in the sectoral structure of the GDP. For example, the country has seen an increase in manufacturing output. According to the Institute for Macroeconomic and Regional Research, industry's share of GDP increased from 21.1% to 26.7% between 2017 and 2022, the result of steady growth in industrial production. Construction's share remained at the level of 2020 and 2021, amounting to 6.7% (Statistics Agency, 2023). The share of agriculture, forestry, and fishing was 25.1%, and services was 41.5% (2022).

The dynamics and growth rate of total per capita income in the Republic of Uzbekistan over the last 5 years (2018–2022) are shown in Table 5. Positive trends have emerged in aspects of living standards such as current consumption patterns, the availability of durable goods, housing, financial assets, and a well-developed social infrastructure. Social support for citizens has been strengthened, reflected in a continuous improvement in the population's standard of living. Uzbekistan currently invests 9.7% of GDP in the national social protection system.

Table 5. Dynamics and growth rates of total per capita income in the Republic of Uzbekistan (2018–2022)

Years	2018	2019	2020	2021	2022
Total per capita income (thousand UZS)	9,128.6	10,891.3	12,122.2	14,869.8	17,807.3
Income growth rate (%)	106.2	104.2	98.6	110.7	107.5

Source: Statistics Agency, 2023.

4.2 Drivers of Environmental Change

The drivers of environmental change are mainly related to the development of industry, agriculture, and construction without regard to the available natural resources, associated with inappropriate use of natural resources.

The growing population and its concentration in cities pose significant demands on the environment and natural resources. The proportion of the population in urban areas was 50.9%, and in rural areas, 49.1% (2022). The development of the resident population and the growth rate over the last 5 years are shown in Table 6. On January 1, 2023, the national population density was 80.2 people per square kilometre, representing an increase of 1.6 persons compared to the same period in 2021 (78.6 persons per square kilometre in 2022). The lowest figures were recorded in Navoi region (9.5 per square kilometre) and the Republic of Karakalpakstan (11.9 per square kilometre).

Table 6. Dynamics of resident population of the Republic of Uzbekistan and growth rates (as of the beginning of the year, 2019–2023)

Years	2019	2020	2021	2022	2023
Population, thousand people	33,255.5	33,905.2	34,558.9	35,271.3	36,024.9
Growth rate (%)	1.8	2.0	1.9	2.1	2.1

Source: Statistics Agency, 2023.

The structure of production and consumption is also significant. The country's leading industries are cotton processing, machine building, textiles, gas production, non-ferrous metallurgy, electrical, radio electronics, instrument making, oil refining, automotive production, as well as agricultural product processing industries. The chemical and petrochemical industry, light industry, power industry, ferrous metallurgy, building materials industry, etc. are also developing rapidly. According to statistics for 2022, Uzbekistan is the world's 14th largest producer of natural gas, the third-largest exporter and sixth-largest producer of cotton, the seventh-largest producer of uranium (4% of the world's uranium reserves), and the fourth-largest producer of gold. Overall, the country has seen an increase in manufacturing, with the share of industry in GDP increasing from 21.1% to 26.7% between 2017 and 2022 (Statistics Agency 2022, 2023).

Table 7. Production and growth rates of consumer goods in the Republic of Uzbekistan (% of previous year)

Years	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Production, trillion UZS	21.5	28.6	33.9	42.1	48.3	59.7	83.5	110.3	129.3	155.2
Growth rate (%)	7.9	9.4	9.7	9.7	6.0	6.7	14.7	10.3	5.7	13.9

Source: Statistics Agency, 2023.

4.3 Pressures – Load and Threats

The manufacturing sector is the backbone of Uzbekistan's industrial base. It represents 83.2% of production volumes (2022). The production volumes and share of the main branches of industry are shown in Table 8. Textiles (49%), chemicals (23.8%), metallurgy (8.6%), construction materials (4.7%), and pulp and paper products (3.7%) form the basis of Uzbekistan's cooperative supplies to the Eurasian Economic Union (Eurasian Economic Union, n.d.). The most promising sectors for cooperation with Uzbekistan for the Eurasian Economic Union are agricultural machinery, the automotive and chemical industries, metallurgy, and the production of building materials.

Table 8. Production volumes and share by major industries (2022)

Industry sector	Production (trillion UZS)	Share (%)
Manufacturing industry (manufacturing, repair and installation of machinery and equipment, production of motor vehicles, metallurgical industry)	460.5	83.2
Mining and quarrying	52.1	9.4
Electricity, gas, steam, and air conditioning supply	37.7	6.8
Water supply, sewerage, waste collection, and disposal	3.0	0.6

Source: Statistics Agency, 2022, 2023.

4.3.1 Energy

Uzbekistan's energy system is the largest in Central Asia, and the country fully meets its needs from its own energy resources. The total installed capacity of power plants is about 14,140.6 MW. About 85% to 89% of electricity generation is thermal power plants (TPPs), mostly fuelled by natural gas; about 14% hydroelectric power plants; and about 1% block and isolated plants. The number of TPPs is 11, including 3 thermal power centres (TPPs). Hydropower comes from 42 hydroelectric power plants (HPPs), including 12 large HPPs, which account for about 90% of the total HPP capacity; 28 small hydropower plants (SHPPs); and 2 micro HPPs. There are 30

HPPs (4 large and 26 SHPPs) operating along the watercourse. There are 10 HPPs at reservoirs. The coefficient of use of the republic's hydro potential is 27%.

Table 9. Indicators of electricity supply to consumers in the Republic of Uzbekistan (2016–2022)

Years	2016	2017	2018	2019	2020	2021	2022
Million kWh	45.7	47.4	50.5	52.7	55.8	59.1	62.4

Source: Ministry of Energy, 2020, 2022.

Electricity is transported from generation sources through backbone networks, which include 77 substations and power transmission lines 9,768 km long. Distribution and supply of electric energy to consumers inside the country is carried out through distribution networks, including 35 substations, transmission lines (35–110 kV) 28,642 km long, transmission lines (0.4–10 kV) 223,987 km long, and 75,534 transformer stations. A considerable number of the power grid facilities are over 30 years old, including 66% of transmission and 62% of distribution grids, as well as over 50% of the transformer stations. This is one of the factors contributing to the growing losses of electric power during transmission and distribution. The average level of losses of electricity in transmission and distribution grids is 2.72% and 12.47%, respectively (Ministry of Energy, 2020). Over the past 6 years, new generating capacity of more than 5,000 megawatts has been created, and the volume of electricity generation and supply to consumers in the republic has increased. Electricity supply to consumers in 2022 is 36.5% higher than in 2016 (Ministry of Energy of the Republic of Uzbekistan, 2022).

Table 10. Net electricity consumption by activity in the Republic of Uzbekistan, billion kWh, including electricity generation, distribution, and transformation costs (2016–2021)

Years	2016	2017	2018	2019	2020	2021
Total (gross consumption)	57.6	60.2	62.5	64.8	69.0	74.9
By type of activity:						
Industry	21.0	22.3	15.0	17.0	18.3	18.7
Construction	0.4	0.3	0.4	0.4	1.4	1.6
Agriculture	9.5	9.7	18.1	15. 1	9.2	9.6
Transport	1.2	1.2	1.4	2.1	1.01	1.1
Commercial enterprises and government agencies	5.2	4.0	4.9	4.9	5.2	7.5
Population	11.2	12.8	13.6	13.5	15.5	15.5

Source: Ministry of Energy, 2022.

The largest consumption of electricity is in the industrial and residential sectors. As a result of measures taken to expand alternative energy sources, mainly solar energy, there has already been an increase in electricity production from renewable energy sources.

At the same time, energy sector development has a significant impact on the environment and its ecosystems. This is due to the fact that about 90% of the energy is produced by burning fuel, a method that is considered a significant source of pollutants entering into the environment due to insufficiently treated emissions of pollutants from burning fuel, discharge of wastewater into water bodies, as well as large-scale disposal of coal ash and slag waste (and dust transfer from them). Thermal power plant emissions also contribute to the greenhouse effect. In turn, the development of hydropower is associated with an allocation of areas for reservoirs. The construction of these reservoirs disturbs the hydrological regime of rivers and destroys the ecosystems and species composition characteristic of this environment.

4.3.2 Agriculture

Agriculture is a key part of Uzbekistan's economy. In 2022, 3.4 million people were employed in agriculture, forestry, and fisheries, representing 25.1% of the total employment. Sales of agricultural products to foreign markets brought Uzbekistan up to 6% of its total export earnings in 2022. In 2022, according to the Statistics Agency (2022), the volume of agricultural production was UZS 362.5 trillion (USD 33 billion), a 3.6% increase compared to 2021.

Cotton is Uzbekistan's main agricultural crop, accounting for 0.02% of exports (2022, the Statistics Agency). Annual production of cotton is about 1 million tonnes of fibre, representing 4% to 5% of global cotton production. Also, Uzbekistan exports 700-800 thousand tons of cotton to the world market (2022), accounting for 10% of world exports. The Republic of Uzbekistan is the sixth largest producer and the second largest exporter of cotton in the world.

Irrigated agriculture, which withdraws about 90% of the water resources used, is the main water consumer, averaging 46.66 km3 per year from 2013 to 2022. In addition, land resources are permanently exposed to water and wind erosion.

4.4 State and Impacts

Due to the rapid development of energy capacity, industrial production, and municipal sector, the danger of **atmospheric air and atmospheric pollution** increases every year. Air pollution is further exacerbated by ever-increasing emissions from motor vehicles (about 80% of total air emissions in major cities come from mobile sources).

At present, about 70 water reservoirs are operated in Uzbekistan, and the **water is mainly used for irrigation**. The largest water reservoirs in the country are used in an integrated manner and are mainly for irrigation, energy, and industrial purposes. Over a 10-year period, there has been a decrease in the volume of water withdrawal because of lower water availability resulting from climate change. At the same time, in recent years, the system and culture of water use have improved, which allows a rational use of water resources and minimization of discharges from irrigated fields into drainage systems. This helps cope with water shortages even in low-water years. In addition, drought-tolerant and early-maturing varieties of crops are increasingly being used in agricultural production.

Agricultural lands make up the largest **area of land** (about 60%). Agricultural lands, unlike other land categories, serve as the main means for food production, animal feed, and raw materials for various industries. Compared to 2012, accounting for population growth and the need to ensure food security, the area of agricultural lands has increased. During the period under consideration, the area of forest land has also increased, as well as lands used for nature-protection purposes. In Uzbekistan overall, there has been a decrease in irrigated areas due to the lack of water resources and reclamation of deteriorated land.

In the next chapters of the report, we provide a detailed overview of the state of the environment, including air, water, soil, land, biodiversity, and others.

4.5 Response

Uzbekistan is making efforts to account for population growth and the negative impacts of economic development on natural resources. In this section, we provide an overview of measures targeting diverse sectors of the economy, such as agriculture, energy generation, and industry.

In 2019, the Strategy for the Development of Agriculture in the Republic of Uzbekistan for 2020–2030 was approved. It covers strategic priorities in terms of ensuring food security for the population while promoting agribusiness and administration by ensuring rational use of natural resources and environmental protection (Decree of the President of the Republic of Uzbekistan, 23 October 2019, No. UP-5853). The country is implementing systematic measures to ensure the efficient use of water resources, the widespread introduction of (and state support for) water-saving technologies in crop cultivation, as well as improving the reclamation condition of irrigated land (Decree of the President of the Republic of Uzbekistan, 17 June 2019, No. UP-5742). The area covered by water-saving technologies makes up about 25% of irrigated areas.

For the current years, the New Uzbekistan Development Strategy for 2022–2026 (Decree of the President of the Republic of Uzbekistan, 28 January 2022, No. UP-60) outlines priorities (Goal 31) focusing on the implementation of a state program to reform the water management and water-saving system, improving water efficiency and reducing electricity consumption at water management facilities.

The Water Resources Management and Irrigation Sector Development Strategy in the Republic of Uzbekistan for 2021–2023 (Decree of the President of the Republic of Uzbekistan, 24 February 2021, No. PP-5005) and the Measures for the Development of Social and Production Infrastructure of the Republic of Uzbekistan in 2022–2024 (Decree of the President of the Republic of Uzbekistan, 22 January 2022, No. PP-98) pay significant attention to the effectiveness and efficiency of irrigation and land reclamation projects. They also request proposals for equipping irrigation and land reclamation facilities with automated equipment for measuring and monitoring water and power consumption. A roadmap was adopted to consistently implement the tasks and ensure that the main targets defined in the Concept of Development of the Water Sector of the Republic of Uzbekistan for 2020–2030 (Decree of the President of the Republic of Uzbekistan, 10 July 2020, No. UP-6024). Measures for further improving the use of water-saving technologies in agriculture are being implemented (Decree of the President of the Republic of Uzbekistan, 01 March 2022, No. PP-144). This decree establishes priorities to improve water use efficiency by

the use of water-saving technologies, including drip irrigation, sprinkling, and other procedures for state support of the introduction of water-saving technologies.

In recent years, the country encouraged the introduction of resource-saving technologies in the **energy sector** as well. Of note are the Measures for Accelerated Development and Financial Sustainability of the Electricity Sector (Decree of the President of the Republic of Uzbekistan 23 October 2018 No. PP-3981), which provide for the implementation of a Road Map for 2018–2022, and the Presidential decree on Accelerated Measures for Increasing Energy Efficiency in the Economy and Social Sphere, Introduction of Energy Saving Technologies and Development of Renewable Energy Sources (Decree of the President 22 August 2019, No. PP-4422). The decree prioritizes the importance of renewable energy, mainly generated by hydroelectric power plants, which currently account for only 10%–14% of total electricity generation in the country. The huge potential power available from solar and wind is not being fully utilized. It is noteworthy that additional decrees provide incentives and preferences in the field of renewable energy sources, including selected tax exemptions and loans allocated for the installation of solar panels.

The next chapters of the report provide additional examples of responses to address specific environmental challenges focusing on air, water, soil, land, and biodiversity, among others.

5.0 States and Impacts on the Environment and Human Well-Being

5.1 Atmospheric Air

Table 11. Key trends and indicators – atmospheric air

Indicator	Long term (10 years)	Medium term (3 years)	Details
Pollution from stationary sources	Negative	Stable	Stationary sources grew in the first half of the period reviewed (2012–2022), but lately, the situation has stabilized.
Pollution from mobile sources	Negative	Negative	The largest contributors are cars, notably in Tashkent city (88% of all mobile emissions) and Tashkent, Fergana, and Samarkand regions.
Specific pollutants			
Solid substances	Negative	Negative	Emissions from industry (cement) are still high, negatively affecting the environment and human health.
Sulphur dioxide (SO_2)	Negative	Positive	Emissions from industry (energy) are still high, negatively affecting the environment and human health.
CO	Negative	Positive	Reduction has been achieved in recent years.
Nitrogen oxide (NO_x)	Negative	Negative	Increases due to industrial and agricultural production.
Hydrocarbons	Negative	Positive	Significant reduction has been achieved in recent years.

Source: Authors.

- Pollution from stationary sources is largely driven by major sectors: energy, the oil and gas industry, metallurgy, the chemical industry, the construction industry, and public utilities. Pollution from mobile sources is largely driven by the growing number of vehicles. Air pollution from stationary sources grew in the first half of the period reviewed but stabilized in the last few years, while pollution from mobile sources peaked in 2018 and has somewhat declined since then.

- Air pollution is exacerbated due to unfavourable climatic conditions in Uzbekistan (arid and drought-prone climate). Furthermore, air pollution episodes in the capital, Tashkent, occur regularly in summer when thermal inversion episodes trap air pollutants near the ground, leading to poor air quality (IQAir, 2022).
- During the period under review (2012–2021), CO emissions declined from 90.7 to 71.0 thousand tons/year and hydrocarbons from 260.6 to 191.8 thousand tons/year. At the same time, there has been an increase in the emissions of NO_x from 10.3 to 21.2 thousand tons/year. An increase in particulate matter concentrations from 154.9 to 176.7 thousand tons/year has also been observed.
- The results of the stationary observations of the atmospheric air monitoring network in 2018–2022 suggest that the average annual concentrations of the main pollutants in most of the monitored cities remained below their maximum permissible concentrations (MPCs). At the same time, main pollutant concentrations, in some cases, exceeded their MPC (such as increased concentrations of cumulative solid suspended particles and nitrogen dioxide (NO_2) in Tashkent and other large cities or of specific pollutants in industrial cities).

5.1.1 Drivers of Environmental Change

In recent decades, there has been an intensification of industrial production, agriculture, and transportation in Uzbekistan. Significant economic development and increases in production have also led to increases in electricity demand. These activities, coupled with the influence of natural features such as the country's dry, arid climate, as well as sandy loam and loamy soils, are driving changes in the state of atmospheric air.

Atmospheric air emissions include a large number of harmful substances—such as dust and its fine fractions, SO_2, NO and NO_2, CO, commonly referred to as "classical pollutants"—which can be observed in terms of their composition. In addition to these, so-called "specific" pollutants, such as formaldehyde, heavy metals, and benzo(a)pyrene, are emitted by individual industries and transported into the ambient air.

The indicator "pollutant emissions" has two components: emissions from stationary sources and emissions from mobile sources. Emissions of pollutants from stationary sources are characterized as the total amount of pollutants entering the atmospheric air from all organized and unorganized stationary sources. Analysis of official statistical reports for Uzbekistan identifies the main sectors polluting the atmospheric air: energy, oil and gas industry, metallurgy, chemical industry, and the construction industry.

The main pollutant emissions from mobile sources are determined by the volume of fuel and lubricants (motor gasoline and diesel fuel) consumed by personal and commercial vehicles. The main factors influencing these emissions are the quality of the fuel type used, insufficient use of public transport by the population, driving one's own vehicle, and insufficient attention paid by car owners to the technical parameters of their vehicles.

Uzbekistan is located in the arid zone of Central Asia, with an arid climate characterized by long, dry and hot summers, wet springs, and variable winters. The Republic also has unfavourable

climatic conditions for the dispersion of pollutants into the atmosphere (doldrums, inversions). A prolonged period without rainfall, weak winds, and temperature inversions contribute to stagnant atmospheric air and create conditions for the accumulation of pollutants.

A combination of meteorological conditions and anthropogenic pressure leads to high levels of urban air pollution. The location of large cities contributes to the accumulation of pollutants in the surface layer of the atmosphere, with high population densities, significant traffic flows, and environmentally unsafe industries in narrow intermountain depressions against a backdrop of specific natural-climatic conditions (frequent inversions, stagnant phenomena in the atmosphere)

5.1.2 Pressures – Loads and Threats

Emissions of Pollutants Into the Atmospheric Air From Stationary Sources

In 2022, air pollutant emissions from stationary sources amounted to 887,700 tonnes, and their level decreased slightly compared to 2018 (883,700 tonnes) (Table 12). The dynamics of pollutant emissions depend directly on the development of the country's industrial production, and their indicators are not evenly distributed over the territorial units. Some factories still lack sufficiently efficient and appropriate cleaning equipment, and the equipment that is available is obsolete and/or has not been modernized. There is also a lack of proper maintenance of such equipment, e.g., timely cleaning or replacement of filters, etc. To reduce pollution from industrial plants, the existing 1,071 filters at 270 plants need to be modernized and upgraded.

The main volumes of pollutants were formed in the territories of Tashkent region (430,000 tonnes), Kashkadarya (128,1000 thousand tonnes), Syrdarya (71,800 thousand tonnes), Samarkand (52,700 tonnes) regions. This is due to the high concentration of industrial enterprises in these regions. The largest volume of emissions is in Tashkent region, where large facilities of mining and processing industry, thermal power plants, chemical industries, and building materials production are concentrated. As a result, there has been a 1.5-fold increase in emissions over the last decade. The Kashkadarya region is also characterized by large volumes of emissions associated mainly with petrochemical complexes. However, a 1.3-fold decrease in emissions is observed here due to improvements in production technologies for the same period. Further development of industrial production has also influenced the growth of emissions in other regions of the country, such as the Republic of Karakalpakstan, Namangan, Surkhandarya, Khorezm regions, and Tashkent city.

Based on the specifics of enterprises' activities, priority substances in terms of emissions were determined: NO, NO_2, SO_2, carbon monoxide (CO), suspended particles, specific pollutants, i.e., ammonia, phenol, heavy metals, hydrogen sulphide, hydrocarbons, etc. Particular attention is paid to monitoring emissions from cement industry enterprises, which are among the most harmful to the environment and human health. The main pollutant of such enterprises is dust, including fine dust. During the presented observation period of air pollution sources, the main pollutants are dust (inorganic), NO_x, and SO_2. The main sources polluting the atmospheric air with industrial dust, NO_x, and SO_2 are enterprises in the Tashkent, Navoi, and Fergana regions and the Republic of Karakalpakstan.

Air Pollutant Emissions From Mobile Sources

There are currently about 4 million vehicles in the country, of which 100,000 are faulty, leading to higher levels of emissions. These emit an average of 1.3 million tonnes of harmful emissions per year, accounting for 63% of total emissions. The largest contribution to emissions from mobile sources comes from Tashkent city (88% of all emissions from mobile sources) and Tashkent, Fergana, and Samarkand regions, and the least from Syrdarya region. There has been an increase in the number of personal vehicles, resulting in increased vehicle emissions. As a result of the increase in the daily number of vehicles in use, the volume of emissions in 2022 increased by 26.6 thousand tonnes compared to 2021.

Table 12. Air pollutant emission trends in 2012–2022 (thousand tonnes/year)

Years	Pollutants		Contaminating substances	
	From stationary sources	From mobile sources	CO	NO_x
2012	817,6	1,181,141	90,7	10,3
2013	855,2	1,253,739	65,5	12,4
2014	1162,1	1,277,315	71,0	13,8
2015	975,1	1,269,633	79,7	14,3
2016	1008,2	1,355,331	79,5	14,3
2017	853,5	1478,0	79,5	14,8
2018	883,7	1521,2	85,9	15,8
2019	952, 8	1494,3	81,2	14,7
2020	924,4	1330,7	68,2	13,2
2021	908,7	1270,3	71,0	21,2
2022	874,0	1296,9	-	-

Source: Ministry of Ecology, 2023.

5.1.3 State and Impacts

Monitoring Systems

Atmospheric air conditions are monitored in 26 cities of Uzbekistan at 66 fixed stations, one background monitoring station (Chatkal Biosphere Reserve) and two automatic monitoring stations located in Tashkent city. In mid-2023, six new automatic air quality monitoring stations, capable of measuring $PM_{2.5}$ and PM_{10}, were installed. Furthermore, the ZAMIN International Public Foundation and Uzhydromet are currently finalizing the procurement of eight additional stations toward an expected total of 16 automatic stations that will soon be providing automatic

monitoring. The country is also in the process of legislating $PM_{2.5}$ and PM_{10}, which will be a substantial improvement on the maximum allowable concentrations (MAC) indexes currently in use.

Monitoring of sources of pollutant emissions into the atmospheric air is carried out monthly at 309 enterprises in the country, mainly of Hazard Categories I and II. Quantification of atmospheric pollution is expressed in terms of pollutant concentration. The concentration of impurities of toxic substances in the atmosphere is highly variable and depends not only on the direct amount of emissions resulting from human activities but also on urban dust pollution during dry winds and dust storms.

According to the existing assessment methods, the pollution level is considered to be low when the value ranges from 0.0 to 5.0, elevated at IPA values from 5 to 7, high at IPA values from 7 to 14, and very high at IPA values above 13. In most cities in the country, the level of atmospheric air pollution in the period 2018–2022 is characterized as low. The API in the cities of Tashkent region between 2018 and 2021 was lower, although in Almalyk the API in 2019 was 5.91, which corresponds to an elevated pollution level. The API in the cities of the Fergana region fell between 2018 and 2021, with only Fergana having an API of 5.39 in 2019 and 5.14 in 2020, corresponding to an elevated pollution level.

Atmospheric Air Quality in Cities and Settlements

Atmospheric air quality in a city is shaped by a complex interaction of natural and anthropogenic factors. The natural topography of the area and climatic parameters (air temperature, wind speed, solar radiation, precipitation, ground-level and elevated inversions, atmospheric stagnation) are important conditions that create the "climate" of air quality. The main sources of atmospheric air pollution in cities are industrial enterprises, the building industry, and motor transport. In large cities, emissions from transportation are higher than those from industry.

Maximum single, average daily, and average annual MPCs of pollutants are used to assess the quality of atmospheric air. In Uzbekistan, SanPiN RUz №0293-11 Hygienic Norms List of Maximum Permissible Concentrations (MPC) of Pollutants in the Atmospheric Air of Settlements in the Territory of the Republic of Uzbekistan is currently in force (Table 13).

Concentrations of the main pollutants, which are subject to mandatory recording, regulation, monitoring, and control throughout the Republic, are determined in all cities: particulate matter (dust), SO_2, CO, NO_x, and NO_2. Concentrations of specific priority pollutants (including formaldehyde, ammonia, phenol, hydrogen sulphide, etc.) are also determined. In all industrial centres, the concentrations of lead and cadmium, benzo(a)pyrene in the air are determined. Concentrations of fine particulate matter of fractions up to 10 microns and 2.5 microns (hereinafter PM_{10}, $PM_{2.5}$) are measured at automatic stations.

Atmospheric Air Quality for Main Pollutants

Particulate Matter (Dust)

Analysis of data on total particulate matter in the air in 2018–2022 showed that their average annual concentrations in almost all monitored cities of Uzbekistan did not exceed MPC with the exception of Andijan, Bukhara, Gulistan, Namangan, Nukus, and Tashkent.

PM_{10} and $PM_{2.5}$ Fine Particles

In 2021, automatic monitoring of fine particles PM_{10} and $PM_{2.5}$ in Tashkent started with two automatic monitoring stations: eight stations in different regions of Uzbekistan are currently operating. SanPiN 0293-11 is currently in force in Uzbekistan, which adopted standards only for suspended PM10 particles; standards for fine $PM_{2.5}$ particles have not yet been developed.

SO_2

The content of SO_2 in the atmospheric air of the monitored cities of Uzbekistan, except for Almalyk, did not exceed MPC levels.

NO_2

The average annual content of nitrogen dioxide in the atmospheric air of the monitored cities of Uzbekistan during the period 2018–2022 exceeded the average annual MPCs in the cities of Bekabad, Margilan, Navoi, Namangan, Tashkent, and Fergana.

CO

In general, annual average CO concentrations in the monitored cities did not exceed the MAC level during the period under review, except for Almalyk.

Table 13. MPCs for some harmful influences

Contaminant	Value of MPCs, µg/m³		
	Maximum one-time	Average daily	Average annual
Main pollutants			
Particulate matter total	500	350	150
Particulate matter with a diameter of less than 10 microns (PM_{10})	500	300	50
SO_2	500	200	50
NO_2	85	60	40
CO	5,000	4,000	3,000
Specific pollutants			
Ammonia	200	120	40
Formaldehyde	35	12	3,0
Phenol	10	7.0	3.0
Hydrogen fluoride[3]	12	8	2.5

Contaminant	Value of MPCs, µg/m³		
	Maximum one-time	Average daily	Average annual
Lead	1.5	1.0	0.3
Cadmium	1.5	1.0	0.3[4]
Copper	3.0	2.0	1.0[5]
Zinc	-	-	-[6]
Nickel	5.0	3.0	1.0
Benzo(a)pyrene			1 ng/m³

Source: SanPiN 0293-11.

Atmospheric Air Quality for Specific Pollutants

Ammonia

The state of air pollution from ammonia is monitored in 11 industrial cities of Uzbekistan. In 2018–2022, some exceedances of average annual concentrations of ammonia were recorded in Angren, Andijan, and Chirchik due to the specifics of industrial cities, as well as unauthorized storage of household waste.

Formaldehyde

Observations of formaldehyde content in the atmospheric air are carried out in two cities, Andijan and Tashkent. The maximum single concentrations of formaldehyde during 2018–2022 did not exceed the MPC.

Phenol

Phenol content in the atmospheric air is monitored in nine cities of Uzbekistan. During the period from 2018 to 2022, exceedances of MPCs were observed in Fergana city, where large oil refineries are located.

Hydrogen Fluoride

The content of hydrogen fluoride in the atmospheric air is monitored in six cities of Uzbekistan. For the period from 2018 to 2022, exceedances of MPCs were observed in Bekabad and Tashkent cities.

Heavy Metals

Heavy metals are monitored in eight cities of Uzbekistan: Almalyk, Navoi, Tashkent, Bukhara, Kokand, Angren, Fergana, and Samarkand. In the atmospheric air of these cities, average annual concentrations of cadmium, copper, zinc, and lead do not exceed the MPCs.

Benzo(a)pyrene

Observations of benzo(a)pyrene in the atmospheric air resumed in 2022, and data to assess trends will be available in the near future.

5.1.4 Response

Uzbekistan's growing economy and population, as well as increasing urbanization, could potentially impact air quality in the country, and so promoting technologies to reduce atmospheric air pollution from stationary and mobile sources is important. In addition, public access to air quality information has significantly improved since 2022, with the establishment of the Monitoring Meteo website and the AirUz mobile app.

A program of measures approved by the Cabinet of Ministers is being implemented to further improve the efficiency of dust and gas collection at large industrial enterprises in the country. As part of the program, in 2022, 357 dust- and gas-cleaning units were installed at 115 enterprises. As a result, atmospheric emissions were reduced by 5,500 tonnes per year. A system for monitoring the status of construction and operation of air-cleaning equipment and installations has been established in the country. There is a positive trend in this direction during the period under review.

In order to lower vehicle emissions into the environment, reduce the negative impact of transport emissions on human health, and ensure compliance with air protection legislation, the Ministry of Ecology, the Ministry of the Interior, and the Ministry of Health carry out an annual Clean Air Operation. During this event, environmental monitoring of the amount of harmful gases emitted into the atmospheric air by vehicles running on petrol, diesel fuel, compressed natural gas, and liquefied gas is carried out at all road patrol stations in the republic on the main streets. In addition, inspection points are organized at 79 road patrol stations during the month, as well as mobile checkpoints in the central streets of regions and cities, with 500 officers involved.

According to the priority directions of the state policy in the field of environmental protection, defined by the Decree of the President of the Republic of Uzbekistan on Approval of the Concept of Environmental Protection of the Republic of Uzbekistan (No. UP-5863 dated 30.10.2019), a number of measures to improve the state of atmospheric air are provided. In particular, it is prohibited to introduce new facilities for the production of motor fuel of an ecological class below "Euro-4" (from January 1, 2020), placement under the customs regime "temporary import" and "release for free circulation (import)" of motor fuel of ecological class below Euro-3 (from January 1, 2022), motor fuel of ecological class below Euro-4 (from January 1, 2023). It is also prohibited to place under the customs regime "temporary import" and "release for free circulation (import)" for the purpose of operation and sale of wheeled vehicles of categories M and N equipped with gas, petrol, and diesel engines, the level of toxicity of which does not meet the requirements of environmental class Euro-4 (from January 1, 2022).

The Ministry of Ecology has been instructed to ensure that the issuance of environmental certificates for new wheeled vehicles of categories M and N equipped with gas, petrol, and diesel engines imported into the Republic of Uzbekistan is organized on the basis of identification of legislative acts of wheeled vehicle exporting states in terms of compliance with the requirements for the production of wheeled vehicles with the requirements not lower than Euro-4 or documents submitted by the applicants confirming the compliance of these wheeled vehicles with the requirements of the Euro-4 environmental class.

In order to improve the quality of the natural environment, it is necessary to adopt standards for wheeled vehicles and motor fuels of the Euro-6 ecological class by 2030.

Measures are being taken to convert the country's public transport to electric vehicles. For this purpose, in the last 3 years alone, 3,319 electric vehicles have been imported into Uzbekistan, and their number is increasing every year—in 2020, only 130 were imported; in 2021 their number increased by 6.2 times to 809, and in 2022, to 2,180.

Also, according to the Decree of the President of the Republic of Uzbekistan on Measures for Socio-Economic Development of Tashkent City Until 2030 (26.07.2023 No. UP - 112), one of the main directions of development of Tashkent City until 2030 is the transformation of the capital into a megacity with clean air by changing the appearance of parks of culture and recreation, squares, boulevards and a sharp increase in the number of green areas. Accordingly, an additional 4,000 hectares of green zones will be created in Tashkent.

It is planned to increase the area of alleys on the banks of canals from 42 to 150 kilometres, the length of bicycle paths from 65 to 170 kilometres, the level of use of public transport from 30% to 60%, and the share of electric buses in public transport from 17% to 50%. It is also planned to reduce harmful gas emissions from 300,000 to 150,000 tonnes in 7 years.

5.2 Water Resources

Table 14. Key trends and indicators for water

Indicator	Long term (10 years)	Medium term (3 years)	Details
Water consumption (agriculture, industry, and municipal services)	Negative	Negative	Water consumption has been increasing in the industrial production and public utility sectors.
Water losses in agriculture, industry, and public utilities	Negative	Negative (very)	Due to large losses of water in main and inter-farm channels, as well as in the internal networks, the efficiency of irrigation systems remains low. Industrial enterprises are not always interested in reusing process water.
Water pollution	Negative	Negative	According to the Water Pollution Index (WPI), most watercourses are listed as class III (moderately polluted). Local deterioration of water quality is observed in areas where large industrial facilities and communal wastewater treatment installations are concentrated.

Indicator	Long term (10 years)	Medium term (3 years)	Details
Extent of glacier reduction	Negative	Negative	Because of climate change, the area of glaciers in Central Asia has shrunk by 30 %, and further reduction is projected.
Per capita water availability	Stable	Negative	Over the last 15 years, per capita water availability has declined from 3,048 m^3 to 1,400 m^3.
Duration and frequency of droughts	Stable	Negative	Occurrence of severe droughts in 2000, 2008, 2011, 2014, and 2018.
Water-saving technologies	Negative	Positive	Water-saving technologies have been introduced in only 23% of the irrigated areas.

Source: Authors.

- For Uzbekistan, water scarcity is a very urgent problem. The country was ranked 25th out of 164 in the ranking of countries suffering from water stress (World Resources Institute [WRI], n.d.). Over a 10-year period, there has been a decrease in the volume of water withdrawal in almost every region. The main reason is the natural-climatic factor expressed in the increase of low-water years.
- Population growth is expected to increase demand for quality water from 2.3 billion m^3 to 2.7–3.0 billion m^3 (i.e., by 18%–20 %) by 2030. This will lead to a yearly increase in water demand in the public utilities sector (FAO, 2022). In recent years, industry and the energy sector have also developed rapidly, and their demand for water has grown every year.
- Agriculture is the main consumer of water resources, accounting on average for up to 90% of the water used. Insufficient implementation of water-saving technologies leads to lower water volume in water reservoirs. There are current measures made to introduce technologies to reduce water, use renewable energy sources, and promote recycling (as well as promoting a sustainable water supply).
- Water resources (surface and groundwater) are prone to contamination. The main polluters are industrial, agricultural, and municipal enterprises.
- Climate change and extreme weather events have led to increases in the dry heat period, reductions in the number of days with precipitation, lower mountain snow accumulation, degradation of glaciation, increased intensification of evaporation across the plains and foothills, increased frequency of droughts and extreme low-water events, as well as increased frequency of extreme rainfall that lead to floods and increased frequency of mudflow. Floods and mudflow lead to soil destruction on mountain and foothill slopes.

5.2.1 Drivers of Environmental Change

The main drivers of environmental change in terms of water resources include the impacts of agriculture, growing demand for water in utilities and sectors such as energy, and the growing impacts of climate change.

In general, the country has approximately 4.3 million ha of irrigated area covering roughly 14% agricultural land. The irrigation system includes 28,400 kilometres of irrigation infrastructure, with 54,432 various related hydraulic structures, and 70 reservoirs and mudflow reservoirs with a total volume of 19.4 billion m^3. Due to the disproportionate distribution of water resources and the difficult topography of irrigated land, about 60% of irrigated land is supplied with water through 1,687 pumping stations, with an annual electricity consumption of 8 billion kWh.

Another source of water withdrawals is significant demand for water in the utilities, industrial, and energy sectors: the utilities sector accounts for 5.4%, the energy sector for 0.7%, industry for 2.3%, fisheries for 2.1% and other sectors for 1.5% of water resource use. Total water resources amount to 50–60 km^3 per year, of which only 12.2 km^3 are formed on the territory of the Republic, while the rest comes from outside—specifically the Tien Shan and Pamir-Alai mountains, from melting snows and glaciers in summer. According to calculations, the total annual water consumption of these sectors will almost double by 2030, from 1.9 billion m^3 to 3.5 billion m^3.

Climate change significantly affects water availability and the formation of surface and groundwater resources. This is primarily manifested in low-water years, when, as a result of changes in the natural regime of rivers, human-made low-water conditions are formed, and average annual discharges of surface runoff significantly decrease. This increases the reduction of groundwater resources. In addition, as a result of global climate change over the past 50 to 60 years, the area of glaciers in Central Asia has shrunk by about 30%. A rise in temperature is projected to further reduce glacier volume by 50%. By 2050, it is estimated that water resources in the Syr Darya basin will decrease by up to 5% and in the Amu Darya basin by up to 15%. If, before 2015, the total water deficit in Uzbekistan was more than 3 billion m^3, by 2030, it may reach 7 billion m^3, and by 2050, 15 billion m^3.

Uzbekistan has 41 tailings ponds identified under a UNECE project funded by the Swiss Federal Office for the Environment in 2020–2023. Ten of those tailings are located close to the border with Afghanistan, Kyrgyzstan, and Tajikistan or on a shared river, e.g., the Syr Darya or Amu Darya. They could, therefore, cause water pollution with potentially widespread transboundary effects in case of an accident. Uzbekistan is also a downstream country; as such, it can be affected by an accident in another upstream country. In particular, in the Syr Darya River Basin, about half of the mine tailings in the upstream countries (Kyrgyzstan and Tajikistan) have the potential to cause transboundary water pollution affecting Uzbekistan in case of an accident. Regional cooperation is therefore crucial to jointly prevent tailings failures and accidental water pollution in the first place, and secondly, for Uzbekistan to prepare for and enable a prompt response in case an accident with transboundary effects occurs.

Moreover, Uzbekistan is suffering from the effects of more frequent and extreme weather and climate events, which also increase the likelihood of natural hazard-triggered industrial accidents at the region's mine tailings ponds, impacting both water quality and quantity if not addressed.

Industrial accidents triggered by natural hazards (Natech events) also threaten rural and urban communities, including their capacities to access public infrastructure and safely manage water resources in sufficient quality and quantity. For example, the disastrous consequences of such accidents were demonstrated during mass floodings in 2020 caused by the accidental dam damage and outburst of Uzbekistan's Sardoba Water Reservoir. Against this background, there is an urgent need to mitigate the potential danger and risks posed by tailings in Uzbekistan and to foster a multi-hazard approach, including at the basin level, addressing the link between natural, climate-related, and technological hazards to prevent industrial accidents and water pollution and mitigate any potential effects should they occur.

5.2.2 Pressures – Loads and Threats

The level of pressure on water resources in Uzbekistan is assessed as critical (greater than 100%)—169% of water reserves (FAO, 2022). The Basin Irrigation Authorities are confronted each year with the problems of managing water allocation between users caused by the climatic conditions of each year. Dry years are the most difficult to manage due to the lack or low amount of solid precipitation and high temperatures in the autumn–winter period. Water inflow to reservoirs in such years is minimal, and small rivers practically dry up in summer. Water availability drops to 60%–65%.

Due to large losses of water in main and inter-farm channels, as well as in the internal networks, the efficiency of irrigation systems remains low. Water is delivered to remote fields using pumping stations. Most of them are obsolete and use a lot of energy. Water-saving technologies have been introduced in only 23% of the irrigated areas. No large pumping station has been converted to alternative energy sources. Many entrepreneurs are interested in this; however, currently, most of the resources are spent on power pumps (President, Republic of Uzbekistan, 2023a).

In the last 3 years, due to low water levels and shortage of water resources, the pressure on water resources has increased. This problem is acutely felt in the regions downstream of the Amu Darya. Analyses show that climate change will further exacerbate water scarcity in Uzbekistan and could increase the duration and frequency of droughts, as in 2000, 2008, 2011, 2014, and 2018, and cause serious problems in meeting the water needs of the economy. Over the last 15 years, per capita water availability has declined from 3,048 m^3 to 1,400 m^3.

Water pollution is another problem. According to the environmental pollution monitoring data, the main polluters are industrial, agricultural, and municipal enterprises. An increase in salinity during low-water periods and deterioration of surface water quality in levee lenses and irrigated areas cause groundwater pollution. Taking into account that groundwater with salinity of over 3.0 g/l is spread on more than 50% of the territory of the republic, the degree of load on aquifers can be assessed as elevated. Within the Syr Darya river valley, aquifers are under medium stress. Chemicalization of agricultural production and the presence of wastewater discharge in collectors contribute to the pollution of water resources. In addition, due to the unsatisfactory condition of the surface water drainage network and drainage systems, some territories of the republic experience intensive rises in groundwater levels, and some cities and other settlements are flooded.

5.2.3 State and Impacts

Hydrological Conditions in Uzbekistan

Uzbekistan's water resources are part of the water resources of the Aral Sea Basin. The basin is divided into two unequal parts with different hydrological functions: a mountainous area and a plain area. The mountain area is a runoff formation zone with an extensive river network and covers about 25% of the total basin area, with the Amu Darya and Syr Darya river basins accounting for 80% of this area. The plains, with their low precipitation and high evaporation capacity (many times higher than the amount of precipitation), essentially do not participate in runoff formation. Moreover, the plains consume the runoff from the mountainous area for evaporation and filtration, a process that is intensified by human activities. Water taken from rivers and reservoirs is delivered by canals to fields, where it undergoes transpiration and evaporation and only partially flows back into the rivers. The Aral Sea is the final link in the natural hydrological cycle, moving water from the mountains to the plains.

Table 15. Overview and distribution of water resources of the Amu Darya and Syr Darya rivers

Countries	Total (in km³)	Including (in km³)	
		Syr Darya	Amu Darya
Uzbekistan	56.19	17.28	38.91
Kyrgyzstan	4.41	4.03	0.38
Kazakhstan	12.29	12.29	-
Tajikistan	12.34	2.46	9.88
Turkmenistan	21.73	-	21.73
Afghanistan	7.44	-	7.44
Total	**114.4**	**36.06**	**78.34**

Source: Scientific-Information Center of the Interstate Commission for Water Coordination of Central Asia, 2022.

Available water resources in Uzbekistan consist of renewable surface and groundwater as well as return water from anthropogenic use (sewage and drainage water). The total estimated available (including transboundary water allocation) for use in Uzbekistan is:

- from surface water – 56 km³
- from groundwater – 7.8 km³
- reuse of return water – 4.1 km³
- total – 68.0 km³

Water abstraction and use varies from year to year depending on water availability of the year. With Uzbekistan's available share in transboundary water allocation (Amu Darya, Syr Darya = 56.19

km³), on average, about 51.8 km³ /year were withdrawn from all water bodies. The above data indicates a deficit of about 24% of water resources. The regions with the greatest deficit include the Republic of Karakalpakstan, Bukhara, Kashkadarya, Jizzakh, and Navoi regions (lower reaches of rivers). The main burden is on agricultural production. At the same time, in recent years, the system and culture of water use have improved, which allows the rational use of water resources and minimization of discharges from irrigated fields into drainage systems, allowing to cope with water shortages even in low-water years. In addition, drought-tolerant and early varieties of crops are increasingly being used in agricultural production; for example, cotton that does not need to be irrigated 5–6 times, with the same yield obtained with only 2–3 irrigation periods.

Table 16. Water abstraction from sources in the main river basins (million m³)

Year	Communal facilities	Fishery	Industry	Energy (irretrievable use)	Irrigation	Others	Total
2013	2,357	621	675	250	48,912	582	53,977
2014	2,283	614	691	256	46,913	582	51,849
2015	2,355	855	667	252	50,039	593	55,208
2016	2,436	628	707	254	49,499	579	54,625
2017	2,408	718	710	272	53,769	584	58,943
2018	2,451	509	830	423	45,696	357	51,003
2019	2,337	650	790	315	48,563	586	53,976
2020	2,262	747	750	294	45,930	496	51,217
2021	2,160	747	745	325	38,452	495	43,662
2022	2,278	806	854	344	38,839	639	44,488
Average	**2,327**	**689**	**741**	**298**	**46,661**	**549**	**51,894**

Source: Ministry of Water Resources, 2023.

In terms of **surface water resources**, there are more than 17,000 natural watercourses in the country: 9,900 in the Amu Darya basin, 4,900 in the Syr Darya basin, and 2,900 in the interfluves of these rivers. However, the bulk of them are small *sai*, i.e., watercourses less than 10 km long, especially in the interfluves of the Amu Darya and Syr Darya, where they are mainly represented by rivers that dry up almost all year round and where even watercourses longer than 10 km do not flow every year. Over 500 lakes are located in mountain river valleys, with the largest being the Aydar-Arnasay lake system.

There are currently about 70 water reservoirs in operation in the republic, mainly for irrigation purposes, the largest reservoirs being Tuyamuyun, Charvak, Tudakul, and Kattakurgan. The largest water reservoirs in Uzbekistan are used in an integrated manner, mainly for irrigation, energy, and industrial purposes.

Uzbekistan's water resources are mainly formed by snow melt (60% in both the Syr Darya and Amu Darya river basins). Additional feeding of water resources by rainfall and glaciers differs by river basins: in the Syr Darya river basin, glacial feeding is 15% and rainfall 25%; in the Amu Darya river basin, glacial feeding is 25% and rainfall is 15%. The main factors influencing changes in river flows are increasing precipitation variability, rising air temperatures, degradation of glaciation, reduced snow accumulation, and increased evaporation in river basins. Changes in the surface flow regime have a significant impact on groundwater resources.

Watercourses formed within the territory of Uzbekistan are mountain-fed (i.e. in ecologically clean zones) and initially create a gradient of favourable environmental conditions. In the mountain zone, there are no obvious sources of pollution of watercourses, and all changes in indicators of water composition and structure of periphyton are natural, conditioned by the peculiarities of orography and general landscape situation along the profile. The water quality of rivers located in the runoff formation zone is made up of pollution from the bedrock and runoff from human activities.

The WPI is used for the integral assessment of water quality in Uzbekistan, calculated as the arithmetic mean of the values in fractions of the model predictive control of six hydrochemical indicators: dissolved oxygen content, biological oxygen demand, and four pollutants having the highest concentrations with respect to the norm. The surface water quality classifier used in the country based on WPI values includes seven quality classes (Table 17).

Table 17. Surface water pollution criteria by WPI

Water quality class	Text description	Value of the WPI
I	Very clean	less than or equal to 0.3
II	Clean	over 0.3 to 1.0
III	Moderately polluted	over 1.0 to 2.5
IV	Contaminated	over 2.5 to 4.0
V	Dirty	over 4.0 to 6.0
VI	Very dirty	over 6.0 to 10.0
VII	Extremely dirty	over 10.0

Source: WHO, 2011.

The pollution comes from both domestic and transboundary sources. For example, the chemical composition of water in the Amu Darya and Syr Darya rivers is influenced by pollution from agricultural, industrial, and municipal facilities of both Uzbekistan and Kyrgyzstan. The results of surface water monitoring and analysis of available information indicate that the majority of watercourses in the republic, according to the accepted WPI classification, belong to Class III, moderately polluted waters. Local deterioration of water quality in watercourses is observed in the areas where large industrial and municipal (wastewater treatment) facilities are concentrated. In the runoff formation zone, water quality, according to the WPI, generally corresponds to Class

II, or "clean" water. Water quality has stabilized along the main watercourses in the Republic of Uzbekistan over the last 3 years.

Groundwater is the main source of domestic and drinking water supply, industrial water supply, and rangeland watering, and in recent years, has also been partially used for land irrigation.

Natural **groundwater resources** refer to sources that provide groundwater supply under natural conditions (infiltration from precipitation, filtration from surface water bodies and watercourses, and water overflow from upstream and downstream aquifers). Natural resources of ground waters comprise 75,580,560 m^3/day, forecast operational resources – 63,986,530 m^3/day. The total amount of groundwater resources in the territory of the Republic is 17,212.2 thousand m^3/day, i.e. 22.8% of natural. A total of 97 groundwater deposits have been explored in the country, with available resources of 63.9 million m^3/day. There are 525 mountain glaciers in the upper reaches of a number of rivers in Uzbekistan (Surkhandarya, Kashkadarya, and Pskem), with a total glaciation area of 54.2 km^2.

Groundwater supplies meet the needs of the population of 69 cities, 335 villages, and 2,902 rural settlements. About 50,839 wells are currently in operation. Of these, 43% are used for domestic purposes, 35% for crop irrigation, 10% for industrial-technical purposes, and 2.8% for pasture watering. Large reserves of fresh groundwater (salinity up to 1 g/l) are concentrated in Tashkent (28.5%), Samarkand (13.7%), Surkhandarya (13.1%), Namangan (12.8%), and Andijan (12.3%) regions. Bukhara and Navoi regions are not provided with fresh groundwater (less than 0.3%); in the Republic of Karakalpakstan and Khorezm region, fresh groundwater reserves are depleted. In order to preserve the condition of groundwater, continuous monitoring is carried out, including in areas of deposits that have been given protected status.

5.2.4 Response

Regulation of the use and protection of water resources is carried out by setting standards for water use and wastewater disposal (permits for special water use, water use limits, standards for maximum permissible discharge of pollutants into the natural environment, and municipal sewerage systems); monitoring of the background condition of water bodies and sources of wastewater discharges into water bodies; establishing restrictions on the use of land in coastal and water protection zones of watercourses and groundwater deposits; the application of administrative measures for breaches of the law; application of economic mechanisms—charging fees for pollution of water resources, tax credits and other benefits, recovery of monetary compensation for damage caused by damage or destruction of natural objects; and application of economic sanctions against water users for excessive water consumption.

The main legal documents regulating the protection of water resources are the following laws: On Nature Protection (1992), On Water and Water Use (1993), On Ecological Expertise (2000), and On Protected Natural Territories (2004), with relevant amendments and additions introduced over time. In addition, over the past 10 years, the country has adopted several legal and regulatory instruments to ensure the protection of water resources and facilities, including the Law of the Republic of Uzbekistan on Environmental Control No. ZRU-363 of 27.12.2013 and a number of presidential decrees and procedures. This notably includes the Decree of the President of the Republic of Uzbekistan on Approval of the Concept of Environmental Protection of the Republic of

Uzbekistan until 2030, 30 October 2019, No. UP-5863, which provides for the protection against depletion and pollution of water resources in agriculture and utilities, as well as the Decree of the President of the Republic of Uzbekistan on Approval of the Water Resources Management and Irrigation Sector Development Strategy in the Republic of Uzbekistan for 2021–2023, 24 February 2021, No. PP-5005, which specifies measures to streamline and improve land irrigation practices, water and energy conservation, public–private partnerships in water resource management, and partial reimbursement by water users. Additionally, there are efforts to improve water resources management and regulate relations between water users at the grassroots level (Decree of the President of the Republic of Uzbekistan, 01 March 2022, No. PP-145).

The country is implementing systematic measures to ensure the efficient use of water resources in the **agricultural sector**, the widespread introduction of water-saving technologies in crop cultivation and their state support, as well as improving the reclamation condition of irrigated land. A key objective is to establish a separate centre for the formation of new water-saving projects under Agrobank and to attract qualified specialists from abroad. A transparent water accounting system is being introduced, and in the next 3 years, some 13,000 water facilities will be digitalized (Decree of the President of the Republic of Uzbekistan, 1 April 2023, No. PP-107). In recent years, drip and sprinkler irrigation technologies have been introduced on 400,000 hectares, with a total implementation rate of 23% of the irrigated area. About 25% of irrigated areas are covered by water-saving technologies; because of this, 3 billion m^3 of water was saved in 2022. In order to further stimulate the introduction of these technologies, urgent measures to stimulate the use of water-saving systems with bank loans available for farmers were taken (Decree of the President of the Republic of Uzbekistan, 01 April 2023, No. PP-107).

In this regard, FAO supports the country in water management, focusing on a more efficient, equitable, and environmentally friendly use of water in agriculture. FAO's Technical Cooperation Programmes in Uzbekistan, such as Supporting Water Policy in the Central Asian Agri-Food Sector with Emphasis on Climate Change Impact, aim to strengthen water policies in the agri-food sector in beneficiary countries, especially the role of women in water management, and facilitate regional dialogue and the exchange of experience and expertise in water governance through an established regional network.

Protecting water resources from pollution and **improving the quality of surface and groundwater** are two of the main objectives of the state water sector policy. Hydrochemical observations of surface water conditions are carried out by the Uzhydromet Agency on 59 water bodies in 86 sites and 108 stations for 43 ingredients. Every year, more than 1,000 water samples are taken and analyzed at observation points, and chemical analyses are carried out to determine the components. The highest levels of mineralization and pollution are found in the middle and lower reaches of the main rivers, posing a serious threat to public health and habitat conservation.

Surface water sampling at observation points is performed monthly or during the main hydrological phases, depending on their category. For instance, in Category III (moderately polluted) monitoring points (usually located in the lowland zone of intensive surface runoff), samples are taken monthly. At Category IV (clean or slightly polluted waters) monitoring points (mostly located in the mountainous-piedmont zone of runoff) formation samples are normally taken during the main hydrological phases. In Category II (dirty and very dirty) water sites in the zone of intensive surface runoff consumption, samples are taken every 10 days. Detected concentrations

(content) of natural components and pollutants in the surface water are compared with the water quality standards, i.e., MAC. To assess the overall level of water pollution in alignments and control points, a standard water quality index (the WPI) is calculated based on the results of hydrochemical analysis.

5.3 Land and Soil

Table 18. Trends in key indicators — land and soil

Indicator	Long term (10 years)	Medium term (3 years)	Details
Land in agricultural production	Stable	Stable	Between 2018 and 2022, agricultural land area increased by 30%.
Land reclamation	Positive	Stable	Indicator was 17,243 (2012), 2,057.3 (2018) and 1,331.1 (2022) in thousands of ha.
Soil salinity	Stable	Negative	The indicator worsened 51.4% (2012) to 55.8% (2022).
Mudflow occurrence	Zero (very low)	Negative	By 2030–2050, the number of mudflows is expected to increase by 19%–24% compared to the present.
Water-saving irrigation technologies	Negative	Positive	Water-saving irrigation technologies cover 23% of the used irrigation infrastructure.
Duration and frequency of droughts	Stable	Negative	Occurrence of severe droughts in 2000, 2008, 2011, 2014, and 2018.
Water-saving technologies	Negative	Positive	Water-saving technologies have been introduced in only 23% of the irrigated areas.

Source: Authors.

- It should be noted that population growth, urbanization and growth of industrial production, as well as the involvement in the turnover of previously undeveloped lands (reserve lands), have affected the changes in the areas by land categories. Thus, compared to 2012, the area of agricultural land increased by 5,758.8 thousand hectares, while sown areas decreased by 48.6 thousand hectares. At the same time, during the period under review, the areas of lands intended for nature protection, health improvement, and recreation increased significantly, by 3,146.8 thousand hectares, and lands of the forest fund, by 2102.2 thousand hectares. Both negative and positive trends in soil management have been observed in Uzbekistan. Negative trends include the emergence of desertification processes caused by both natural-climatic factors and anthropogenic activities. Natural

factors include Uzbekistan's main climatic conditions, such as high temperatures, reduced precipitation, and the salinization of the soil.

- A high degree of anthropogenic desertification is associated with increasing economic and demographic pressure on land resources. These anthropogenic factors include salinization, waterlogging, overgrazing, irrigation erosion, cutting of trees and shrub vegetation, as well as soil contamination from industrial and agricultural activities.
- Positive trends include the adoption of responses to increasing green space, a reduction in the area used to grow cotton, an increase in the area dedicated to grain crops, vegetables, fruit and fodder crops, and increased state support for the introduction of water-saving irrigation technologies.

5.3.1 Drivers of Environmental Change

Desertification is caused by natural and climatic factors as well as anthropogenic pressure. Uzbekistan's arid climate is the reason for poor soil-forming processes. Much of the country has arid soil with poor texture, high salinity, and low humus content, and a large area of the country (70%) has desert sandy soils. Uzbekistan ranks 13th in the world in terms of drought risk (WRI, n.d.) and has an arid and sharply continental climate over almost its entire area, with a significant range between summer and winter air temperatures. Low rainfall in the country's plains facilitates desertification.

The vast expanses of natural sandy deserts with wind erosion and the transport of large masses of muddy and sandy sediments lead to the spread of desert areas and the development of dust storms, particularly in the Aral Sea region and the southern regions of the country. Other natural and climate factors that facilitate desertification include water and wind erosion in unforested areas; development of ravines and destruction of slopes by mudflows; destruction of vegetation cover in different areas due to avalanches and fires; and mineralization of surface and groundwater waters due to the scarce vegetation of desert zones; strong vulnerability of ephemeral plants in spring depending on climatic factors and anthropogenic impact; and poor afforestation of foothills and mountainous areas.

Uzbekistan has the highest population density in the Central Asian region—as of January 1, 2023, the country's population density was 80.2 persons per km^2. Population growth, which is a positive factor in the country's development, creates pressure on land conversion for development and for agriculture. Agriculture contributes to desertification because of Uzbekistan's outdated irrigation system, along with overgrazing. In addition, agricultural land has a high proportion of soil-depleting crops in the cropping pattern, leading to land degradation. The increasing areas with legumes and fodder crops (including alfalfa) are contributing to soil fertility, but this is still underdeveloped. Other anthropogenic factors with varying degrees of impact on desertification and soil erosion include illegal tree cutting, inadequate planning and use of land for housing, intensive development of the road network and communications, and expansion of the area and scale of mining and the oil and gas industry.

5.3.2 Pressures – Loads and Threats

Uzbekistan's dry and continental climate means that agriculture (which covers almost 60% of the land area, Table 19) is completely dependent on irrigation. This high dependence of agriculture

on irrigation, together with the country's natural predisposition to desertification, creates the preconditions for land degradation. In irrigated agriculture, there are significant water losses due to the low efficiency of irrigation techniques and irrigation systems, poor planning of irrigated plots, and cases of over-watering. The share of areas where modern water-saving irrigation technologies (drip irrigation, sprinkler irrigation, and solar and discrete irrigation) have been introduced remains low, at only 23%. Irrigation systems with a lower technical level are often 5 to 60 years old; 77% of canals require repair, rehabilitation, or reconstruction, and network losses are significant. As a result, the annual volume of water consumption per complex hectare of area is 10,690 m^3 and remains high in relation to developed countries (Decree of the President of the Republic of Uzbekistan, 10 July 2020, No. UP-6024).

Overgrazing on the pastures of arid zones is the main cause of their desertification. The sparse vegetation cover and low productivity of desert vegetation mean that grazing easily results in deterioration. The low level of watering of pastures and a very sparse network of wells in deserts sharply aggravates this process. Within a radius of 2 to 3 km from the wells, the native vegetation of deserts undergoes severe changes as a result of overgrazing. In recent years, 70% of pastures have been degraded due to unbalanced pasture use in distant pastures, erosion, overgrazing, and other anthropogenic influences. As a result, storm water runoff, mudflow recurrence, and landslide events are increasing. By 2030–2050, the number of mudflows is expected to increase by 19%–24% compared to the present situation.

5.3.3 State and Impact

The territory of Uzbekistan is divided into two large areas: the plains and the foothills and mountains. The plains include the Ustyurt plateau, the lower reaches of the Amu Darya, and Kyzylkum. The foothills–mountainous areas include Surkhandarya, Kashkadarya, Zeravshan valley, Mirzachul, Chirchik– Akhangaran and Fergana valley. A total of 70% (31.4 million ha) of the country is arid and semi-arid (arid) and prone to natural salinization, the spread of shifting sands, dust storms, and dry winds. Various natural factors have resulted in the following types of soils emerging in Uzbekistan: floodplain alluvial, meadow-sierozem, desert sandy, desert takyr, solonchak, grey-brown desert, irrigated (cultivated) sierozem, light sierozem, ordinary (typical) sierozem, mountain-brown, and high mountain meadows.

As of 2023, the total land area in the Republic of Uzbekistan is 44,892.4 thousand hectares. Of this area, the largest area of land, 26,232.3 thousand hectares (58.44%), is classified as agricultural, including cultivated areas, hayfields, pastures, gardens, vineyards, household plots, etc. At the same time, hayfields and pastures occupy 21,215.4 thousand hectares, which is about 81% of the area of agricultural land, or slightly less than half of the total area of the country (47%). The structure of the land fund by category is shown in Table A7 in the Appendix.

Table 19. Structure of land fund by categories as of January 1, 2023 (thousand ha)

No.	Categories of land	Total area	
		Total, thousand hectares	%
1.	Agricultural land	26,232.3	58.44
2.	Settlement land	225.8	0.50
3.	Land for industrial, transport, defence and other special purposes	767.7	1.71
4.	Land for nature protection, recreation, and health improvement	3,222.7	7.18
5.	Land of historical and cultural heritage	14.8	0.03
6.	Forest fund land	11, 738.1	26.15
7.	Water fund land	827.2	1.84
8.	Reserve lands	1,863.8	4.15
	Total land:	**44,892.4**	**100.0**

Source: Inventory of the Land Resources of the Republic of Uzbekistan, 2023.

Soil samples for agricultural toxins are taken twice a year (at the beginning and at the end of the growing season) in 261 locations. More than 520 samples are analyzed for insecticides, herbicides, and defoliants. In addition, soil acidity (pH) and humus content are determined. **The main pollutants of the surveyed soils are detected around the cities** and include ammonia nitrogen, copper, zinc, petroleum products, and other substances (Figures A1–A2 in Appendix). According to the analysis of soil samples collected from agricultural lands in the territory of Uzhydromet activity during the period from 2015 to 2019, the average level of contamination with residual amounts of DDT was 0.57–1.28 MPC, with the highest levels in the Ferghana region: 3.97 MPC (2015), 3.17 MPC (2016), and 2.3 MPC (2018); Syrdarya region, 2.9 MPC (2017); and Andijan region, 1.55 MPC (2019). **A survey of soils for industrial toxins** shows that the priority pollutants in different regions include mobile and acid-soluble forms of copper, oil products, and other substances. The average amounts of nitrate nitrogen, mobile forms of copper, lead, zinc, arsenic, and mercury for the soils around the cities surveyed for the period 2015–2022 did not exceed the MPCs.

A number of territories are "primary saline" due to specific soil and climatic conditions, as well as insufficient natural drainage and high levels of groundwater salinity. A total of 68% of the area has a humus content of up to 1%. In addition, 707,000 ha of pastures (12%) are subject to degradation. In subsequent years, due to observed water deficits, poor land reclamation practices, and failure to take other timely organizational measures, the level of water supply to 560,000 ha of irrigated land area remains low. A significant portion of land resources affected by human economic activity is exposed to the processes of desertification.

Land degradation leads to the loss of natural fertility, which takes a long time to restore. Some forms of land degradation are reversible by natural processes when grazing is reduced. Desert soil vegetation recovers when lands are left fallow for 15 to 20 years. Substantial reduction or complete removal of grazing leads to restoration of grasses on pastures. Some types of deep degradation are irreversible, for example, topsoil destroyed by industrial and domestic waste. In the case of barchan (mobile) sands, technological solutions are possible for incomplete restoration of natural sites, but they are expensive.

5.3.4 Response

Agricultural lands, unlike other land categories, serve as the main means for food production, animal fodder, and raw materials for various industries. This is the main reason why agricultural land is significant. Using grants from international financial institutions, Uzbekistan plans to build wells and introduce drip irrigation based on alternative energy sources on 500 ha of pastures (President of the Republic of Uzbekistan, 2023).

In addition, the Regional Project on Integrated Natural Resource Management in Drought-prone and Saline Agricultural Production Landscapes in Central Asia and Türkiye (CACILM-2) is being implemented. The project beneficiaries have received more than 500,000 fruit tree and grape seedlings, 108 small greenhouses, over 100 units of small agricultural machinery and equipment, and over 100 tons of seeds of drought- and salt-tolerant crops. In addition, 12 modern automatic agrometeorological stations were handed over to Uzhydromet and installed in the agricultural areas of Jizzakh and Kashkadarya regions.

Soil contamination is monitored on a multi-annual basis. The findings of the environmental monitoring of soils and an assessment of the degree of land contamination by pesticides and industrial toxicants are provided to the ministries and departments concerned for the adoption and implementation of appropriate measures to prevent soil contamination by toxic substances.

Finally, the Concept on Efficient Land and Water Resources Use in Agriculture and the Road Map for its implementation (Decree of the President of the Republic of Uzbekistan, 17 June 2019 No. UP-5742) was adopted. The focus of this document is to attract potential investors and reclaim deteriorated lands, introduce water-saving technologies, and rebuild irrigation networks.

5.4 Land Use and Biodiversity

Table 20. Trends in key indicators — land use and biodiversity

Indicator	Long term (10 years)	Medium term (3 years)	Details
Number and area of protected areas	Stable	Improved	There were 11 protected natural areas created between 2019 and 2022. Protected natural areas amount to 6,321 ha, or 14.08% of the country's total area.

Indicator	Long term (10 years)	Medium term (3 years)	Details
Forest land	Stable	Positive	Significant increase in forested areas
Land designated for nature protection, recreation, and health improvement	Stable	Positive	The area under this allocation increased almost 10 times between 2017 and 2022.
Degree of natural habitat degradation	Negative	Negative	The area of natural habitats has declined over the past 20 years as a result of economic activities.
Status of endangered species	Stable	Positive	The Red Book of the Republic of Uzbekistan (2019) includes 206 species of animals and 314 species of plants. Protected natural areas cover the habitats of 102 animal species (83%) and 280 plant species (89%) that are currently in the Red Book of the Republic of Uzbekistan.

Source: Authors.

- An analysis of the current state of protected areas in Uzbekistan and current trends in this area shows that the number and area of protected areas in the country have increased in recent years.
- Reforms in the forestry sector are underway. These have resulted in a marked increase in the amount of forest reserve land in the country, which now stands at 26.1%, whereas in 1990–2000, the state forest fund land did not exceed 5.3%.
- At the same time, floral diversity continues to decline, mainly as a result of the reduction and transformation of natural habitats and the overexploitation of biodiversity and natural resources.
- The negative impact on floral and faunal diversity of anthropogenic factors, such as agricultural land development and redistribution of surface runoff, distant pastoralism, energy and mining development and, in mountainous areas, infrastructure and growth in human settlement, remains constant or is increasing.
- Climate change is intensifying land degradation and desertification and thus affecting the state of biodiversity.

5.4.1 Drivers of Environmental Change

The drivers of ecological change in the state of biodiversity are mainly related to agricultural and economic development, with limited focus on the sustainable use of biological resources. The country's rapidly growing population and economy are leading to intensive use of all resources. These processes lead to increasing demand for natural resources, land conversion, and pollution that directly impact ecosystems and biodiversity. In addition, illegal hunting and poaching

(combined with ineffective management of natural resources and biodiversity protection) further exaggerate the negative impacts on habitat and biodiversity.

Degradation and loss of natural habitats due to agricultural development, including livestock farming. As a result of agricultural development, vast areas have been modified to such an extent that their biodiversity has been dramatically degraded, and individual species have disappeared or are on the verge of extinction. Some of the natural habitats have been used in agriculture, while others have been fragmented by roads, communications infrastructure, and other construction. In addition, livestock herding puts the largest pressure on productive landscapes in desert ecosystems and foothills. Degradation affects rare and globally threatened species of mammals and rare and endemic plant species. The pressure is further increased by the abandonment of the traditional practice of moving livestock between summer and winter pastures, as it is convenient to graze livestock close to the settlements throughout the year.

There has also been a reduction in forest habitat due to the additional pressures caused by industrial and recreational activities. The loss of forests is mostly due to conversion to agricultural land but also because of the use of wood by local people for construction or as fuel. Additional impacts include forest fires and changes in the hydrological regime of rivers, negatively impacting forest habitat and biodiversity. Disturbance also results from the construction of industrial facilities and associated infrastructure and the extraction of minerals. Finally, the degree of anthropogenic disturbance can reach 90%–100% near populated areas and drop below 20% elsewhere. To regulate tourist flows in recreational areas, a strategy for the management and development of ecotourism in different areas of the country is needed.

Illegal harvesting (poaching) and trade in rare and endangered species, as well as inefficient hunting management, are creating additional pressure on biodiversity in the country. There has been a decline in the number of some game species, primarily due to land-use change and increased illegal hunting. Rare and globally threatened species of animals (turtles, ungulates, marmots, and gazelles) have been added to the list of illegally hunted animals. Traditional illegal capture of birds of prey and songbirds occurs in the mountainous regions of Uzbekistan. In terms of flora, there is a threat in the form of the unauthorized harvesting of fruits and collection of medicinal plants (as well as flowers, seeds, and bulbs) for sale. Commercial hunting is currently not practised in the country due to a significant decline in the number of key commercial species. For wild ungulates, there is competition with domestic livestock for food resources and habitat, and for all species for grazing, in the context of a general degradation of natural ecosystems, including reduction and fragmentation of habitats.

Ineffective resource management has a negative impact on biodiversity. Sustainable exploitation of biological resources is one of the main ways of maintaining the biological richness, high productivity, and viability of species populations. There is a need for research to clarify the status of the resource species, their economic assessment, and the impacts of alien species and climate change. Climate change intensifies land degradation and desertification and thereby affects the condition of ecosystems and habitats. These processes are particularly intense in the Aral Sea region, on the Ustyurt plateau, in the Kyzylkum desert, in the mountain forests, and in the foothills of the country. Finally, there is a lack of awareness among the public and decision-makers of the importance of biodiversity, a lack of up-to-date scientific information on the status of biodiversity, and insufficient integration of biodiversity conservation and sustainable use into national policies, strategies, and programs.

5.4.2 Pressures – Loads and Threats

The main effects of the different drivers (e.g., pollution, land-cover change, and loss of habitat, climate change, and unsustainable use of natural resources) create direct pressures on habitat, ecosystems, and the biological characteristics of species. Such pressures lead to a reduction of specific species and disruption of their reproduction and/or overall life cycles, including migration cycles; disruption of the sex and age structure of the population; disruption of the genetic structure of populations; loss of genetic diversity; and disruption of the population structure of the species. These disturbances vary depending on the combination of influencing drivers and pressures and specific environmental conditions. Ultimately, however, they all lead to the decline and extinction of individual populations and the specific species as a whole.

For example, population growth has resulted in the expansion of human settlements, which has increased pressure on natural ecosystems in terms of the services they provide. Unregulated grazing and the cutting of trees and shrubs for fuel have led to a loss of forests, causing tangible damage to the forest fund. Destruction of forests has inevitably led to the disappearance of wildlife habitats. While forest cover has been increasing in the last couple of years, the quality of reforested areas, in terms of biodiversity, is below natural mature forest and will require many years to reach a certain richness of species and quality of the habitat.

5.4.3 State and Impacts

The territory of Uzbekistan is characterized by a great diversity of natural ecosystems: deserts and semi-deserts cover almost 85% of the country, and mountains and foothills occupy about 13% of the territory in its eastern and south-eastern parts. Alluvial valleys cover about 2% of the area (UNDP, GEF, SCEEP, 2018). Each ecosystem contains myriad natural components that determine the development and functioning of the plant and animal communities. The ecosystems are increasingly fragile, especially in the western part of the country, where the Aral Sea ecological crisis zone is located. It is important to stress that six terrestrial ecoregions on the World Wildlife Fund (WWF) Global 200 List (WWF, n.d.) are at least partially located in Uzbekistan, and the country is home to 27,000 plant and animal species.

The flora of Uzbekistan represents about 11,000 species of plants, fungi, and algae: more than 4,300 species of vascular plants, of which 8% are endemic to the country (relict endemics account for 10% to 12%). Of particular interest is the presence of wild relatives of cultivated plants of great importance to creating new (and improving existing) economically valuable plant varieties, such as walnut, common and Bukhara almond, persimmon, and other species. Uzbekistan is also rich in species composition of vegetable crops and is home to onions, carrots, radishes, and other vegetables. The spicy and aromatic plants used by the local population are highly valued in the republic.

Five classes represent the vertebrate fauna of Uzbekistan and include 715 species: 77 species of fish, 3 species of amphibians, 61 species of reptiles, 467 species of birds and 107 species of mammals. Endemics of Uzbekistan and Central Asia are represented by 53 species and subspecies of terrestrial vertebrates. The endemism rate for reptiles is 50%, the mammal class is less endemic, at 14%, and a small number of endemics are noted in the bird class (1.7%).

The level of endemism in fish is over 50%. Some animal species stay in Uzbekistan only seasonally, i.e., during migration. Migratory species include mammals (saiga, Bukhara deer, kulan, snow leopard, etc.), birds (cranes, waterfowl, and others) and fish.

Figure 2. Red List Animal species in Uzbekistan (selected)

Photo (clockwise from top-left): Anna Barashkova, Mariya Gritsina, Natalya Marmazinskaya, Mariya Gritsina.

Source: Red Data Book of Uzbekistan, 2019.

Uzbekistan is a low-forest-cover country. As of 2023, the lands of the state forest fund occupy 11.74 million ha, which is 26.1% of the total area of the country, of which about 3.46 million ha are covered by forests (forest cover of 7.7%). The forests of Uzbekistan differ significantly in their natural composition, productivity, and functions. The largest fragmented areas of tugai ecosystems, occupying about 30,000 ha, are located in the Republic of Karakalpakstan and make up about 10% of the original area of tugai forests in the Amu Darya delta. The same areas account for 75% of all remaining tugai forests in Uzbekistan and 20% of the tugai forests of all Central Asia. Forest resources are a natural long-term carbon sink.

The Red Book of the Republic of Uzbekistan (2019) includes 314 plant species. The number of endangered species with the status 0 decreased from 19 to 10. Another 15 rare and endemic species were included in the Red Book.

5.4.4 Response

The National Biodiversity Strategy and Action Plan (NBSAP) 2019–2028 is being implemented. The goal is to achieve a sustainable balance between economic development in the country and the continued functioning of ecosystems. The conceptual framework for the updated NBSAP was the National Strategic Objectives and Targets, developed taking into account national biodiversity conservation needs and priorities and the need for national contributions to the global targets adopted in Aichi in 2010. A total of four national strategic objectives and nine targets have been developed. Indicators and targets have been developed to assess progress toward the national targets on biodiversity conservation and sustainable use. The national goals and targets, as well as indicators of their implementation, were presented in Uzbekistan's Sixth National Report on Biodiversity Conservation (UNDP, Global Environment Facility [GEF], & SCEEP, 2018).

The conservation and sustainable use of biological resources are policy priorities. State regulation of the use of biological resources is carried out through the establishment of annual quotas for wildlife harvesting and plant collection. These quotas are approved by the Ministry of Ecology in agreement with the Academy of Sciences, by decision of the Interdepartmental Commission on Determination of Annual Norms for Use of Objects of Biological Resources. Quotas are formed on the basis of applications received from users of natural resources, taking into account the results of regular stocktaking and counts of animals and plants harvested/collected. However, there is an acute shortage of information on the current state of the natural populations of the most sought-after medicinal, food, and other raw plants of Uzbekistan, as well as game animals. Since 2021, a nationwide Yashil Makon project is being implemented to increase tree plantations. This 5-year project provides for the planting of 200 million seedlings, tree cuttings, and shrubs annually. In addition, a 1-year moratorium on the felling of valuable tree species has been imposed since 2019, followed by an indefinite extension of the moratorium on the felling of valuable tree and shrub species as of 2022 (Decree of the President of the Republic of Uzbekistan, 30 December 2021, No. UP-46).

Conducting an inventory of resource fauna species, both in terms of administrative regions and throughout the country, is the basis for their sustainable use. The Ministry of Ecology and the Academy of Sciences maintains a unified system of state cadastres, which includes systematized and standardized qualitative and quantitative characteristics of flora and fauna objects for accounting, assessment, and sustainable use of natural resources of the country. The cadastral data are the basis for planning the development of forestry and the system of protected areas, for determining the status of plant and animal resources and setting quotas for their use, maintaining the Red Book, conducting environmental impact assessments of various economic facilities, etc.

Protected areas form the basis for the conservation of biodiversity in the country. The new classification of protected areas takes into account the recommendations of the IUCN to create a unified ecological network of protected areas of different regimes, providing a combination of ecological and economic interests. New categories and types of protected areas have been introduced, such as complex (landscape) nature reserves, protected areas for resource management and nature nurseries. Currently, there are seven state nature reserves, one complex (landscape) reserve, 12 natural parks, one national park, 11 natural monuments, two state biosphere reserves, 12 sanctuaries, and one specialized nursery, "Jeyran." Their total area is 6,321,258.21 ha. There are 36 key biodiversity areas, of which 12 areas overlap partially or completely with existing protected

areas. National experts of the UzSPB (Uzbekistan Society for the Protection of Birds) and the Institute of Zoology of the Academy of Sciences have identified 10 key biodiversity areas important for faunal diversity conservation, five of which have been identified by the Critical Ecosystem Partnership Fund as priority research priorities (Critical Ecosystem Partnership Fund, 2017).

According to the IUCN's classification, the area of Category I–IV protected areas and biosphere reserves is **6.321 million ha** or **14.08%** of the total area of the country (Tables A9–A12 in Appendix). These areas contain 102 species (83%) of the vertebrates listed in the Red Book of the Republic of Uzbekistan and 280 plant species (89%).

Several Resolutions of the President of Uzbekistan and the Cabinet of Ministers on the implementation of the Law of the Republic of Uzbekistan on Protected Areas and the development of ecotourism have created opportunities to manage tourism in some protected areas. The protected area system provides a high level of protection for natural habitats. However, it has limitations in terms of overall size, representativeness, and funding. A disadvantage of protected areas is the fragmentation and insufficient area of individual protected areas—the areas of nature reserves and other protected areas are too small to support viable populations of animal species, limiting the full protection of species and ecosystems. In addition, almost all nature reserves are located in the border zone, which has a particular impact on their effectiveness. As a whole, natural habitat area has declined over the past 20 years due to economic activities.

The Republic of Uzbekistan has been a party to the UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage since 1993. The Western Tien Shan transnational serial site, nominated by Kazakhstan, Kyrgyzstan, and Uzbekistan, was inscribed on the UNESCO World Cultural and Natural Heritage List in 2016. The World Heritage Committee has unanimously recognized the unique natural wealth of the region, which is characterized by its high level of endemism and the presence of rare and endangered species of flora and fauna, including the Menzbir marmot, the snow leopard, the Tianshan mountain sheep, and many others. At the 45th session of the UNESCO World Heritage Committee held in 2023 in Riyadh, Saudi Arabia, the Transboundary Natural World Heritage Site Turanian Temperate Deserts was inscribed on the UNESCO World Natural Heritage List. The Turanian Deserts are the first site to be included in the category of temperate deserts on the UNESCO list. The inscribed sites are located in three countries in the territories of desert reserves, national parks, and landscape reserves in Uzbekistan, Kazakhstan, and Turkmenistan. Inclusion of the Turanian Temperate Deserts in the World Natural Heritage list is also important from the point of view of preservation of unique biological diversity; in particular, it brings to the international level the protection of 41 species of mammals, 167 species of birds, and 42 species of reptiles, among which the kulan, saiga, gazelle, urial and many globally threatened species of animals and plants are of special value.

6.0 Cross-Cutting Issues

6.1 Climate Change

Table 21. Key trends in indicators — climate change

Indicator	Long term (10 years)	Medium term (3 years)	Details
GHG emissions	Stable	Stable	From 1990 to 2017, total growth in emissions amounted only to 6.7%.
Average annual temperature	Negative	Not relevant	Average annual temperature from 13.2 to 14.8C for the period between 1880–2016.
Average number of days with maximum air temperature above 40°	Negative	Negative	On average, 5–7 days in the last 5 years and 12–17 days in the Aral Sea region and the lower reaches of the Amu Darya.
Total volume of glaciers	Negative	Not Relevant	For 1957–2010, the indicator in the Pskem River Basin decreased by 24.3%, in the Kashkadarya River Basin by 67.4%, and in the Surkhandarya River Basin by 40.1%.

Source: Authors.

- Uzbekistan's GHG emissions declined by 0.6% compared to 2013. In 2017, it emitted 189.2 million tonnes. The energy (76%) and agriculture (18%) sectors are the most significant contributors to these emissions. Over a longer time frame, GHG emissions increased by approximately 6.7% from 1990 to 2017.
- Uzbekistan is very vulnerable to climate change. Using the average annual temperature as the indicator, the temperature has increased by 1.6°C since 1880. This rate of increase is higher than the global average. Based on projections for the Central Asian region, the temperature may increase by another 1.5°C to 3°C (IPCC, 2014).
- The country's climate is expected to become hotter and drier. More frequent and intense periods of abnormal heat waves and droughts and changes in precipitation patterns will lead to an increase in extreme weather events associated with these changes, such as heavy rainfall, floods, and mudflows.
- In the long-term perspective up to 2030, the country submitted its intended nationally determined contribution (Government of Uzbekistan, 2021) that outlined the commitment of the country to reduce GHG emissions per unit of GDP by 35% by 2030 from the 2010 level by promoting energy saving and environmentally sound technologies and providing resources for climate financing.

- Adaptation and mitigation are key components of the long-term global response to climate change to protect people, livelihoods, and ecosystems and economic sectors, especially water availability in agriculture, which in turn plays a key role in ensuring economic stability and food security.

6.1.1 Drivers and Pressures

In 2017, CO_2-equivalent GHG emissions totalled 189.2 million tonnes. From 1990 to 2017, GHG emissions increased by 6.7%; from 2013 to 2017, they decreased slightly (by 0.6%). GHG emissions consist of the following: carbon dioxide (53.6%), methane (38.6%), nitrous oxide (7.6%), and hydrofluorocarbons (0.2%). GHG emissions per capita are 5.8 t CO_2-eq/person. The energy (76%) and agriculture (18%) sectors are the largest contributors to these emissions.

Table 22. Summary of GHG emissions (Mt CO_2 eq.)

Year	CO_2 Mt CO_2 eq.	CH_4 Mt CO_2 eq.	N_2O Mt CO_2 eq.	HCF_s Mt CO_2 eq.	Total Mt CO_2 eq.
1990	111.7	56.3	9.4		177.7
2000	111.0	89.7	7.7	0.001	208.5
2010	103.4	84.5	12.0	0.02	199.9
2011	106.6	83.0	12.4	0.03	202.0
2012	106.8	83.2	12.6	0.05	202.7
2013	96.7	80.6	12.9	0.09	190.3
2014	99.7	79.6	13.6	0.06	192.9
2015	95.9	74.9	14.5	0.09	185.3
2016	95.4	72.9	14.4	0.17	182.8
2017	101.4	73.1	14.4	0.27	189.2
Trend					
Δ (1990–2013)	-9.2%	29.9%	52.3%		6.7%
Δ (2013–2017)	4.9%	-9.3%	11.2%	464.1%	-0.6%
Contribution					
1990	63.0%	31.3%	5.3%	-	100.0%
2013	50.8%	41.4%	6.8%	0.0%	100.0%
2017	53.6%	38.6%	7.6%	0.2%	100.0%

Source: First Biennial Update Report for UNFCCC, 2021.

6.1.2 State and Impacts

The consequences of climate change, such as warming and unpredictable weather patterns, can be observed everywhere as the outcome of the increasing concentration of GHGs in the atmosphere. According to the UN World Meteorological Organisation, the global average annual surface air temperature has increased by 1°C from 1880 to the present (likely between 0.8°C and 1.2°C) above pre-industrial levels in 2017, increasing at 0.2°C (likely between 0.1°C and 0.3°C) per decade (high confidence) (Allen et al., 2018; Crippa et al., 2021).

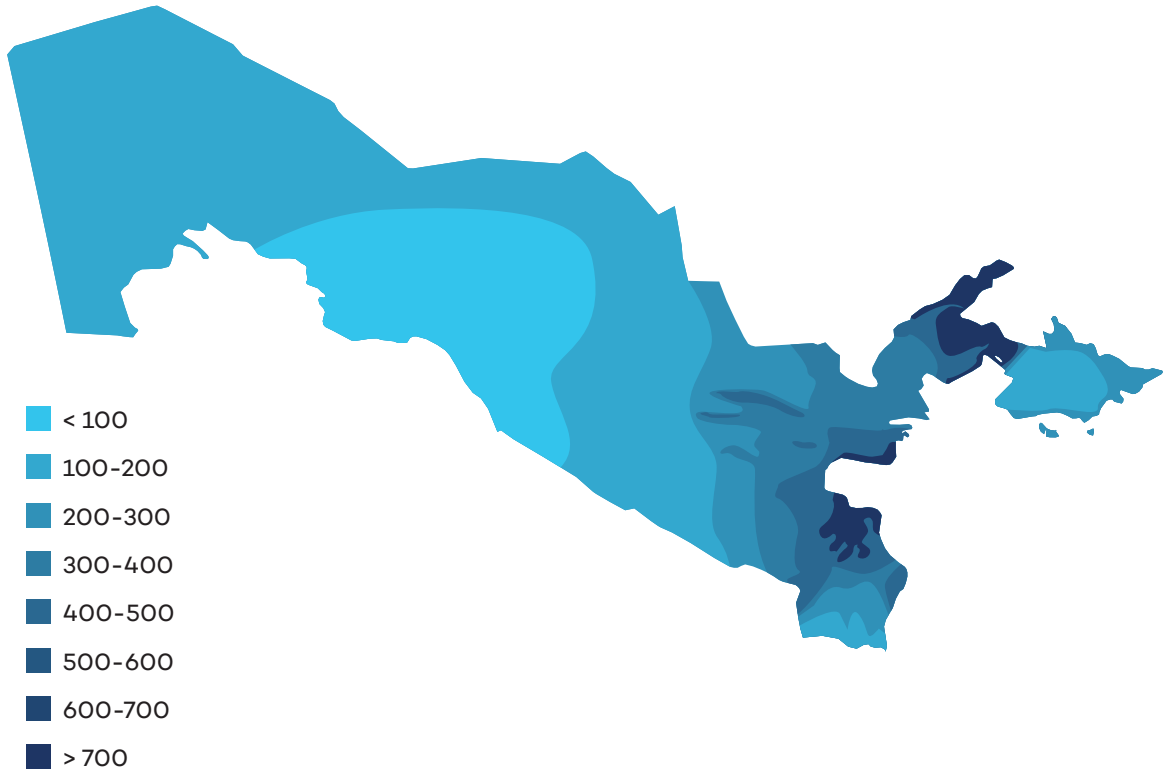
Uzbekistan is very vulnerable to climate change. Using the average annual temperature as the indicator, the temperature has increased by 1.6°C since 1880. This rate of increase is higher than the global average. Based on projections for the Central Asian region, the temperature may increase by another 1.5°C to 3°C. Here, the greatest increase in air temperature is expected in Prearalie (Republic of Karakalpakstan, Khorezm region), as specific local climatic changes are taking place due to the drying up of the Aral Sea.

Research shows that climate change in the country is accompanied by increased weather extremes, degradation of glaciers, more dust storms, salinization and desertification of land, formation of floods, and mudflows in villages. In particular, in Uzbekistan, the maximum number of days with air temperatures above 40°C has exceeded the average by 5–7 days in the last 5 years and by 12–17 days in the Aral Sea region and the lower reaches of the Amu Darya.

Uzbekistan is characterized by a continental and subtropical climate with considerable diurnal and seasonal amplitudes of air temperatures, with long, hot summers, relatively wet springs and unstable winters. Maximum temperatures in summer exceed 45°C, and minimum temperatures in winter fall well below -20°C. During the winter and spring months, cold intrusions are accompanied by winds and heavy precipitation, so precipitation mainly occurs from November to May (about 90% of the annual average for Uzbekistan). In terms of warming and experiencing increasing temperatures, the high level of solar radiation inflows in Central Asia creates conditions for the formation of extensive heat pockets, especially over the hot deserts (Karakum and Kyzylkum). Absolute maximum summer temperatures in desert areas reach 45°C–49°C. According to climate monitoring by Uzhydromet, the average annual temperature increase in Uzbekistan since 1880 was about 1.6°C (from 13.2°C to 14.8°C), i.e., the warming rate is higher than the global average.

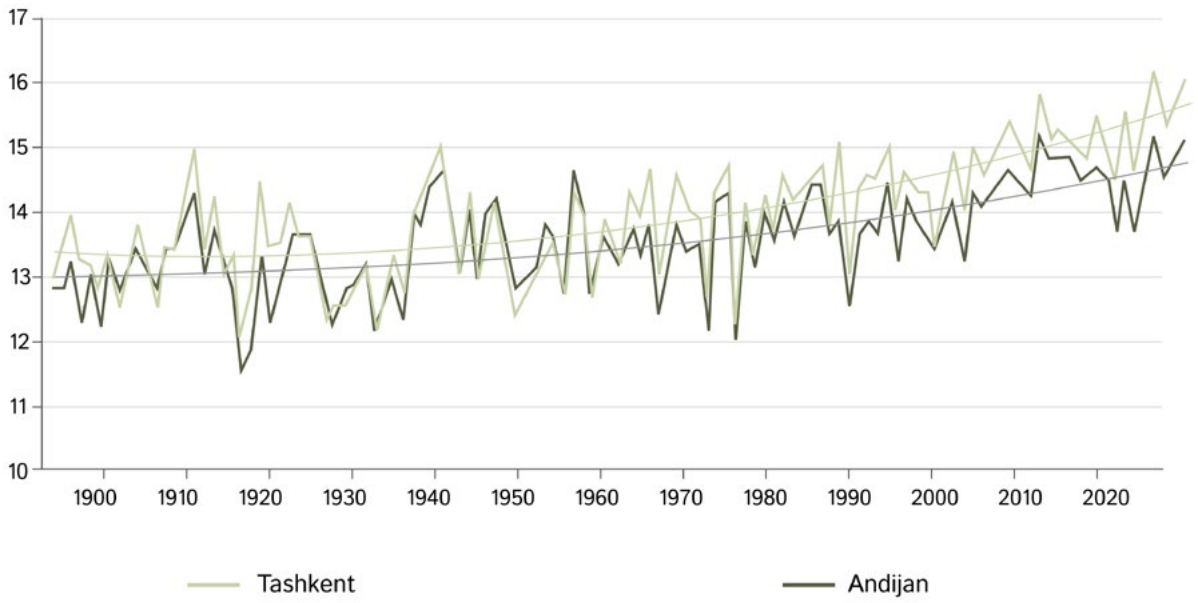
Uzbekistan can be considered an arid country where precipitation is largely driven by differences in geographical characteristics, with the most significant amount of precipitation occurring in the mountainous regions in the south-eastern and eastern parts of the country (Figure 3). Increased precipitation is noted in the foothills and mountainous areas, especially on windward slopes. Climate change is expected to contribute to an overall decrease in precipitation, with the exception of mountainous areas, where a slight increase in overall precipitation is expected during the winter months. Despite an overall downward trend in precipitation, changes in precipitation patterns will contribute to an increase in extreme meteorological events, such as heavy rainfall.

Figure 3. Distribution of multi-year average rainfall totals (1990–2019)



Source: Hydrometeorological Service Agency at the Ministry of Ecology of the Republic of Uzbekistan, 2022.

Figure 4. Variation of air temperature by stations in Uzbekistan cities Tashkent and Andijan, respectively



Source: Hydrometeorological Service Agency at the Ministry of Ecology of the Republic of Uzbekistan, 2022.

Together with the increasing periods of dry weather, there has been an increase in extremely heavy precipitation over a limited area. In recent years, precipitation has fallen mainly in the form of rain, including in the low- and mid-mountain areas. These circumstances lead to a deterioration of snow conditions and a reduction of snow reserves, which have a direct impact on the reduction of river flows during the growing season. Heavy downpours across the foothills of Uzbekistan pose the greatest threat. In 80% of the cases, heavy rainfall and heavy rainfall are the causes of mudflows. During 2016–2020, more than 40 mudflows with destruction of infrastructure (such as roads and bridges) and flooding of households were recorded; 15 such events were observed in the spring of 2022. More than 800 settlements are located in the zone of debris flow impact. Eight-hundred settlements are located in the mudflow impact zone. The most mudflow-prone areas are in the Fergana Valley, where 44% of all mudflows occur.

Uzbekistan has a scarcity of water resources, and this problem is expected to be exacerbated by increased water demands resulting from population growth and an expected redistribution of surface runoff in the Aral Sea Basin. The mountain glaciation of the Aral Sea catchment area is of great importance for Uzbekistan's water resources. The rate of glaciation reduction varies by territory and by time period from 0.1 to 1.65% per year (Tuchin et al., 2003). An assessment of future water demand has shown that water demands for irrigation and environmental purposes are already unmet, and water scarcity will increase significantly due to climate change.

The country's water resources consist of the surface runoff of the Amu Darya, Syr Darya, and other rivers of the Aral Sea basin. The total average annual flow of all the rivers is about 116.2 km^3/year, of which 67.4% is formed in the Amu Darya river basin (78.3 km^3/year) and 32.6% in the Syr Darya river basin (37.9 km^3/year). The total groundwater supply is 1.17 billion m^3, of which 14.7 billion m^3 is located in the Amu Darya river basin and 16.4 billion m3 in the Syrdarya river basin (EPR of Uzbekistan, 3rd Review). The flows of the Amu Darya and Syr Darya rivers are characterized by strong inter-annual variability, which may be further exacerbated by climate change due to changes in precipitation. An increase in temperature and river water availability will have a detrimental effect on agriculture, hydropower, and industry. Based on climate change models, the two main waterways in Central Asia, the Amu Darya and Syr Darya, could shrink by 10%–15% as early as 2030. Some parts of the country are experiencing extremely high water stress. In Bukhara, Samarkand, Fergana, Navoi, Jizzakh, and Kashkadarya regions, more than 80% of all available water is withdrawn (WRI, n.d.).

In recent decades, the volume of water resources per capita has declined fourfold, from 8,400 m^3 in 1960 to 2,100 m^3 currently (Niyazi, 2022). As a result of climate change and population growth in Uzbekistan, the risks of extreme low water and drought have increased significantly, especially in the lower reaches of the Amu Darya basin (Republic of Karakalpakstan, Khorezm, and Bukhara regions) (Government of Uzbekistan, 2021; Talskih & Beglov, 2008).

According to interstate water allocations, the volume of water resources available to Uzbekistan is 59.2 km^3 for a year of 90% availability. The actual water withdrawal from surface water courses depends on the availability of water resources, i.e., on water availability that year. In addition to surface water from large and small rivers, the needs of water users are covered by operational groundwater reserves and the reuse of collector-drainage runoff. In the mountain zone, water quality in terms of total salinity is high (60 mg/l to 400 mg/l). Specific pollutants, such as heavy

metals, phenols, and natural hydrocarbons, are present within the background values. In the plains area, in the river flow consumption zone, and at the river mouths, surface waters have elevated salinity (from 1070 mg/l to 2500 mg/l), and in the zone of influence of industrial-urban agglomerations, waters are characterized by increased content of nitrite nitrogen, organic substances, and heavy metals.

According to climate scenarios, by 2050 the flow volume in the Amu Darya and Syr Darya basins will decrease by 10% to 15% and 6% to 10%, respectively, which will undoubtedly lead to increased water scarcity. Adaptation needs to address climate change impact require improvements in water management, innovative land management technologies, and a shift toward the conservation and rational use of water at all levels of use (Government of Uzbekistan, 2016).

According to a recent assessment (Government of Uzbekistan, 2021), in the period 1957–2010, the total volume of glacier ice in the Pskem River Basin decreased by 24.3%, in the Kashkadarya River Basin by 67.4%, and in the Surkhandarya River Basin by 40.1%. According to the results of the analysis given in the Third National Communication (Government of Uzbekistan, 2016), under all developed scenarios, glaciers can be expected to decrease in area, and it is predicted that in the extreme scenario of GHG emissions, the glaciers in the country will disappear within the next 30 to 50 years.

6.1.3 Responses

Understanding the importance and urgency of action in addressing climate change issues, including the transition to environmentally safe energy sources and meeting the energy needs of sustainable development, Uzbekistan acceded to the UN Framework Convention in 1993 and ratified the Kyoto Protocol in August 1999.

In accordance with the decision of the Government, Uzhydromet implements the obligations under the UNFCCC. Within the framework of implementation of its UNFCCC obligations, Uzbekistan has prepared and submitted the following to the UNFCCC: its First National Communication (1999) and its Phase 2 report (2001); Second National Communication (2008); and Third National Communication (2016). The Fourth National Communication is currently being prepared. The First Biennial Update Report has been prepared, which includes two main areas: greenhouse gas inventories for 1990–2017 and an assessment of the effectiveness of mitigation measures.

In the long-term perspective up to 2030, a number of strategies and concepts for individual sectors of the economy have been developed to define the country's development priorities and objectives for the period to 2030. The Strategy for the Transition of the Republic of Uzbekistan to a Green Economy for the period 2019-2030 and the Decree of the President of the Republic of Uzbekistan on Measures to Increase the Effectiveness of Reforms Aimed at the Transition of the Republic of Uzbekistan to a "Green" Economy Until 2030, 02 December 2022, No. PP-436, are strategic documents aimed at fulfilling the country's commitments under the Paris Agreement. The achievement of the target for GHG remissions reduction would require wide up-take of energy-saving technologies and would rely on a significant amount of financing.

Adaptation and mitigation are key components of the long-term global response to climate change to protect people, livelihoods, and ecosystems, and adaptation measures are part of the Paris

Agreement's NDCs. The most vulnerable sectors to climate change in Uzbekistan are water and agriculture, which, in turn, play key roles in ensuring economic stability and food security. Uzbekistan will also continue its efforts in adaptation capacity building to reduce the risk of climate change's adverse impacts on various sectors of the economy, social sectors, and Priaralie (Aral Sea coastal zone) (Government of Uzbekistan, 2016, 2021).

As part of the ongoing institutional reform, a number of new specialized ministries and agencies have been established with responsibility for implementing energy efficiency and GHG emission-reduction measures. Medium-term development priorities are defined in the State Development Programs.

6.2 The Aral Sea Region

Table 23. Trends in key indicators — the Aral Sea region

Indicator	Long term (10 years)	Medium term (3 years)	Details
Dynamics of Aral Sea drying up	Negative	Stable	Since 1960, the volume of water in the Aral Sea has declined from 1,083 km3 to 69.31 km3.
Water, soil, and air pollution	Negative	Stable	Use of polluting substances, such as agrichemicals, has been reduced, but the cumulative impacts of pollution remain.
Biodiversity loss	Negative	Negative	It is estimated that over 50 species of wild animals and plants disappeared (Turanian tiger, Asian cheetah, striped hyena, etc.), and the number of endangered species increased (12 species of mammals, 26 species of birds, and 11 species of plants).
Food security	Negative	Negative	Around 60 % of households have limited food availability. In most areas, households own garden plots to grow vegetables, fruit, and gourds; they also have cattle.
Disease occurrence	Negative	Negative	The local population suffers from a high incidence of respiratory diseases, anemia, cancer, and digestive diseases. Liver and kidney diseases are also on the rise.
Access to drinking water and sanitation	Stable	Positive	To address water supply issues, 1,500 km of domestic and drinking water supply networks were built, thereby increasing the level of centralized drinking water supply from 40% to 68.1%.

Source: Authors.

- The Aral Sea entered a period of instability in the last half of the 20th century. Spurred by anthropogenic impacts, this period saw decreased water volume and flow, increased salinity, reduced fish biodiversity, and other negative trends.
- The shrinking of the Aral Sea has significant impacts on the ecosystems of all neighbouring countries; its critical situation extends directly to Turkmenistan, Kazakhstan and Uzbekistan, in particular to the Republic of Karakalpakstan, Khorezm, Bukhara and Navoi regions, and indirectly to Tajikistan and Kyrgyzstan.
- Excessive use of water for irrigation, increased salinity, water runoff from local fields containing pesticides, and windstorms that can carry salt, dust, and pesticides negatively affect the Amu Darya delta in the south, the most densely populated and economically and environmentally important area in the whole region. The local population suffers from a high incidence of respiratory diseases, anemia, cancer, and digestive diseases. Liver and kidney diseases are also on the rise.
- According to forecasts, if the current trends in the salinization of water bodies and soils continue, in a few decades, most of the agricultural land in the Syr Darya basin will become unsuitable for irrigated agriculture, and a similar situation will occur in the Amu Darya basin. The level of salt pollution in the rivers will also make them unsuitable for drinking water supply. Such pollution of the rivers may cause irreparable damage to the ecological and socio-economic development of the territory.

6.2.1 Drivers and Pressures

The main driving forces behind the dramatic regression of the Aral Sea since the 1960s have included prioritizing economic development not balanced with natural resource potential and consumption, a resource-dependent economy, large-scale abstraction and use of valuable water and land resources, increased construction of water intake facilities, competition for transboundary water resources, and certain demographic processes.

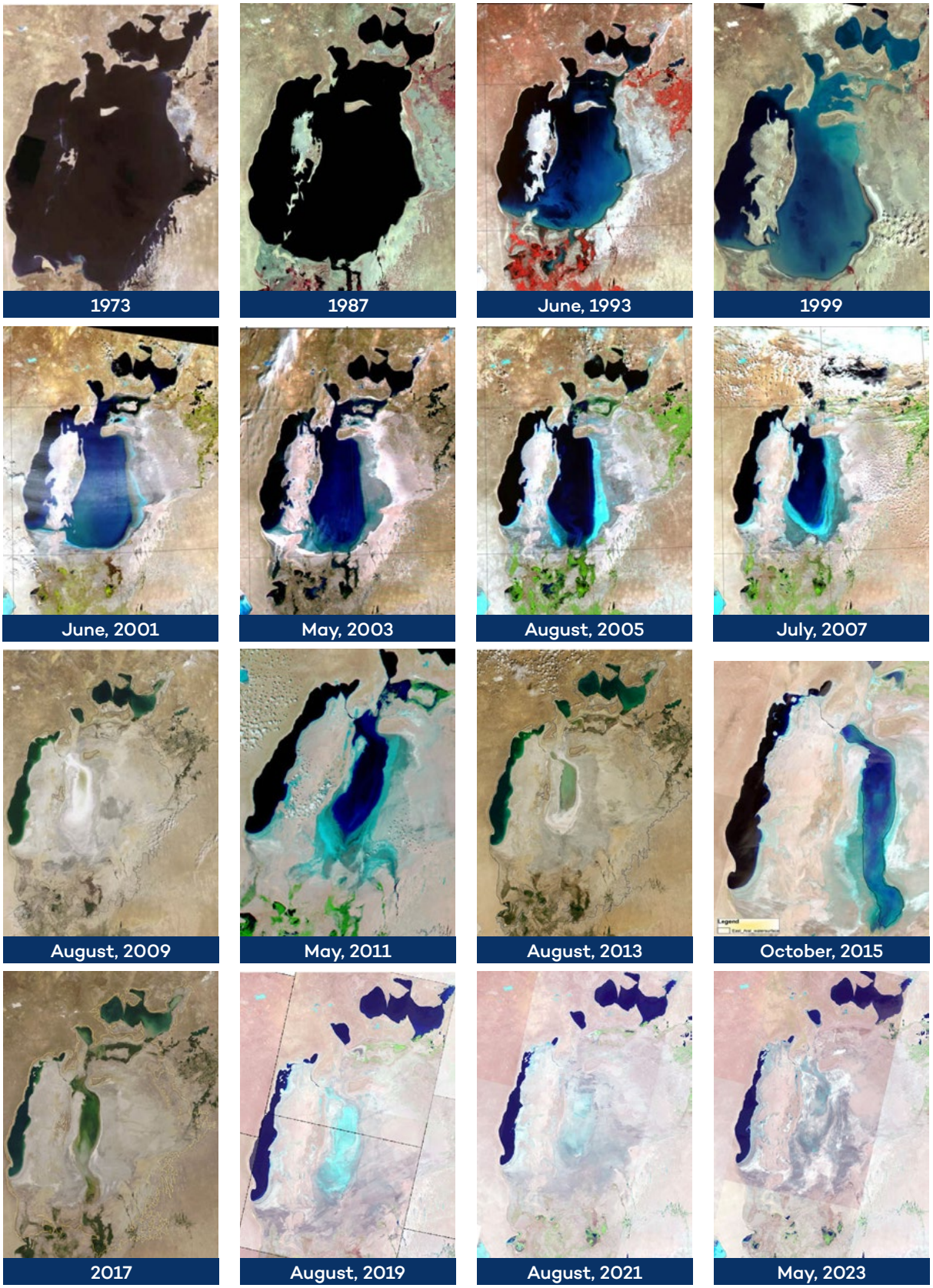
Cotton monoculture, with its water-intensive agricultural practices, developed over many years in Uzbekistan, and the expansion of irrigation has exacerbated water shortages. Water availability in the Aral Sea region is the lowest in the country (60%–70%) due not only to limited water resources but also to their inefficient use, including high filtration losses in irrigation systems and unsatisfactory condition of hydraulic engineering structures technology. The irretrievable diversion of irrigation water from the Amu Darya and Syr Darya rivers disturbed the balance between runoff and evaporation in the Aral Sea.

Scientifically unsound cropping patterns have led to water and wind erosion. A significant proportion of irrigated land has been degraded: 2 million ha of deflation, 619 ha of irrigation erosion, and 40,000 ha of gully erosion. The situation could worsen if Afghanistan begins construction of the 285 km Kosh Tepa diversionary irrigation canal upstream from the Amu Darya, which would divert 25% of the flow of the Amu Darya into Afghanistan.

Climate change creates additional pressures on the Aral Sea region. The surface flow of the rivers flowing into the Aral Sea varies due to natural and climatic conditions and is characterized

by frequent low-water years. As a rule, low-water years alternate with high-water years, with low-water years currently being observed more frequently.

Figure 5. Dynamics of the transformation of the Aral Sea (satellite images, 1973-2022, selected years)



Source: Scientific-Information Center of the Interstate Commission for Water Coordination of Central Asia Aral Sea Database. http://www.cawater-info.net/aral/data/satellite.htm

6.2.2 State and Impacts

The Aral Sea is a drainless salt lake in the northern desert part of Central Asia. Located in Uzbekistan and Kazakhstan, it was the fourth largest lake in the world after the Caspian Sea, Lake Superior, and Lake Victoria. The Aral Sea and region are characterized by complex natural processes, including sharp fluctuations in its level and salinity, and by air, water, and land pollution, climate change, desertification, land degradation, loss of biodiversity, and socio-economic problems.

Pollution

Uzbekistan's use of agrochemicals was among the highest in the Soviet Union, 15 to 20 times higher than the overall Soviet level. At that time, about 80 different products were used, and for many years more than 50–54 kg of pesticides per hectare of cotton were sprayed. As a result, irreparable damage was caused to the natural environment and public health. Between 1990 and 1993, the use of pesticides and mineral fertilizers was reduced by 30%. However, this had no effect on reducing pollution. Residues of DDT, 2.5 times the sanitary standard, were found in more than half of the soil samples and remained at the same level for a long period of time (Alibekov & Alibekova, 2007). Current air and water pollution is one of the highest in the Aral Sea region. These are all consequences of the recession of the Aral Sea.

Climate Change

Over 80% of the population of Central Asia (60 million people) live in the Aral Sea Basin (EDB, 2022). The EDB (2022) study *Regulation of the Water and Energy Complex of Central Asia* notes that the Aral Sea Basin countries are most exposed to high risks and threats from global and local climate change. Significant changes in the hydrographic regime of surface waters due to the accelerated melting of glaciers and reduction of snow cover, acceleration of desertification, land degradation and salinization, loss of biodiversity, and deforestation are expected. The cumulative negative impacts of climate change will increase competition for water between countries in the region and have a long-term impact on the region's political, food, energy, and environmental security.

Desertification

Since 1960, the volume of water in the Aral Sea has declined from 1,083 km^3 to 69.31 km^3. This shrinking has resulted in an additional severe aridification of the Aral Sea region. The frequency and intensity of periods of abnormally high temperatures in late spring and summer are increasing. The new Aralkum desert has formed over an area of about 5 million hectares. The vast seabed, filled with salt, fertilizers, and pesticides, is the source of more than 700 million tonnes of dust and salt mixtures, hazardous to humans and the environment, which are released into the atmosphere every year. They accumulate over an area of 1.5-2 million km^2.

Land Degradation

As a result of salt deposition during dust storms and the resulting increased salinity of irrigation water and rising water tables, the quality of land resources has declined sharply. Droughts have become more frequent. This has led to a decline in crop yields (maize crops have fallen by a factor of 3, rice by a factor of 2, cotton by a factor of 1.6, and potatoes and vegetables by a factor of 1.5–2.5). Land salinity exceeds 80% in some districts and 96% in Muynak district (Based on Institute

of Social Research of the Republic of Karakalpakstan, 2017). Groundwater salinity remains high (groundwater table of 1 to 2 metres in 64% of irrigated land). Low rainfall and high evaporation result in the need for frequent irrigation (6–10 times) and leaching of saline soil (2–4 times).

Loss of Biodiversity

The Aral Sea catastrophe worsened the continent's climate and resulted in a loss of landscape biodiversity. These included weathered plains with unique coastal morphology, Ustyurt channels, island dry lowlands, piedmont aeolian plains, erosional solonchak depressions, ridge cells, hills, plateaus, and massifs of sand dunes. As a result, over 50 species of wild animals and plants disappeared (Turanian tiger, Asian cheetah, striped hyena, etc.), and the number of endangered species increased (12 species of mammals, 26 species of birds, and 11 species of plants). Eleven fish species disappeared, including rare species, such as Aral spike and Aral salmon, and the number of commercial fish species decreased in 13 species. As of January 1, 2023, the Aral Sea Region (Republic of Karakalpakistan, Khorezm and Bukhara regions) has nine protected natural areas totalling 3.756 million ha.

Socio-economic Problems

Pollution and deterioration of air, soil, and water quality have adverse impacts on the population's health. The most serious problem is the population's access to quality drinking water. More than half of the population in the Aral Sea region, especially in rural areas, has to use poor-quality water with high mineral content. Water pollution and the amounts of dust and salts rising from the bed of the dried-up Aral Sea play a decisive role in high rates of morbidity, general and child mortality, as well as high rates of several somatic diseases: anemia, kidney disease, gastrointestinal disorders, increased rates of respiratory disease, blood disease, cholelithiasis, cardiovascular disease, and cancer. For 60% of households, food availability is low. In most areas, households own garden plots on which they grow vegetables, fruit, and gourds. They also raise cattle. The products produced on homestead plots are mainly consumed by the households themselves, and only one-tenth of them are sold.

There are problems related to the lack of sustainable electricity and fuel supply in the surveyed areas. The Republic of Karakalpakstan and Uzbekistan experienced a decline in centralized natural gas supply between 2006 and 2016. The rural population primarily uses natural gas, liquefied gas, and fuel (coal) for heating and cooking. There is a need to develop alternative energy sources, such as solar and wind energy.

The economy is dominated by agriculture, while the share of industry and services in the economy lags far behind the national average. Employment in the agricultural sector accounts for 33% of total employment. According to official estimates, half of the irrigated land is below average quality, and agricultural land has declined by 177,100 ha over the past decade. Overall, reduced pasture and land productivity, tugai vegetation loss and drying up of lakes have resulted in the loss of over 100,000 jobs.

In the past, more than 80% of the inhabitants of the Aral Sea coast were engaged in the extraction, processing, and transportation of fish and fish products. As a result of the drying up of the sea, marine navigation ceased by 1979, and from 1984 onward, the sea lost its commercial importance completely, leaving tens of thousands of people unemployed. The region, in particular the Republic of Karakalpakstan, ranks last in terms of economic potential, agricultural production, and retail

turnover and second last in the production of consumer goods (https://www.aral.mptf.uz/site/aralsea.html#drying).

6.2.3 Response

Following the drying up of the Aral Sea, the region found itself in an unfavourable socio-environmental situation. Measures have been taken in response to stabilize the situation in the region.

The International Fund for Saving the Aral Sea (IFAS) was established in 1993 by a decision of the heads of Central Asian states. The main objective of IFAS is to finance and credit joint practical actions and prospective programs and projects for saving the Aral Sea, and environmental rehabilitation of the Aral Sea region and the Aral Sea basin as a whole, taking into account the interests of all states in the region. As the analysis of IFAS activity for 1993–2021 shows, the work of the Fund and its structures needs to be improved in order to achieve its objectives, taking into account geopolitical processes and changes taking place in the regions adjacent to Central Asia. A serious shortcoming in the activities of IFAS bodies is the lack of cooperation in planning activities and sharing responsibility for the implementation of regional programs and plans, especially the Aral Sea Basin Programme of Action (ASBP).

A total of four ASBPs have been adopted since 1994. The new ASBP-4 for the period 2020–2030 was adopted on June 29, 2021. The list of ASBP projects can be found on the official website of the IFAS Agency, which manages projects in the Aral Sea Basin (IFAS, 2018). Projects for stabilizing and improving the environmental, social, and economic situation in the Aral Sea region include the following: Creation of Small Local Water Reservoirs in the Amu Darya Delta; Development of the Dried Part of the Aral Sea on the Basis of Local Salt-Dusting Plants (Saxaul, Cherkez, etc.); Recultivation of the Dried Aral Sea Bed and Forest Plantations; Creation of Protective Forest Plantations on the Dried Aral Sea Bed; Ornithological Monitoring of Water Bodies in the Southern Priaralie; and the Organization of Social Assistance to the Aral Sea Region Population in Adapting to Market Conditions in the Ecological Crisis Zone. These projects aim to achieve a stable water level in the lakes of the Central Priaralie zone, restore biodiversity, support local employment, and stabilize the environment.

The International Innovation Centre of the Priaralie under the President of the Republic of Uzbekistan was established in 2018 with the scientific and technical support of the Islamic Development Bank and the International Centre for Biosaline Agriculture to improve the ecosystem, support sustainable livelihoods, and introduce best practices in the saline lands of the dried Aral Sea bed (Decree of the President of the Republic of Uzbekistan on Establishment of the International Innovation Centre of the Aral Sea Region under the President of the Republic of Uzbekistan, 6 October 2018, No. PP-3975).

The Aral Sea Region Development Fund was established in 2017 as part of the Strategy of Actions on the Five Priority Development Areas of the Republic of Uzbekistan in 2017–2021 and the State Programme for the Development of the Aral Sea Region for 2017–2021. The program provides for the implementation of projects totalling UZS 8.422 trillion (USD 2.4 billion), focusing on creating opportunities for employment, investment, improvement of water supply, sewerage systems and sanitation, and strengthening public health measures in the region. The Aral Sea

Region Development Fund has been established under the Ministry of Finance of Uzbekistan (currently the Ministry of Economics and Finance of Uzbekistan) to implement this state program.

The UN Multi-Partner Trust Fund on Human Security for the Aral Sea Region (2023) has become a reliable platform for practical assistance to the Aral Sea Region from the international community. This hub of environmental innovations and technologies coordinates efforts and implements targeted programs and projects. The program strategy of the Foundation, established in 2018, is built on the UN Human Security Concept. The Governments of Uzbekistan, Norway, Finland, the Republic of Korea, and the EU, Alwaleed Philanthropies, and other donors have made earmarked contributions to the Trust Fund (AralDream, 2023). Over USD 16 million has been mobilized under the Trust Fund, financing the development and implementation of five projects focused on promoting sustainable rural development and climate change adaptation. Together, these programs reached more than 250,000 direct beneficiaries, including youth, women, and the elderly.

The Strategy for Water Resources Management and Irrigation Sector Development in the Republic of Uzbekistan for 2021–2023 envisages measures for the conservation of natural water resources and water-dependent ecosystems, including the implementation of the investment project Water Resources Management in the Aral Sea Basin with Consideration of Climate Change Adaptation.

The Decree of the President of the Republic of Uzbekistan on Measures for the Comprehensive Socio-Economic Development of the Republic of Karakalpakstan in 2020–2023, 11 November 2020, No. PP-4889, was adopted in 2020 to address the consequences of the desertification of the Aral Sea. To address water supply, 1,500 km of domestic and drinking water supply networks were built and reconstructed with funding from the Development of Water Supply and Sanitation Fund at a total cost of UZS 489 billion, thereby increasing the level of centralized drinking water supply from 40% to 68.1%. For the first time, 61 makhallas were provided with drinking water, and the water supply to more than 100,000 families was improved. Attention has also been focused on green energy in Karakalpakstan. As a result of actions for the development of Karakalpakstan, it is expected that in the next 5 years industrial production will grow 1.6 times, agricultural production 1.3 times, and services 2.9 times. Exports will increase 4.2 times, reaching USD 500 million in 2026.

The Aral Sea Region—a Zone of Environmental Innovation and Technology is a United Nations resolution adopted in 2021 (Decree of the President of the Republic of Uzbekistan on Measures to Implement the United Nations General Assembly Special Resolution of 18 May 2021 on Declaring the Aral Sea Region a Zone of Environmental Innovation and Technology, 29 July 2021, No. PP-5202). The Roadmap for the implementation of the tasks identified in the special resolution was approved and provides for the creation of an enabling environment and the development of an institutional framework for structural and transformational change in the Aral Sea region.

The Action Plan to Combat and Prevent Land Degradation and Soil Protection, envisaging pilot projects for reclamation of soils subjected to secondary salinization, will be implemented during 2023–2025 in the Republic of Karakalpakstan, Khorezm, and Bukhara regions (Decree

of the President of the Republic of Uzbekistan on Measures to Combat Land Degradation, 10 June 2022, No. PP-277).

Since 2018, comprehensive work has been underway to mitigate the negative consequences of the Aral Sea aridification, improve the ecosystem on degraded lands and socio-economic development, and further improve the living standards of the population of the Aral Sea region.

In particular, five new protected areas with a total area of 3.6 million hectares have been created in the Republic of Karakalpakstan to preserve unique biodiversity and their habitats.

During 2018–2022, the government carried out large-scale work to create "green covers," i.e., protective forests on the dried Aral seabed. As a result, 1.7 million hectares of forest plantations of salt- and drought-tolerant plants—saksaul, cherkes, and kandym and other desert plants—were planted on the dried seabed.

In 2023, afforestation is taking place on 100,000 hectares of the dried seabed, and "green belts" are being created in Navoi, Bukhara, and Khorezm regions on 50,000 hectares, 40,000 hectares, and 11,000 hectares, respectively.

6.3 Waste Management

Table 24. Trends and indicators — waste management

Indicator	Long term (10 years)	Medium term (3 years)	Details
Waste generation	Negative	Negative	Increase in the total volume of waste generation and the amount of waste per capita.
Municipal waste generation	Negative	Stable	The amount of waste has been increasing since 2016, but it has been stable or slightly lower since.
Municipal solid waste collection	Positive	Positive	Increase of household solid waste collection (coverage of population with waste collection and removal services) to 85%. However, most of the waste is disposed of in landfills.
Waste management for specific types of waste (industrial, medical, and e-waste)	Negative	Negative	Very limited facilities, processing and neutralization of different types of wastes such as industrial, medical, and e-waste and others

Source: Authors.

- Population growth and development in Uzbekistan have resulted in greater production, lifestyle changes, and increasing consumption, leading to an increase in the total volume of waste generation and waste per capita. However, there is an opportunity to improve waste management practices and recycling and to promote overall waste reduction.

- Investments have been made in recent years to promote the dynamic development of solid waste management infrastructure with increasing levels of waste collection (coverage of population with waste collection and removal services). However, there is limited implementation of waste recycling and utilization technologies, resulting in waste being disposed of mainly in landfills.
- While improvements have been made to manage municipal waste and improve both collection and recycling, there are challenges in managing industrial waste. Currently, there are insufficient rates of implementation of waste recycling and utilization technologies, with a primary focus on industrial waste.
- There is also a lack of a unified system for storage, transport, and disposal of medical waste. The introduction of modern methods of detoxification and disposal of medical waste is still in the pilot stage.
- In addition, there are challenges in ensuring proper collection and neutralization of e-waste and batteries.
- From January 1, 2024, Uzbekistan will ban the production and sale of plastic packaging with a thickness of less than 100 microns. This does not apply to plastic roll bags and biodegradable bags for farm products.

6.3.1 Drivers and Pressures

The amount of waste is increasing due to population growth, socio-economic development, and changing lifestyles, together with increased production and use of disposable containers.

Municipal solid waste (MSW) generation increased from 6.933 million tonnes in 2016 to 7.425 million tonnes in 2020. In 2022, MSW generation volumes were 6.817 million tonnes (Table 25). As shown by the average annual results of studies that determined the norms of MSW accumulation in the Republic of Uzbekistan, the average MSW generation rate per 1 inhabitant is 0.775 kg/day. In line with the increase in the volume of waste generation, the volume of waste disposed of also increases. MSW has a complex multicomponent composition. One part is food waste (vegetables, fruits, peels, peelings, etc., as well as the organic part of other waste) and polymers, including polyethylene terephthalate (PET) containers. An average of 990.0 tonnes of polymer waste, including 273.0 tonnes of PET containers, are generated daily, and an average of 395,000 tonnes of such waste are generated annually, of which 145,000 tonnes are PET containers. Some 1.6 million tonnes of polymer waste, of which 0.44 million tonnes are PET containers, are stored in 221 landfills.

Table 25. Volumes of MSW generation

	Years (tonnes)						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Total for the Republic	6,933,000	7,034,300	7,151,900	7,283,100	7,425,400	7,108,010.2	6,816,840.5

Source: Republican Center for Organization of Sanitary Cleaning Works, 2023.

Currently, MSW is deposited in landfills, and it has become widespread in Uzbekistan. SDW is stored at 165 registered sites (landfills), currently occupying an area of more than 1,445 ha. By 2022, over 33,533,000 tonnes of waste will have accumulated in these landfills. (Table A11). About 1,445 ha of land has been allocated for the organization of landfills, not counting spontaneous uncontrolled dumps. Despite the ongoing environmental control, today, there is still solid waste dumping by the population, including the formation of illegal dumps in settlements, on the lanes of motorways, along the edges of fields, and on the banks of water bodies. In recent years, the number of administrative offences of citizens throwing waste in prohibited places has been 28,900 in 2020, 18,700 in 2021 and more than 20,300 in 2022.

Approximately 115 million tonnes of **industrial waste** are generated annually. The most significant amount is generated by mining and processing industrial enterprises located in Navoi, Tashkent, and Fergana regions. The amount of waste accumulated at 20 industrial waste disposal sites with a total area of 286.3 hectares is 40,879,400 tonnes, at 21 sludge storage sites with an area of 985.1 hectares, 256,831,500 tonnes, and at 15 tailing ponds with an area of 7,751.0 hectares—2,953,788,000 tonnes. Most of the waste is stored in sludge collectors and tailing ponds, and an insignificant part of industrial waste is used as secondary raw materials.

There are different types of **medical waste**, depending on the degree of its epidemiological, toxicological, and radiation hazard, as well as the negative impact on the environment. An average of 42,411 tonnes of medical waste is generated annually in Uzbekistan at 7,950 medical facilities, of which 1,668 tonnes is hazardous medical waste. Medical institutions are not provided with special containers for proper storage of this waste. Infected medical waste is destroyed by autoclaving at 132°C with an exposure time of 20 minutes at the sites where it is generated. Cases when medical waste is thrown away together with household waste are not exceptional.

According to the country-**specific e-waste** statistics, the volume of e-waste produced in Uzbekistan is 102,000 tonnes (Balde at al., 2021). There is some infrastructure for the collection and treatment of e-waste, but it is very limited.

One of the main problems in Uzbekistan is **waste from used batteries**, which are usually collected together with MSW. By order of the State Committee for Ecology and Environmental Protection (currently the Ministry of Ecology), in 2020, all territorial subdivisions of the State Unitary Enterprises Toza Hudud and Makhsustrans were instructed to start large-scale installation of special containers of a certain pattern for battery collection, starting with waste collection points. A similar proposal was addressed to specialized sanitation companies. To date, 530 containers from the Makhsustrans State Unitary Enterprise and 171 from private sanitation companies have been installed in Tashkent. The installation of battery collection containers at all existing collection points in Ferghana region continues. It is also necessary to ensure that containers with such batteries are emptied regularly. The issue of their further recycling has not yet been resolved, as there are no relevant processing facilities in Uzbekistan. The introduction of special rules and technical instructions will improve the situation for e-waste management (Balde at al., 2021).

Waste from the energy sector. In Uzbekistan, 10 thermal power plants use natural gas as the main fuel. At two thermal power plants—Angren and Novoangren—electricity is generated by burning coal. Angren coal is characterized by its low quality and high ash content. The ash and slag are stored in four dumps with a total volume of 15 million tonnes. Ash and slag generation is

in the range of 600,000 to 700,000 tonnes per year. There is an upward trend in recycling of these wastes by up to 30%. Energy wastes are mainly used in the production of cement and building materials (EPR, Uzbekistan, 3rd review, 2020).

Volumes of formation, processing, and disposal of **construction waste** (tonnes) are done at six construction waste disposal sites with a total area of 80.8 hectares. Of the 1,300,193 tonnes of construction waste generated in 2021–2022, only 2%, or 26,415 tonnes, was recycled. The remaining volume, 1,273,778.3 tonnes, was buried in landfills for construction waste and MSW. At the same time, the largest percentage of construction waste recycling (13%) exists in the Andijan region, while in Andijan, Jizzakh, Namangan, Samarkand, Fergana, and Khorezm regions and the Republic of Karakalpakstan, construction waste is not recycled. Construction waste generation is associated with large infrastructure and housing projects. Construction and demolition waste is often used as backfill material. The practice of recycling and reusing beams, frames, and bricks by the population is widespread.

6.3.2 State and Impacts

Collection and removal of SDW is carried out in the multi-apartment residential sector from waste collection points (WCPs) and in the individual residential sector from garbage bins (special rubbish bags [bags] or containers with wheels and tightly closing lids can be used) or via the "signal method"—SDW is temporarily stored until the arrival of a special vehicle. The minimum frequency of SDW removal is once a day, in the case of the signal method, once every 3 days.

Table 26. Level of coverage of MSW removal services

	Years (%)					
Region	**2016**	**2017**	**2018**	**2019**	**2020**	**2022**
Total for the Republic	12.88%	26.92%	32.35%	53.36%	85.57%	86.06%

Source: Republican Center for Organization of Sanitary Cleaning Works, 2023.

Currently, there are 4,160 WCPs in the country, of which 2,455 are equipped with cabins and 1,121 without cabins. A total of 79 are underground, and 505 are modular. Recyclable solid and hazardous household waste is sent for sorting for subsequent sale and/or transfer on a contractual basis to legal entities engaged in waste disposal and recycling. There is a dynamic of increasing providing the population with solid municipal waste services (Table 26). At present, this indicator is 85%. This was ensured through the acquisition and commissioning of new specialized equipment. The degree of waste recycling in the Republic is 32.4% (Table 27).

Table 27. Degree of waste recycling on the territory of the Republic of Uzbekistan (as of January 1, 2023)

	Number of enterprises	Population coverage	Disposed waste (tonnes)	Recycling waste (tonnes)	Degree of processing (%)
Total for the Republic	256	36,024,947	6,816,840	2,208,235	32.4

Source: Republican Center for Organization of Sanitary Cleaning Works, 2023.

Waste segregation is done at waste collection stations, collection trucks, and waste disposal facilities. Separately collected recyclable waste, mainly plastics, paper, and scrap metal, is bought up by resellers or agents who sell it to recycling companies. An important step toward improving the efficiency of MSW management is the establishment of specialized clusters in nine cities (Andijan, Nukus, Bukhara, Jizzakh, Karshi, Navoi, Termez, Gulistan, and Urgench) for collection, transportation, sorting, processing, and final disposal. Toshrangmetzavod Recycling LLC is engaged in e-waste recycling in Uzbekistan, including temperature control equipment, screens, monitors, and other large-sized equipment.

A number of enterprises have started processing such toxic waste as chromium-containing galvanic sludge, glass sludge, refractory bricks and abrasive materials, paint and plastic waste, aluminum slag, car batteries, and car tires. Dewatered sludge from municipal wastewater treatment plants is successfully used as organic fertilizer in farms near cities.

The allocated areas for SDW disposal are not equipped with means of controlling pollution of atmospheric air or surface waters of the neighbouring territories. According to the Programme of State Monitoring of Environment in the Republic of Uzbekistan for 2021–2025, monitoring of sources of soil pollution is carried out twice a year in the areas of SDW storage, sludge and tailing ponds, and industrial waste storage. Missing or insufficient information does not allow the establishment of a cause-and-effect relationship of pollution of environmental components from the impact of landfills and areas allocated for MSW storage. From an environmental point of view, MSW storage at landfills leads to groundwater pollution, dust generation, emissions of methane and other toxic gases, and unpleasant odours.

Organic food waste is the least hazardous waste, as it does not damage the environment and decomposes relatively quickly (in about 2 weeks). However, excessive organic waste, when affected by high air temperatures, promotes an accelerated development of microflora, including pathogenic microorganisms, which can lead to the spread of harmful and dangerous bacteria.

6.3.3 Response

Waste in Uzbekistan is regulated by the Law on Waste dated 5 April 2002 No. 362-II. The purpose of this law is to regulate waste management, aiming to protect citizens from the harmful effects of waste while promoting waste reduction and re-use. Another important legislative act for the country is the Resolution of the Cabinet of Ministers of 27 October 2014 No. 295 on Approval of the Procedure for State Accounting and Monitoring in the Sphere of Waste Management,

which defines the reporting procedure for waste data in the country. Data on waste are published in the publication Main Indicators of Nature Protection, Rational Use of Natural Resources, Forestry and Hunting. Data on wastes and scrap are gathered using the state statistical industry reporting format.

Since 2017, there have been significant improvements in the waste management system in Uzbekistan. A number of resolutions and decrees of the President of the Republic of Uzbekistan and the Cabinet of Ministers were adopted. They include the following: Decree of the President of the Republic of Uzbekistan on Measures for Cardinal Improvement and Development of the Waste Management System for 2017-2021, 21 April 2017, No. PP-2916; Decree of the President of the Republic of Uzbekistan on Measures for Further Improvement of the Household Waste Management System, 18 May 2018, No. PP-3730; and the Decree of the President of the Republic of Uzbekistan on Measures to Further Improve the System of management of Activities in the Sphere of Household and Construction Waste Management of 29 September 2020, No. PP-4846. In general, seven decrees, six resolutions, one order of the President of the Republic of Uzbekistan, 21 resolutions of the Cabinet of Ministers of the Republic of Uzbekistan, and five departmental normative legal acts were adopted to regulate waste management issues. From these, the Solid Waste Management Strategy in Uzbekistan for 2019–2028 aims to create an effective solid waste management system. The Strategy was approved by the Decree of the President of Uzbekistan of 17 April 2019, No. PP - 4291. The objective of the strategy is to reduce and minimize the negative impact of MSW on the environment. This new strategy aims to create an efficient waste management system and offer opportunities for investors to realize various waste management projects.

Significant work has been done to improve the infrastructure of the household waste management system and to create clusters for integrated household waste management with a total capacity to process more than one million tonnes of household waste per year. Public-private partnership projects in waste management have been expanded. Under the Agreement between the Ministry of Natural Resources of the Republic of Uzbekistan and the South Korean Institute of Environmental Industry and Technology, the implementation of USD 6.6 million worth of environmental projects has started. In March 2023, UNICEF handed over medical waste management facilities to the Ministry of Health of the Republic of Karakalpakstan. Medical waste disposal facilities are being prepared for launch in Surkhandarya and Syrdarya regions under a program funded by the Vaccine Alliance and UNICEF.

From January 1, 2024, Uzbekistan will ban the production and sale of polymer packaging with a thickness of less than 100 microns. This does not apply to plastic roll bags and biodegradable bags for farm products. Uzbek specialists have developed a technology for the production of biodegradable household bags certified by the prestigious British–Canadian laboratory WELLS and the Queen Mary University of London. In Tashkent city in the last year, 720 special bins of three different colours for separate collection of waste (paper, plastic, and other wastes) were installed.

In the sphere of SDW management in Uzbekistan, new procedures and mechanisms based on Zero-Waste principles will be introduced. The Decree of the President of the Republic of Uzbekistan on Measures to Transform the Sphere of Ecology and Environmental Protection and the Organisation of the Activities of the Authorised State Body, 31 May 2023, No. UP-81, provides for transition to separate collection and disposal of household waste depending on its type. It is

planned to introduce circular economy practices: newly generated waste should be recycled or incinerated to the maximum level without sending it to landfills. It is planned to gradually achieve full recycling and incineration of waste in landfills.

7.0 Human Health and Well-Being

Table 28. Trends in key indicators — human health and well-being

Indicator	Long term (10 years)	Medium term (3 years)	Details
Life expectancy	Positive	Stable	Life expectancy at birth (both sexes) decreased from 75.1 (2019) to 74.3 years (2022).
Children's food security and nutrition	Stable	Positive	All indicators improved between 2019 and 2022. Further improvements in children's health are a policy priority.
Cardiovascular and respiratory health	Stable	Positive	Improvements were made, but the rate is still high compared to Organisation for Economic Co-operation and Development countries.
Occurrence of cancers	Negative	Stable	The incidence rate of malignant tumours (per 100,000 people) with first-time diagnoses among the total population ranges from 66.1 (2013) to 72.4 (2018). The proportion of cancer as a cause of death in the population aged 30–69 years: 15.1% (2019) to 14.0% (2022).
Food and nutrition	Positive	Positive	Significant improvements in consumption of nutritious food, including milk, diary products, eggs, and fruits.

Source: Authors.

- Proportion of children under 5 years of age who are stunted and underweight has been decreasing in recent years. As a result, there has been a clear improvement in the health of the population. In particular, the number of underweight children has decreased three times in the past 16 years, i.e., from 5.1% (Multi-Indicator Cluster Survey [MICS], 2006) to 1.8% (MICS, 2021–2022; UNICEF 2007, 2022). In addition, reducing child mortality by 2030 is one of Uzbekistan's development goals. The WHO estimates that more than 11 million child deaths could be prevented by increasing the availability of vaccinations, improving health care, and providing women with education on family planning and reproductive health.
- According to recent data, the probability of dying prematurely (under the age of 70) from four major groups of noncommunicable diseases (NCDs) (cardiovascular diseases, diabetes, chronic respiratory diseases, or cancer) for an Uzbek citizen is higher than 1 in

4 (26.9%), with a much higher probability for men (32.9%) than for women (21.4%) (WHO, 2018). In addition, diseases of the cardiovascular system occupy a special place in the structure of mortality causes.

- A large number of patients with oncological diseases are registered in the Republic each year. The incidence rate of malignant tumours (per 100,000 people) with first-time diagnoses among the total population ranges from 66.1 (2013) to 72.4 (2018). Given that many epidemiological studies point to solar radiation as a cause of skin cancer in humans, a retrospective analysis of the incidence of melanoma has been carried out. In addition, the proportion of cancer as a cause of death in the population aged 30–69 years is as follows: 15.1% (2019) to 14.0% (2022).
- Recent years have seen positive trends in nutrition through structural changes in food consumption by the Uzbek population. In particular, clear evidence of this is the per capita increase in the consumption of meat and meat products by a factor of 1.3, milk and dairy products by a factor of 1.6, eggs by a factor of 2.2, vegetables by a factor of 2.6, and fruit by a factor of 4.

7.1 Drivers, Pressures, State and Impacts

Non-communicable Diseases

Numerous scientific studies indicate that widespread noncommunicable diseases such as cancers, cardiovascular diseases, blood and hematopoietic diseases, etc. are multifactorial diseases, i.e., diseases that are shaped by a combination of genetic, environmental, and accidental factors. According to the State Statistics Agency of Uzbekistan, NCDs are responsible for more than 70% of all deaths in Uzbekistan, almost similar to the NCD mortality rate (71%) at the global level. According to recent data, the probability of dying prematurely (under the age of 70) from four major groups of NCDs (cardiovascular diseases, diabetes, chronic respiratory diseases, or cancer) for an Uzbek citizen is higher than 1 in 4 (26.9%), with a much higher probability for men (32.9%) than for women (21.4%) (WHO, 2018).

Respiratory diseases are the most common NCDs in most regions; in some regions, especially in Karakalpakstan, blood and haematopoietic diseases come first. In general, the population most often seeks medical care in medical institutions for diseases such as those of the respiratory organs, blood and blood-forming organs, cardiovascular system, endocrine system diseases, and neoplasms (Ministry of Health, n.d.). Diseases of the cardiovascular system are unique in the structure of mortality causes, accounting for more than 50% of all causes of death. Every fifth disabled person who has lost permanent working capacity has cardiovascular disease (Data sources: Ministry of Health; Institute for Health Metrics and Evaluation, n.d.).

A large number of patients with oncological diseases are registered in the Republic each year. The incidence rate of malignant tumours (per 100,000 people) with first-time diagnoses among the total population ranges from 66.1 (2013) to 72.4 (2018). The highest rates are in Bukhara region (72.6 and 78.7 respectively), Tashkent city (144.9 to 176.4 respectively), and Tashkent region (64.9 to 80.8 respectively). Given that many epidemiological studies point to solar radiation as a cause of skin cancer in humans, a retrospective analysis of the incidence of melanoma has been carried out. An increase in skin cancer "melanoma" has been noted in a number of regions of the

republic: the Republic of Karakalpakstan, Andijan, Jizzakh, and Khorezm regions, and in the city of Tashkent. At the same time, a decrease in the incidence of melanoma has been noted in some regions: Bukhara, Navoi, Tashkent and Fergana regions (Data source Ministry of Health).

Air Quality

Numerous studies carried out in cities in the Republic (Tashkent, Almalyk, Chirchik, Fergana, Navoi, and Angren) confirm the quantitative relationship between the degree of atmospheric air pollution and the levels of morbidity in the population. In particular, air quality affects the prevalence of cardiovascular and respiratory diseases and cancers. Respiratory diseases account for more than 20% of the primary morbidity rate (according to the population's demand for medical care in the country's health care establishments). Epidemiological studies show that bronchitis symptoms in children with asthma worsen with long-term exposure to NO_2. In addition, sporadic cases of C0 concentrations in household indoor air exceeding the hygienic standard have been reported yearly during the heating season (Ministry of Health of Uzbekistan, n. d.).

Children under 5 years of age with physical development delays have been identified in almost all districts of the Republic of Karakalpakstan, with an upward trend in recent years in comparison with the initial 1998 figure. The study of the functional capacity of the respiratory organs has revealed a decrease in the average values of the vital capacity of the lungs and muscle strength in modern school-age children, which indicates the impact of adverse environmental factors (Kamilov et al., 2007).

Water Access

In recent years, dangerous infections, such as cholera and plague, have not been registered among the Uzbek population. However, infectious diseases are of some concern. Global experience shows that the indicator of public access to safe drinking water and adequate sanitation is of paramount importance in the prevention of waterborne diseases. In 2021, about 69.6% of the population of the Republic was covered by centralized water supply networks. However, the lowest coverage of centralized water supply networks was observed (mainly among the rural population) in the Republic of Karakalpakstan (52.4%), Bukhara (53.4%), Kashkadarya (54.2%), Surkhandarya (54.5%), and Khorezm regions (56.5%). Overall, 30.3% of the population (predominantly rural) uses water from alternative sources; the population living remotely or without alternative sources (about 0.1%) uses imported water. The hourly supply of drinking water, practised in most regions of the country, contributes to changes in its quality in terms of microbiological indicators. For this reason, the provision of safe drinking water is a major concern in a number of regions.

The Sanitary-Epidemiological Welfare and Public Health Service supervises 405 municipal and 4,743 rural and departmental water supply systems. Of these, 65 and 79, respectively, open reservoirs serve as sources of drinking water, which supply the population, mainly in large settlements. The rest of the water pipes, i.e., more of them, are fed from underground sources. Of the total number of urban water pipes, 11.8% did not meet sanitary and technical requirements, including 50% because of non-compliance with sanitary protection zone area standards and 60.4% because of a lack of a complete set of necessary water treatment facilities. Rural waterworks (6.8%) did not meet sanitary and technical requirements, mainly due to lack of disinfection facilities (67.9%) and 33.0% due to non-compliance with the sanitary protection zone (33.0%). Worn out

and untimely replacement of water networks in water supply systems in settlements causes major accidents, secondary contamination of drinking water, and large losses of drinking water.

During the COVID-19 pandemic, the quality and safety of potable tap water was stable. With the start of the pandemic, disinfection regimes at water intake facilities were tightened and a strengthened schedule for sampling water for microbiological and virological issues and control of especially dangerous intestinal infections was implemented to prevent a worsening of the epidemic. As a result, the quality of drinking water met the national standard for microbiological indicators.

High levels of mineralization in drinking water contribute to a number of diseases, such as coronary heart disease, hypertension, diseases of the blood and blood-forming organs, urolithiasis, liver and urinary tract diseases, and cancer. In Uzbekistan, the highest levels of mineralization and general hardness of drinking water are annually registered in Bukhara and Khorezm regions, some districts of the Ferghana, Tashkent, Syrdarya, and Navoii regions, and the Republic of Karakalpakstan. Low levels or lack of fluoride in drinking water is experienced in all regions of the Republic.

During the summer months, during the low-water period, the concentration of mineral salts in water in centralized water supply sources increases, especially in the lower reaches of the Amu Darya River and parts of Fergana, Tashkent, Syr Darya, Navoi, and Bukhara regions. This is especially relevant in the current context of a growing shortage of clean fresh water and unfavourable environmental conditions of water bodies, including sources of centralized and decentralized drinking water supply in the Republic of Karakalpakstan and Khorezm region.

Food and Nutrition

Recent years have seen positive trends in nutrition due to structural changes in food consumption by the Uzbek population. In particular, clear evidence of this is the per capita increase in the consumption of meat and meat products by a factor of 1.3, milk and dairy products by a factor of 1.6, eggs by a factor of 2.2, vegetables by a factor of 2.6, and fruit by a factor of 4. As a result, there has been a clear improvement in the health of the population. In particular, the number of underweight children has halved in the past 16 years, i.e., from 5.1% (MICS, 2006) to 1.8% (MICS, 2021–2022; UNICEF, 2007, 2022). The prevalence of overweight (4.5%) among children in Uzbekistan is considered a minor public health problem. This rate is lower than that found by the MICS in 2006 (7.3%) (UNICEF, 2007). This rate is comparable to and lower than that found recently in Turkmenistan (5.9%), Tajikistan (5.51%), and Azerbaijan (5.2%).

There are significant dangers associated with a lack of nutrients such as iodine, vitamin A, folic acid, and iron. In Uzbekistan, fortification of foodstuffs with these micronutrients is practised (iodization of food salt, fortification of flour) to ensure their sufficient intake in the human body. The quality of edible salt is also regularly checked in the country. Iodine content was found in 60% of samples of food salt tested, of which more than 40% were considered sufficiently iodized (Ministry of Health, 2019).

Most households (62.0%) included in the studies baked their own bread (cakes). Only a third of the flour samples sampled in the households were fortified with vitamin A and iron-containing preparations. It should be noted that the national standard regulates only the fortification of first-grade flour and does not apply to imported flour varieties. Half of the households surveyed were

found to consume imported flour. Consumption of iron-fortified bread by children was quite high (more than 60%).

Anemia among women has declined by a factor of 2.5. As a result, average life expectancy has increased by 6.5 years. However, about a third of pregnant women are anemic. This fact represents a moderate public health problem, according to the WHO classification. Pregnant women aged 40–49 years and women in the third trimester of pregnancy were more likely to be anemic compared with other women. No correlation has been established between anemia and the well-being of households living in either rural or urban areas, and women's education.

Almost half of the non-pregnant women had iron deficiency. The prevalence of iron deficiency was not statistically different between urban and rural women (Narmukhamedova et al., 2019). There was a statistically significant difference in the prevalence of iron deficiency by region, ranging from 52.1% in Kashkadarya region to 62.4% in the Republic of Karakalpakstan. Women with a higher level of education were more likely to suffer from iron deficiency than women with a lower level of education. This analogy was also found among women according to income level: women from wealthier households were more likely to suffer from iron deficiency than women from poorer households (Narmukhamedova et al., 2019).

In contrast to other regions of the country, the prevalence of iron deficiency anemia in children is 2.5 times higher in the Republic of Karakalpakstan. The nature of the course of anemia has changed. Mothers with children with iron deficiency anemia and living in environmentally disadvantaged areas were significantly more likely to have abnormal pregnancy, childbirth and other perinatal abnormalities: anemia was 3 times more frequent, pregnancies were twice as often terminated, and the number of bed days was 2.5 days higher than in Tashkent (Kurbanov et al., 2006).

Food Safety

Ensuring food safety requires cross-sectoral cooperation at all stages, from primary production processes and feed production to delivery to the final consumer. In Uzbekistan, deviations from hygienic standards are noted for organoleptic indicators (acidity, transparency, and sediments), as well as for the content of toxic elements (lead, cadmium, and zinc), for the energy value of food products, for the content of iodine in food salt, for organic impurities in beverages, for the content of nitrates in crop products, and other indicators (Ministry of Health of the Republic of Uzbekistan, 2022).

7.2 Responses

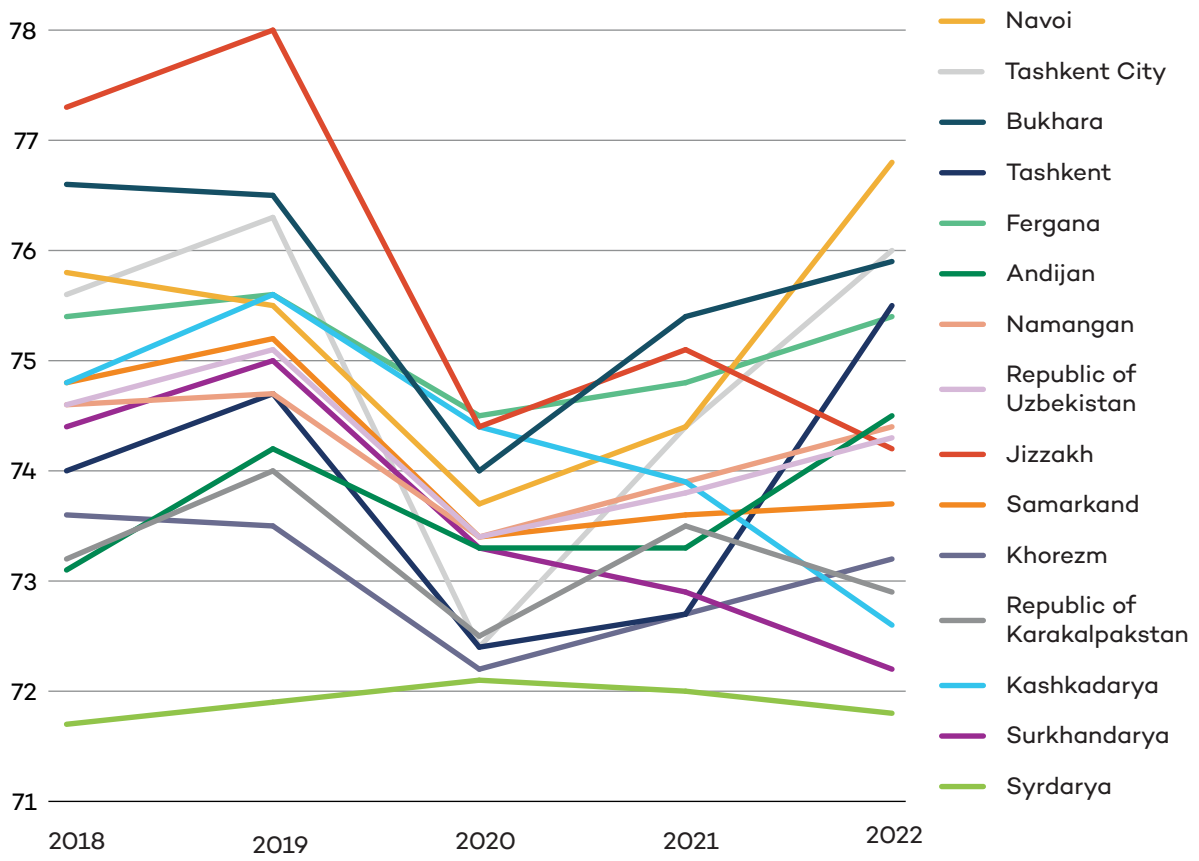
Improving the quality of life of the population is one of the priorities of Uzbekistan's socio-economic policy. The relationship between policy and practice becomes evident in the assessment of demographic indicators: life expectancy, total mortality, and under-1 and under-5 mortality. Since independence, Uzbekistan has achieved a significant increase in life expectancy, a reduction in mortality rates, and a significant reduction in rates of infectious diseases through scientific and technical progress in the reform of health care and changes in living conditions. In 2021, life expectancy for women was 75.8 years, compared to 73.6 years in 2000; for men, it was 71.7 years and 68.4 years, respectively; for the country as a whole, 73.8 years and 70.8 years. The maternal mortality rate decreased from 21.4 per 100,000 live births (2000) to 14.4 (2021) according to official statistics (SDG 3.1), the newborn mortality rate (under 1 year/per 1,000 live births)

decreased from 17.3 (2000) to 6.4 (2021); under 5 mortality was 28.5 and 12.3 respectively (SDG 3.2) in the same period.

Reducing child mortality by 2030 is one of Uzbekistan's development goals. The WHO estimates that more than 11 million child deaths could be prevented by increasing the availability of vaccinations, improving health care, and providing women with education on family planning and reproductive health.

One of the main public health challenges in Uzbekistan is the proper development and implementation of disease-prevention strategies and tactics among the population. The Concept for the Development of the Health Care System of the Republic of Uzbekistan for 2019–2025, established by the Decree of the President on Comprehensive Measures to Radically Improve the Healthcare System of the Republic of Uzbekistan of 7 December 2018 No. UP-5590, defines the goals, tasks, and main directions for the further development of health care, improving the quality and accessibility of medical care, supporting healthy lifestyles, preventing and combating infectious and non-infectious diseases, and improving the system of health care for mothers and children.

Figure 6. Life expectancy at birth, Uzbekistan



Source: Statistics Agency, 2022.

Uzbekistan, which supported the principles of the Rio Declaration and the Global Agenda 21 and adopted 16 SDGs until 2030, has defined the main directions of the country to provide its population with good-quality drinking water in the main national program documents: the State Programme for Rural Drinking Water Supply, the Rural Water Supply Development Project in Western Uzbekistan (Karakalpakstan and Khorezm region), the Urban Water Supply Improvement

Programme in some cities of Bukhara, Syrdarya, Jizzakh, and Khorezm regions. These national programs and projects are implemented with the support of international organizations.

In particular, the Decree of the President of Uzbekistan on Measures for the Further Improvement of the Drinking Water Supply and Sanitation System, as Well as Increasing the Efficiency of Investment Projects in This Area, 25.09.2020, No. UP-6074, establishes the summary parameters of the program of comprehensive development of the drinking water supply system in republican and regional cities and district centres in 2021–2025, as well as the summary parameters of the program of comprehensive development of sewage systems. According to them, it is envisioned to increase the level of supply of the population with good-quality drinking water in cities by up to 98.5% and in rural areas by up to 87%. The level of supply of sewage services is envisioned to be increased in cities by up to 87% and in rural areas by up to 53.7%.

Uzbekistan has adopted and implemented a framework and a set of measures to ensure healthy nutrition for its population for the period 2015–2020. The Republic continues to work to provide the population with good-quality and safe food products, cooperating with international organizations, such as FAO, WHO, and others. In this regard, the Decree of the President of the Republic of Uzbekistan on Additional Measures to Ensure Healthy Nutrition for the Population, 10.11.2020, No. PP-4887, established a procedure for ensuring the health of the population, according to which: a) starting from June 1, 2021, micronutrient powders are provided free of charge to children aged 6–23 months to enrich food prepared for them at home; vitamin A to children aged 6 months to 5 years; and special preparations for the prevention of helminthiasis to children aged 2–10 years; b) starting with July 1, 2022, free iodine preparations for pregnant and lactating women, as well as children aged 3-15; iron and folic acid preparations for women of childbearing age up to 35 years; c) starting with April 1, 2021, in addition to first grade wheat flour, the highest grade wheat flour may be sold in the country, fortified with micronutrients.

Along with laws, food safety issues are one of the main areas of State policy, which has, in recent years, led to the adoption of presidential decisions and decrees on food safety, food items labelling and healthy diets. In addition, the agricultural development strategy of the Republic of Uzbekistan for the period 2020–2030 was validated, and the New Uzbekistan Development Strategy for 2022–2026 has been adopted (Decree of the President 2019; Decree of the President, 2022) with specific efforts to promote healthy and nutritious food production and consumption, while also promoting growth in the agricultural sector.

A number of targeted national programs have been implemented to improve the reproductive health of the population and protect maternal and child health. National and regional screening centres have been set up to prevent the birth of children with hereditary and congenital diseases. New standards for the diagnosis and treatment of patients have been approved as part of the national program for improving endocrinological care to the population of the Republic in the period 2019–2021. About 75,000 patients are provided with free insulin at a cost of more than UZS 40 billion from the state budget; the material and technical basis of 14 regional endocrinological institutions has been strengthened at a cost of about UZS 200 billion, and they are provided with modern equipment worth USD 3.3 million. Nevertheless, work is underway to review the effectiveness of medical and social measures relating to the establishment of the endocrinology service as a single integrated system throughout the country, the prevention of diseases related to iodine deficiency, the prevention of diabetes and treatment of its consequences, and the

monitoring of each patient through the introduction of a modern dispensary (online register) of diabetic patients.

Immunization against infectious diseases is part of the government's comprehensive health care for children and adolescents. It is available, compulsory, and free. Children and adolescents are 95%–99% vaccinated annually at government expense under the Vaccine Alliance program, as well as technical and financial assistance from UNICEF and WHO. The creation of a system to provide primary health care through the organization of rural health units and urban and rural family outpatient clinics has made it possible to make such care more accessible to the population.

Approved and being implemented are the concepts for the development of the health, physical education, and sports system until 2025 and for the prevention of non-communicable diseases, support for healthy lifestyles, and the enhancement of physical activity in Uzbekistan until 2022, as well as measures for the broad introduction of healthy lifestyles and the further development of mass sports. The results of two studies on health risk factors show that the population does not follow the norms and rules for physical activity and diet. In addition, excessive consumption of food and sweets with high salt, sugar, and fat content, as well as inadequate intake of vitamins and minerals. All district (municipal) central multidisciplinary polyclinics have Proper Nutrition and Healthy Lifestyle Offices staffed by doctors and nurses who have received special training in eating and healthy lifestyles.

8.0 Raising the Levels of Environmental Knowledge and Public Awareness

On a regular basis, the Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan, with the assistance of the Information and Mass Communications Agency under the President of Uzbekistan, with the involvement of the media and the public, holds briefings, press conferences, and round tables devoted to current aspects of environmental protection. https://eco.gov.uz; https://t.me/ecogovuz

With a focus on **air pollution and protection**, there are campaigns and activities to address air quality challenges:

- "Car-Free Day" campaign. The aim of this campaign is to reduce the impact of vehicles on the environment and to encourage the use of bicycles for a healthy lifestyle. https://www.gazeta.uz/ru/2023/04/26/car-free-day/
- "European Mobility Week in Uzbekistan" is a campaign to improve the environment. Organized by the Delegation of the EU to the Republic of Uzbekistan, it encourages people to adopt sustainable means of transport, thus reducing greenhouse gas emissions and contributing to solving environmental problems. https://www.eeas.europa.eu/delegations/uzbekistan; https://www.facebook.com/EuropeanMobilityWeekUz

There are activities to promote **water conservation** and explore linkages between water resource management, biodiversity, and climate change. Specific examples include the following:

- International Amu Darya River Day and International Syr Darya River Day. As part of the events, various drawing, essay and video competitions on water-protection topics, races, etc. are organized for schoolchildren and young people; for example, a round table dedicated to the International Day of the Amu Darya River is organized. https://bigasia.ru/mezhdunarodnyj-den-amudari-otmetit-zabegom-uzbekistan/; http://ekois.net/mezhdunarodnyj-den-amudari-v-nukuse/; https://www.youtube.com/watch?v=MwcUluVwa68
- Under the auspices of the Ministry of Water Resources of the Republic of Uzbekistan within the framework of the National Water Management Project in Uzbekistan (funded by the Swiss Agency for Development and Cooperation), the mobile application Tomchi (Drop) was created in 2018. https://play.google.com/store/apps/details?id=app.nwrmp.tomchi&hl=ru&gl=US&pli=1
- The FAO, in collaboration with the Sustainable Development Innovation and Research Cluster, is implementing the project Effective Management of Digital Agriculture through GIS and Spatial Data. The project aims to improve the capacity and knowledge of local specialists and farmers in the field of spatial data to further develop smart farming. Source: https://www.uzdaily.uz/ru/post/69752; FAO-Uzbekistan. Information Bulletin, 2Q 2022(5), https://www.fao.org/3/cc1686ru/cc1686ru.pdf
- Additional activities include the following: a project on Awareness Raising and Partnership for Sustainable Water and Environmental Development in Uzbekistan (UzWaterAware). Component 3. European Union Program on sustainable water resources management

in the rural areas of Uzbekistan, whose national partner is the Ministry of Water Resources of the Republic of Uzbekistan. The project was implemented from November 2016 to November 2020 in nine regions of the country and the city of Tashkent. The UzWaterAware project developed and launched an online education platform in Uzbek and Russian, containing a training course called Reporting Water Efficiency for Sustainable Development. In addition, outputs in Uzbek, Russian, and English can be accessed at the UzWaterAware Project channel; https://eco.gov.uz/ru/site/news?id=1101

- Charity events in honour of the World Water Day "Drop of Life." The flash mob is to draw people's attention to water conservation and to encourage them to protect this precious gift of nature.
- Training project for journalists and bloggers on raising awareness of journalists and bloggers in Uzbekistan on covering water use and water conservation issues. Organizers: Centre for Retraining of Journalists of Uzbekistan together with the Canadian Foundation for Local Initiatives.
- A publication aimed at policy-makers, sector managers, and technical experts based on the findings of a study conducted by the FAO team under the World Bank's Regional Programme Exposure and Practical Steps for Irrigation Modernisation in Central Asia. Source: https://www.fao.org/publications/card/en/c/CB8230EN

Awareness-raising efforts and communication on **climate change** include the following examples:

- Uzbekistan is a party to the UNFCCC, and Article 6 of the Convention (Education, Training and Public Awareness) has a number of obligations, in particular ensuring public access to information on climate change and its impacts. In 2018, the Republic began work on adapting and implementing the Climate Box, a training manual published by UNDP in 2014.
- The Climate Box kit was adapted as part of a joint project of UNDP, the Adaptation Fund Climate Resilience of Farms and Dekhan Farms in the Arid Territories of Uzbekistan, funded by the Russian Federation, in close cooperation with Uzhydromet and the Republican Centre for Education of MNO. To implement the project in Uzbekistan, the Republican Education Centre developed a training manual for teachers in general education schools. The pilot of the training manual was carried out in three schools of Tashkent city. https://climate-box.com/wp-content/uploads/2021/04/Climate-Box_Training-Module-for-Teachers_RUSSIAN-1.pdf
- Conducting training seminars on the importance of zero-tillage in crop production in Bukhara and Kashkadarya regions. Participants in the event were told about the advantages of zero-tillage, an arable farming technology in which soils are not mechanically cultivated, and the surface is covered with shredded crop residues. Zero-tillage practices are recommended in arid areas, including the project areas of ISCAUZR-2.
- The FAO and Ministry of Agriculture of Uzbekistan project Smart Farming for the Future Generation. By adapting greenhouses and optimizing production along five interlinked factors — climate management, pest and disease control, cultural practices, water management, and plant nutrition — providing rural residents with a stable source of income. The beneficiaries were selected from rural households with low and irregular

incomes. Emphasis is placed on providing employment for women and young people. To date, greenhouses in 20 households in Andijan, Namangan, and Fergana regions have been upgraded and optimized. FAO and Ministry of Agriculture project Preparing the Ground for Digital Transformation of Agriculture has been implemented.

Examples of activities aiming to increase awareness and education about **biodiversity and ecosystem management** include the following:

- World Biodiversity Day activities (https://eco.gov.uz/ru). and the We Care for Nature campaign as part of the national Yashil Makon movement. Source: @ekologuzru
- Actions of the Ekomaktab NGO Environmental Resource Centre. Every year, it organizes volunteer movements in cooperation with the Green World club in Gazalkent for the restoration of the Chimgan forest. For example, students from the Gubkin Russian State University of Oil and Gas in Tashkent took an active part in the Chimgan forest restoration movement. https://gubkin.uz/ru/sveden/987/studenty-goroda-tashkent-vmeste-s-proektom-ekomaktab-i-klubom-zelenyy-mir-goroda-gazalkent-pomogayut-v-vosstanovlenii-chimganskogo-lesa
- For the One Million Fruit Trees initiative, CACILM-2 has donated 2,000 grape seedlings as well as 10,000 apple tree rootstocks to the branch of the Academician Mahmud Mirzaev Scientific Research Institute of Horticulture, Viticulture and Winemaking in the Kegeili district of Karakalpakstan. CACILM-2 also supports farmers by providing seeds of drought- and salt-tolerant crops. In the past, 2,000 kg of chickpea seeds, 6,900 kg of safflower seeds, 5,800 kg of flax seeds and grape seedlings of Sogdiana (2,000), Rizamatota (2,000), Toifi (2,500), and Kishmish (5,000) were distributed to farmers in the Kamashin district of Kashkadarya region. A Regional Training and Outreach Centre at Kitab Forestry has been opened, providing training sessions with forestry experts for farmers and other stakeholders from the southern regions of Uzbekistan.
- Global Framework Programme–Supporting Early Action project. This initiative is a new joint project of the Ministry of Ecology of Uzbekistan and UNDP, funded by GEF. The program provides a good framework for global action on biodiversity, complementing the Paris Climate Agreement and paving the way for a climate-neutral, nature-positive, and sustainable world by 2050. The project will support the Government of Uzbekistan in revising the National Biodiversity Strategy and Action Plan as well as related policy, monitoring, and financing for nature conservation.
- An environmental event to mark the International Year of the Mountains. https://livingasia.online/2022/05/09/god-gor-v-samarkande/
- Projects of the GEF Small Grants Programme (GEF SGP) in Uzbekistan to support environmental initiatives, https://sgp.uz/

In addition, various environmental education and awareness projects have addressed the preservation of the Aral Sea and region, including the Aral Sea Dream project promoting the Aral Sea issues in the world's mass culture and contributing to the cultural and intellectual development of the region; the Programme for the Involvement of Civil Society and the Younger Generation in Activities for the Conservation of the Saiga Population and the Restoration of its Natural Ecosystems in the Republic of Karakalpakstan for 2019–2021, and other activities and events to encourage innovative solutions to the Aral Sea region.

Specific activities to increase awareness and education about **waste management, reduction, and recycling** include the following:

- **Hashar Week project**. This project aims to make citizens more responsible for waste management and recycling. The main message of the project is "**clean not where you clean, but where you litter.**" There were 21 waste collection sites staffed by volunteers who explained the essence of the project. During the week, activities were carried out in four areas: Action, Education, Art, Business. During Hashar Week, over 1.5 tonnes of sorted litter was collected, 60% of which was plastic, 35% paper, and 5% glass. Volunteers also conducted interactive lessons in 22 schools in Tashkent and four public lectures. https://uznature.uz/ru/site/news?id=105; https://livingasia.online/2019/04/17/hashar_week/
- A youth ecological expedition to the Ugam–Chatkal National Nature Park. The eco-volunteers cleaned up the natural area of the Leskhoz along the Gulkamsay riverbed. https://www.uznature.uz/uz/site/news?id=1034
- The campaign under the slogan "**Give Nature a Chance**." This is an innovative project of the AI company and the republic's environmental agency. It included the launch of Toshrangmetzavod Recycling LLC, whose activities focus on the collection, recycling, and disposal of electronic waste among individuals and legal entities, as well as the creation of related infrastructure in the capital and other regions of the country.
- **Action Plogging**. This is a marathon that actively involves volunteers who care about the cleanliness and well-being of their area.
- **Zero Waste Action**. https://uza.uz/ru/posts/plogging-sposobstvuet-predotvrascheniyu-ekologicheskix-problem_468708
- Participating in **World CleanUp Day**: Volunteer Mass Outreach. World CleanUp Day actions **#WorldCleanUpDay**: Youth for Cleanliness. Uzbekistan, together with the international community, has been taking the most active part in World Cleanup Day since 2019, and it gets bigger every year. Since 2019, every year, on the third Saturday of September, on the occasion of **World Cleanliness Day**, waste collection events are held in the regions among different parts of the population. A competition is being announced for the best social videos dedicated to World Cleanliness Day.
- **GO Wasteless** project, implemented by the NGO Ekomaktab, Environmental Resource Centre. Objective: To provide intelligent collection of recyclable waste from the public catering sector (HoReCa sector) and to establish a collection and recycling chain through the "Wasteless" mobile app. The project is implemented in partnership with the Ministry of Ecology of Uzbekistan and the Coca-Cola Company in Uzbekistan, with financial support from The Coca-Cola Foundation. As part of the project, the #PET2NATUREUZ environmental challenge has been launched. https://ru.coca-cola.uz/media-center/navruz-coca-cola-eco-pet2nature-uzbekistan

8.1 Environmental Education

Article 4 of the Law of the Republic of Uzbekistan on Nature Protection prescribes **compulsory nature education in all types of educational institutions**. Cabinet of Ministers Decision No. 434 of 27 May 2019 approved the Concept for the Development of Environmental Education

in the Republic of Uzbekistan. The aim of the Concept is to form and develop environmental knowledge, awareness, and culture among the younger generation, to organize the environmental teaching and educational process effectively, and to further improve science in the field of ecology, using advanced and innovative technologies.

The basic Bolajon program is used in **preschool educational** institutions, focusing on awakening children's first ideas about the conservation and preservation of their native environment and on covering the topics of conservation, ecology, and environmental protection. In order to fully organize the thematic and practical environmental education activities defined in the basic program in pre-school educational institutions, the "environmentalist child" program is being introduced. In the framework of a joint project of the Ministry of Preschool Education of Uzbekistan and the Ekomaktab NGO Environmental Resource Centre with the support of the Project Coordinator of the Organisation for Security and Co-operation in Europe Office in Uzbekistan, a partial program "The Earth Is Our Common Home" was developed for pre-school educational organizations on environmental education and upbringing.

The educational programs for the middle, older, and pre-school preparatory groups aim to instill ideas about plant and animal life as well as about non-living and living nature, which take place on walks. In redefining the topics, special attention is paid to the conservation and preservation of endangered and rare species of flora and fauna. Pre-school educational programs are enriched with concepts such as environmental protection and cleaning up domestic waste.

In the Republic's general education schools, there are no special subjects on ecology or environmental protection. Issues of ecology are integrated into existing subjects such as biology, chemistry, botany, zoology, geography, and others. The content of the state educational standard and general secondary education curricula is enriched by the following qualifications: broad introduction of knowledge, skills, and abilities that contribute to the formation of an environmentalist culture among students and application of environmental knowledge within academic disciplines in practice. Environmental specialists are trained at a number of higher education institutions. Each year, about 300 environmental specialists graduate from the country's higher education institutions.

In the system of secondary, specialized, and vocational education, environmental knowledge is given to students, taking into account the focus of educational institutions. In addition to the requirements of general environmental education in secondary vocational and professional educational institutions, the daily rules of environmental protection and environmental features of sustainable development at the local level are included. For example, topics such as "the concept of the main factors of environmental and ecological systems," "biological and geological laws in nature, and causes of different ecological problems," "nature protection and rational use of natural resources," and "use of innovative ideas and technologies in ecology" are included into the structure of specific general and unique disciplines.

The undergraduate curricula of 5630100 "Ecology and Environment Protection" direction of higher education are improved with consideration of conducted reforms in the field of ecology and modern pedagogical technologies. Based on the analysis of demand and proposals of ministries and agencies, staffing requirements, and the current environmental situation, proposals on the inclusion of new directions and majors to the "Classifier of Directions and Majors of Higher Education" have been developed.

The Central Asian University for the Study of Environment and Climate Change (Green University) has been established in Uzbekistan. The university was opened on the basis of the relevant decree of the President of the Republic of Uzbekistan. The university aims to effectively manage local, regional, and global environmental problems, strengthen regional cooperation in the field of ecology and environmental protection, and introduce innovative ideas, practices, and technologies to realize Uzbekistan's scientific and intellectual potential.

Environmental non-governmental organizations (NGOs) and non-commercial organizations in Uzbekistan are the main driving forces behind environmental education and education for sustainable development programs and activities. The NGOs include the Ecological Movement of Uzbekistan, Ecoforum of NGOs of Uzbekistan, International Fund Ecosan, Association of Volunteers of Uzbekistan, Society for the Protection of Birds of Uzbekistan, Ecological Resource Centre Ekomaktab, and Ekolog.uz. The following NGOs are involved in the implementation of environmental programs and projects: Ecology of the Aral Sea and the Amu Darya, Logos, Zaravshan, For Ecologically Clean Fergana, Salomatlik Plus Ecology, Zhonli Tabiat, Shohimardonobod Suv, Orzu, KRASS, and Eko-Tib.

Environmental NGOs make many important contributions to managing natural resources and sustainable development. They focus on climate change, biodiversity, mountain area development, and environmental education and journalism. A specific feature of the organization of public participation in environmental protection in Uzbekistan is the existence of one major public organization, the Ecological Movement of Uzbekistan, with territorial branches in all regions of the country. In January 2019, representatives of the Ecological Movement established a political party called the Ecological Party of Uzbekistan (EPR, Uzbekistan, 3rd Review, 2020).

9.0 Way Forward

The relationship between environmental conditions and human well-being is extremely complex. Environmental factors vary in nature and character. They are social, economic, biological, chemical, physical, natural-climatic, etc. In order to answer all the questions related to the impact of the above factors, research should encompass a fundamental study of cause and effect relationships, risk assessment, assessment of population vulnerability, adaptive capacity, and intervention programs under different scenarios.

The report provides an overview of environmental trends in the context of socio-economic drivers and pressures. Uzbekistan is undergoing major development with considerable population and economic growth. The development progress leads to improvement in employment, income, production, and consumption; it also relies on natural resources, especially water and land. At the same time, this development trajectory is impacting the environment by emitting pollutants, using natural habitat for industrial and agricultural production, and impacting habitat and biodiversity. To explore these linkages between development and the environment, this report uses the DPSIR framework to connect major drivers and pressures of socio-economic development to the status of the environment. This report summarizes the trends across the major environmental components such as air, water, land, soil, and biodiversity. It also looks at the impacts of climate change, the challenges of Aral Sea degradation, and waste generation.

An environmental performance review conducted in 2020 confirmed the main achievements in the environmental sphere in 2009–2019. In addition, a number of key priority future directions were presented (EPR, Uzbekistan, 3rd Review, 2020).

Currently, however, interagency collaboration on the issue of monitoring the implementation of the recommendations proposed in that document has not been established. In light of this, it is advisable to establish a system of monitoring of implementation of these recommendations.

In addition, numerous studies of the connection between the environment and health carried out both in Uzbekistan and abroad, show that environmental pollution has a significant adverse effect on the health of the population. The report also outlines examples of major responses to indicate current efforts and inspire future actions.

Balancing environmental, social, and economic development aspects is the primary challenge in protecting Uzbekistan's environment and public health. The well-being of the population in terms of environmental, sanitary, and epidemiological conditions is fundamental for citizens to exercise their constitutional rights to health and a clean environment. This requires understanding the impact of a polluted environment on health and well-being.

The priority directions of state policy in the field of environmental protection, target indicators, and the Roadmap for the implementation of measures in 2019–2021 and subsequent years are determined within the framework of the Concept of environmental protection of the Republic of Uzbekistan until 2030, approved by Decree of the President of the Republic of Uzbekistan on Approval of the Concept of Environmental Protection of the Republic of Uzbekistan until 2030, 30 October 2019, No. UP-5863. As provided for in the approved document, the implementation of the Concept is carried out through the adoption of 3-year roadmaps. However, for the subsequent

period 2022–2024, a roadmap has not been approved. In this regard, it is advisable to consider the issue of developing and approving, in the prescribed manner, comprehensive environmental protection measures for the near future.

An increased demand for goods and services associated with a growing economy will result in increased GHG emissions, in particular from energy production and use as well as from industry. As a result of measures taken to expand alternative energy sources, mainly solar energy, there is an increase in electricity production from renewable energy sources. However, about 90% of Uzbekistan's energy is produced by burning fuel, a significant source of pollutants in the environment. Addressing air pollution and its effects on human health, water, soil, biodiversity, and other natural resources is an important task.

This report provides information on actions and activities aimed at improving the state of atmospheric air. At the same time, it is also necessary to provide for institutional measures, such as strengthening the legislative framework for measures to stimulate actions to improve energy efficiency and the use of low-carbon technologies in industrial production.

Ineffective resource management has a negative impact on the state of the environment. Sustainable exploitation of natural resources is one of the main ways of maintaining a healthy environment, biological richness, high productivity, and the viability of species populations. Climate change intensifies the processes of land degradation and desertification and thereby affects the condition of ecosystems and habitats.

The increasing scarcity of water resources in the republic, including those suitable for household and drinking purposes, and the desertification of large territories pose significant problems for the sustainable development of the republic. In addition, agriculture is the largest consumer of water resources, accounting on average for up to 90% of the water used. Insufficient implementation of water-saving technologies includes water losses in canals. There are current efforts made to introduce technologies to reduce water, use renewable energy sources and promote recycling along with sustainable solutions. Furthermore, food security is supported through projects to promote sustainable agriculture with the expansion of organic food production adapted to the current environmental and natural climatic conditions.

The Decree of the President of the Republic of Uzbekistan on The Concept of Development of the Water Sector of the Republic of Uzbekistan for 2020–2030, 10 July 2020, No. UP-6024, and the Strategy for water resources management and development of the irrigation sector in the Republic of Uzbekistan for 2021–2023, approved by the Decree of the President of the Republic of Uzbekistan on 24 February 2021 No. PP – 5005, provide for a number of priority measures, including adaptation measures, aimed at the stable provision of water to the population and all sectors of the republic's economy, taking into account climate change and the growing shortage of fresh water. It is necessary to integrate all water users into the process of managing water resources and their quality, as well as interdepartmental intensification of actions within the framework of national dialogues on water policy.

It is also important to stress that there are significant development prospects for many industries in the country, such as cotton, textiles, light, food, chemicals, and others, that are directly dependent on agriculture and energy. There are efforts made to introduce technologies to reduce water, use renewable energy sources and recycling, and promote sustainable solutions for urban and rural

populations. Given that Uzbekistan is an active party to international climate change, environment protection, and sustainable development mechanisms, much of this work is done in partnership with UN and other international bodies, the EU, other states, other Central Asian governments, and other partners.

Uzbekistan is a party to many international conventions, as well as protocols, agreements, and memoranda of understanding in the field of environmental protection and sustainable development. Uzbekistan has updated and strengthened its commitments on GHG emissions under the Paris Agreement for the period up to 2030. Various initiatives are being implemented on biodiversity conservation, ecosystem restoration in the Aral Sea region, ozone layer protection, and climate change mitigation. There are also strategies and programs to ensure access to healthy nutrition and clean water for the population. Regionally, Uzbekistan, together with other Central Asian countries, is working to expand mutually beneficial bilateral and regional cooperation on the use and introduction of modern energy and resource-efficient technologies and low GHG-emission technologies, as well as biodiversity monitoring and preservation programs and platforms to protect and support sustainable development in the Aral Sea region.

The report provides examples of awareness and educational efforts, but further efforts are needed to address the lack of public and decision-maker awareness of the importance and ways of improving aspects of the environment and improving scientific information on the status and importance of the environment, not only in strategies and policies focused on the environment but also in those oriented toward economic development. In addition, the public and various organizations in the country can take an active role in managing the environment and improving public health.

Finally, it is important to stress that this report provides an overview of the trends for a decade covering the period 2012 to 2022. There is a significant opportunity to continue the development of the environmental reports on a bi-annual basis to keep the decision-makers and public aware of the changes in the environment as well as drivers and pressures.

It should be noted that 2023 saw certain structural changes in the system of nature protection authorities. This has been an additional impetus in the intensification of activities in the field of ecology and a number of key events and programmes of 2023 can already be noted both at the national and international levels.

9.1 Selected Initiatives

13-17 NOVEMBER 2023
SAMARKAND, UZBEKISTAN
CRIC 21
United Nations Convention to Combat Desertification

21st session of the Committee for the Review of the Implementation of the UN Convention to Combat Desertification—CRIC-21

November 13–17, 2023, Samarkand, Uzbekistan | Silk Road Samarkand Congress Center

More than 700 participants, including delegates from member countries of the Convention, as well as 35 international organizations, 28 intergovernmental organizations, 74 non-governmental organizations, and leading academics, addressed challenges and opportunities in implementing strategic objectives on sustainable land management and drought resilience, supporting women's leadership in agriculture, preventing land degradation, and combating forced migration related to climate change.

President **Shavkat Mirziyoyev's** speech was delivered to participants at the **CRIC-21** opening ceremony session:

> The forum's agenda comprises critical topics related to joint efforts in countering climate challenges and fostering broad international cooperation in the fight against desertification. It is noteworthy that Uzbekistan and the entire Central Asian region are particularly vulnerable to the adverse impacts of climate change. The social and environmental problems caused by it have severe consequences that are fully felt in the region.
>
> **Shavkat Mirziyoyev**, President of the Republic of Uzbekistan

The UN Secretary-General addressed participants for the first time in the history of CRIC:

> Around the world, we see examples of land being given a new lease on life, including in Uzbekistan. And the world could surpass its neutrality target if it works together to halt new land degradation and accelerate restoration. To achieve this, we need governments, businesses, and communities to work together to conserve natural areas, scale up sustainable food production, and develop green urban areas and supply chains.
>
> I urge all of you to use this intersessional meeting to step up ambition and action to help make that a reality. Together, let's see degraded lands thrive once more.
>
> **António Guterres**, UN Secretary-General

More than 40 side events on desertification and drought issues were organized by international partners and stakeholders within the framework of CRIC-21. They served to widely publicize the ongoing work on a global scale and provided an opportunity for specialists to hold discussions and voice their expert opinions and forecasts. Over 80 international experts from 60 countries participated in the meeting of the Intergovernmental Working Group on Drought Solutions of the UN Convention to Combat Desertification. The high-level event on dust and sandstorms at the Samarkand session was recognized as the first global event on the subject and the full format of the UN officially emphasized the global nature of dust and sandstorm problems.

Uzbekistan initiated the development of the Samarkand Declaration on dust and sandstorms and proposed to consider and adopt it at the 16th Conference of the Parties (COP16) to be held in Saudi Arabia in December 2024.

Opening statements were made by:

Tanzila Narbaeva, Chairwoman of the Senate of the Oliy Majlis of the Republic of Uzbekistan.

Ibrahim Thiaw, Executive Secretary of the United Nations Convention to Combat Desertification (UNCCD)

Aziz Abdukhakimov, Minister of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan.

Selected quotes:

> The droughts, wildfires, and heat waves we are seeing around the world are symptoms of climate and natural crises that are worsening and interconnected. Since 2015, 4 million square kilometres of healthy and productive land has been lost—an area roughly the size of Central Asia. We urgently need to stop further land degradation and restore at least 1 billion hectares to meet global land use goals by 2030.
>
> **Ibrahim Thiaw**, Executive Secretary UNCCD

> It is no coincidence that CRIC-21 is being held in Uzbekistan, as it is an example of one of the most vulnerable countries experiencing all the negative impacts of land degradation, from increased droughts and sand and dust storms to loss of agricultural productivity and biodiversity.
>
> **Aziz Abdukhakimov**, Minister of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan

Figure 7. Overview of the 21st session of the Committee for the Review of the Implementationof the UN Convention to Combat Desertification (CRIC-21)

Source: Ministry of Ecology, 2023.

Figure 8. Executive Secretary of the UN Convention to Combat Desertification I. Thiaw at the action on laying the "CRIC-21 Green Park" in Samarkand

Source: Ministry of Ecology, 2023.

Figure 9. Minister of Ecology of the Republic of Uzbekistan A. Abdukhakimov meets with Feras Ziadat, Chairman of the UN Coalition to Combat Sand and Dust Storms

Source: Ministry of Ecology, 2023.

More information: https://www.unccd.int/convention/official-documents/cric-21-samarkand-uzbekistan-2023

World Summit on Climate Action and the 28th Conference of the Parties to the UN Framework Convention on Climate Change (COP 28)

November 30 - December 12, 2023, DUBAI (UAE) | Expo City Exhibition Center

> Climate change has already turned into a core challenge to sustainable development. It is even affecting the global geopolitical landscape.
>
> The adverse effects of climate change are particularly evident in Central Asia due to the Aral Sea catastrophe. In our region, the increase of temperature is twice as high as that of the global average. The number of extremely hot days has extended two times, and one third of the glaciers have completely melted down.
>
> **Shavkat Mirziyoyev**, President of the Republic of Uzbekistan

The National Pavilion of Uzbekistan at the Blue and Green zones at the Expo City Dubai displayed information about the environmental challenges and achievements in the country, information about biodiversity, activities in the field of the environment, as well as the tourist potential of the country. In addition, at the Central Asian Regional Pavilion, Central Asian state delegations actively promoted regional cooperation under the slogan "5 countries - 1 region - 1 voice."

Figure 10. Photos from Uzbekistan's National Pavilion, Expo City Dubai

Source: Ministry of Ecology, 2023.

Uzbekistan is one of those countries that have been most severely affected by the negative impacts of climate change, which has seriously affected ecosystem degradation, loss of habitat, and biodiversity. The government of the republic is committed to strengthening regional cross-border cooperation and is an advocate of strengthening measures to conserve and protect biodiversity and migratory species of animals, taking measures at the national, regional, and global levels. At the 14th meeting of the Conference of the Parties to the Convention on the Conservation of

Migratory Species of Wild Animals (CMS COP14), which will be held on February 12 to 17, 2024 in Samarkand under the slogan "Nature knows no borders," these problems will be given special attention.

More than 20 side events were held with coverage of various topics, such as the Aral Sea, climate migration, environmental education, ethnoecology, eco-journalism, green economy, environmental law, low-carbon development, and green energy.

Figure 11. A. Abdukhakimov, Minister of Ecology of the Republic of Uzbekistan, at a press conference on the presentation of the UN Report on Climate Change and Migratory Animals at COP28

Source: Ministry of Ecology, 2023.

Figure 12. Bilateral meeting of A. Abdukhakimov, Minister of Ecology of the Republic of Uzbekistan, and T. Molchan, UNECE Executive Secretary, at the National Pavilion of Uzbekistan

Source: Ministry of Ecology, 2023.

Figure 13. A. Abdukhakimov, Minister of Ecology of the Republic of Uzbekistan, and Dr G. Aguilar, Director General of the International Union for Conservation of Nature, on the margins of COP28

Source: Ministry of Ecology, 2023.

The events were attended by about **400 delegates** from different countries, international experts, and **Nobel Prize** winners. Heads of environmental agencies of the Central Asian region were also familiarized with the ongoing efforts on climate change adaptation in Uzbekistan.

Regional dialogues with representatives from Central Asian countries were organized on climate measures to achieve the Paris Agreement commitments, conservation of mountain ecosystems, glaciers, protection of iconic species, and the Regional Strategy for Adaptation to Climate Change in Central Asia.

A separate session dedicated to the Aral Sea Trust Fund's activities was held, with a focus on the transformation of the Aral Sea region into a climate-resilient region and promoting green innovations. The Center for Ethnoecological Research of Uzbekistan project was launched, which will initiate interdisciplinary research and equal cooperation with local communities in Central Asia, and will contribute to environmental protection, expansion of cultural heritage, and sustainable development. A session on Uzbekistan's tourism potential, stability, green agenda, and cooperation with Middle Eastern countries was also organized and revealed the great interest of participants.

The Minister of Environment participated in the High-Level Dialogue of the Economic Cooperation Organization (ECO) Member States on Accelerating the Transition to Resource Efficient, Sustainable Development and Circular Economy in the ECO Region.

Together with representatives of various ministries and governmental representatives, various side events, meetings, round tables and seminars involving international organizations such as the German Society for International Cooperation (GIZ), the United Nations Economic Commission for Europe (UNECE), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), the Global Green Growth Institute (GGGI), the Organization for Security and Cooperation in Europe (OSCE) and the International Organization for Migration (IOM).

The dialogue discussed cooperation with leading environmental organizations and financial institutions as well as the World Bank, Asian Development Bank (ADB), European Bank for Reconstruction and Development (EBRD), International Union for Conservation of Nature (IUCN), International Center for Biosaline Agriculture (ICBA).

In the conference framework, an important agreement was made to establish the first Central Asian office of the IUCN in Tashkent.

9.2 Green Energy in Uzbekistan

A total of 28 large-scale projects were launched as public–private partnerships in the construction of solar, wind, and hybrid power plants with a total capacity of 6.3 GW. Among them, the first seven projects (representing a capacity of 2.6 GW) were launched in 2023.

In particular, the capacities of five solar photovoltaic stations in Samarkand, Jizzak, Surkhandarya, Bukhara, and Kashkadarya regions, as well as a wind power station in the Navoi region, were connected to the power grid.

Work is underway on 12 projects to build green power stations and energy storage systems with companies from various countries, including Saudi Arabia, UAE, China, France, Switzerland, and France.

In 2024, the total power station capacity is planned to reach 2.6 GW, wind power stations to 900 megawatts, and 400 megawatts of energy storage units in the pipeline.

The country has set a target to generate 27 GW of energy through green power plants by the year 2030. This initiative will help save 25 billion cubic metres of natural gas each year and reduce harmful emissions into the atmosphere by 34 million tons.

Figure 14. Solar panel installation

Source: Ministry of Ecology, 2023.

9.3 The National Project Yashil Makon ("Green Land")

In 2021, the President of the Republic of Uzbekistan launched the Yashil Makon nationwide program. This program aims to plant 200 million trees and bushes annually until 2030. The goal is to increase the area of green spaces in cities from the current 8% to 30% and to raise the forest cover of the state forest fund from 7.5% to 15%.

Since the launch of the Yashil Makon initiative, 500 hectares of green parks, 935 hectares of green zones, and 6,179.2 hectares of green public parks have been established. In addition, 40 kilometres of green belts around the cities of Bukhara, Nukus, Khiva, and Urgench have been created.

Figure 15. Tree planting as part of the Yashil Makon nationwide program

Source: Ministry of Ecology, 2023.

As part of a systematic approach toward developing green areas, over 219.7 million trees and shrubs were planted in 2023 alone. Additionally, around 189 industrial enterprises that have a high environmental impact planted 2.83 million seedlings, while green belts consisting of 220,000 tree seedlings were created alongside roads. This effort was accompanied by the creation of 196 waste-collection points, as well as the establishment of arboretums around them.

9.4 Websites on environmental issues

https://sreda.uz/ The site contains some 3,000 publications focusing on environmental conservation issues in Uzbekistan and Central Asia.

http://ekolog.uz/ is an information and news website on ecology and environmental protection. It publishes up-to-date news in the field of ecology in Uzbekistan, near and far.

http://www.uzspb.uz/ Website of the Bird Preservation Society of Uzbekistan.

Since 2015, Uzbekistan has had an open data portal (https://data.gov.uz/) that contains information on 18 areas of government activity, including the environment, population, and health.

Information on environmental protection and management, awareness-raising events, and environmental actions is disseminated through the websites of the Ecological Movement of Uzbekistan (http://eco.uz).

9.5 Telegram channels as well as bots to contact on environmental issues and problems

https://t.me/ekologuzru; @ekolguz_bot;

https://t.me/potrebitel_uz; @potrebitel_uz

@ecogovuz_bot - Ministry of Environment, Conservation and Climate Change feedback bot for applications and suggestions to combat illegal tree felling, waste accumulation, or other similar situations that cause environmental damage.

9.6 Publications

Teaching aids, textbooks, visual, and promotional materials are published for educational institutions at all levels.

Publication of the Ministry of Ecology, Environmental Protection, and Climate Change of the Republic of Uzbekistan, Ecological Herald of Uzbekistan magazine has resumed.

Traditionally, the GEF SGP publishes calendars in the form of infographics on various topics: Climate Smart Agriculture,Water Conservation and Use, etc. The GEF SGP newsletters. Source: https://sgp.uz/ru/publikacii/

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Appendix

Table A1. List of international multilateral treaties in the field of ecology, environmental protection, and climate change to which the Republic of Uzbekistan has acceded (ratified, approved)

№	Document title	Date and place of signature	Information about ratification, accession, etc.	Information about instruments of ratification, instruments of accession, entry into force, denunciation
1.	Vienna Convention for the Protection of the Ozone Layer	22.03.1985 Vienna	18.05.1993.	Entry into force for RUz from 18.05.1993
2.	UNFCCC	09.05.1992 Rio de Janeiro	Accession of the RUz 20.06.1993.	Entry into force for RUz 21.03.1994
3.	Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/ or Desertification, Particularly in Africa.	17.06.1994. Paris	Ratified By decree OM RUz from 31.08.1995. N 125-I	Ratification letter sent (letter No. 05/9880) dated 20.10.1995) Entry into force for RUz from 29.01.1996
4.	Convention on Biological Diversity	05.06.1992. Rio de Janeiro	Joining in accordance with By decree OM RUz from 06.05.1995. N 82-1	Instrument of accession delivered on 19.07.1995. Entry into force for RUz from 17.10.1995
5.	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	03.03.1973. Washington	Joining in accordance with By decree OM RUz from 25.04.1997. N 433-I	Deed of Accession deposited 10.07.1997. Entry into force for RUz from 08.10.1997
6.	Convention on the Conservation of Migratory Species of Wild Animals	23.06.1979. Bonn	Joining in accordance with By decree OM RUz from 01.05.1998. N 631-I	Entry into force for RUz from 01.09.1998

№	Document title	Date and place of signature	Information about ratification, accession, etc.	Information about instruments of ratification, instruments of accession, entry into force, denunciation
7.	Convention on Wetlands of International Importance Especially as Waterfowl Habitat	02.02.1971. Ramsar	Joining in accordance with By decree OM RUz from 30.08.2001. N 278- II	Instrument of accession of 28.09.2001 N 05/11823 Entry into force for RUz from 08.02.2002
8.	Convention concerning the Protection of the World Cultural and Natural Heritage	23.11.1972. Paris	Ratified By decree OM RUz from 22.12.1995. N 182-I	Notice of succession dated 13.01.1993
9.	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.	22.03.1989. Basel	Joining Convention in accordance with By decree OM RUz from 22.12.1995. N 188-I	Document sent of joining from 18.01.1996 N 05/490 Entry into force for RUz from 07.05.1996
10.	Stockholm Convention on Persistent Organic Pollutants	22.05.2001 Stockholm	Ratified By Law of the Republic of Uzbekistan 08.05. 2019 N. ZRU-535	Entry into force for RUz from 26.09.2019
11.	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management	05.09.1997. Vienna	Joining in accordance with the Law of the Republic of Uzbekistan dated 11.12.2008. N ZRU-186	

№	Document title	Date and place of signature	Information about ratification, accession, etc.	Information about instruments of ratification, instruments of accession, entry into force, denunciation
12.	Convention on the Protection and Use of Transboundary Watercourses and International Lakes	17.03.1992. Helsinki	Joining accordingly. by decree of the President of the Republic of Uzbekistan dated 09.08.2007. N PP-683	Entry into force for RUz 03.12.20
13.	Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques	10.12.1976. Geneva		Entry into force for RUz since 26.05.1993
14.	Convention on the Marking of Plastic Explosives Substances in Order to Detect Them	Montreal, 1 March 1991	Joining accordingly. by decree OM RUz dated 26.12.1997. N PP-683	Entry into force for RUz since 08.08.1999
15.	Kyoto Protocol to the Framework Convention on Climate Change	11.12.1997 . Kyoto	Ratified By decree OM RUz from 20.08.1999. N 834-I	Ratif. letter of commendation passed into storage on 12.10.1999 Entry into force for RUz from 16.02.2005
16.	Paris Protocol to the UNFCCC	12.12.2015 Paris	Ratified By Law of the Republic of Uzbekistan 01.10.2018 N. ZRU-491	
17.	Cartagena Protocol on Biosafety to the Convention on Biological Diversity	29.01.2000 Cartagena		

№	Document title	Date and place of signature	Information about ratification, accession, etc.	Information about instruments of ratification, instruments of accession, entry into force, denunciation
18.	Montreal Protocol on Substances that Deplete the Ozone Layer	16.09.1987. Montreal	Succession	Note dated 10.05.1993 N 11/2734 Entry into force for RUz from 18.05.1993
19.	London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	29.06.1990. London	Ratified By decree OM RUz from 01.05.1998. N 627-I	Entry into force for RUz from 08.09.1998
20.	Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	25.11.1992. Copenhagen	Ratified By decree OM RUz from 01.05.1998. N 628-I	Entry into force for RUz from 08.09.1998
21.	Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	03.12.1999. Beijing	Ratified Law of the Republic of Uzbekistan dated 07.09.2006. N ZRU-44	Entry into force for RUz from 29.01.2007
22.	Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	17.09.1997. Montreal	Ratified Law of the Republic of Uzbekistan dated 07.09.2006. N ZRU-45	Entry into force for RUz from 29.01.2007
23.	Energy Charter Treaty	17.12.1994. Lisbon	Ratified By decree OM RUz from 22.12.1995. N 192-I	A letter of commendation has been sent dated 12.03.1996 N 05/2184 Entry into force for RUz from 16.04.1998

№	Document title	Date and place of signature	Information about ratification, accession, etc.	Information about instruments of ratification, instruments of accession, entry into force, denunciation
24.	Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects	17.12.1994. Lisbon	Ratified By decree OM RUz from 22.12.1995. N 192-I	A letter of commendation has been sent dated 12.03.1996 N 05/2184 Entry into force for RUz from 16.04.1998
25.	Agreement on the Conservation of African-Eurasian Migratory Waterbirds	16.06.1995. The Hague	Joining in accordance with By decree OM RUz from 12.12.2003. N 577-II	Entry into force for RUz from 01.04.2004
26.	Agreement on the establishment of a global green growth institute	20.06.2012. Rio de Janeiro	Approved By decree of the President of the Republic of Uzbekistan dated 07.02.2019. N PP-4164	Entered into force for RUz from 09.03.2019

Source: Ministry of Ecology, Information and Legal Portal of Uzbekistan Norma.uz

Table A2. List of international ground projects in the field of ecology, environmental protection, and climate change implemented in the Republic of Uzbekistan

No.	Project name	Donor	Years of implementation
1.	Full Completion of HCFC Phase-out in Uzbekistan by Promoting Energy Efficient Zero Ozone Depleting Technologies With Low Global Warming Potential. (State Committee on Ecology, UNDP)	GEF	2019–2024
2.	Capacity Development and Technology Transfer to Improve the Use of Data and Information for Environmental Monitoring in Central Asia Regional Project - Uzbekistan, Tajikistan and Kyrgyzstan; (State Committee on Ecology, UNEP)	ODA MFA RF	2021–2023

No.	Project name	Donor	Years of implementation
3.	Project on Green Actions and Rehabilitation of the Territory of the Republic of Karakalpakstan From the Aral Sea Crisis; (State Committee on Ecology, GGGI)	KOICA	2021–2024
4.	Support for the Implementation and Review of the Progress of the Global Framework for Biodiversity Beyond 2020 (Pan-European region) Regional project - Uzbekistan, Ukraine and Moldova; (State Committee on Ecology, UNEP)	UNEP	2021–2023
5.	Combating Wildlife Trafficking in Central Asia; Regional Project - Uzbekistan, Kyrgyzstan, Tajikistan and Kazakhstan; (State Committee on Ecology, Academy of Sciences of the Republic of Uzbekistan, FFI)	INL, IWTCF	2021–2024
6.	Enhanced Response to Climate Change-Related Security Risks in South-Eastern Europe, Eastern Europe, the South Caucasus and Central Asia; (State Committee on Ecology, Organisation for Security and Co-operation in Europe)	Organisation for Security and Co-operation in Europe	2022–2024
7.	BioFIN - Biodiversity Financing Policy and Institutional Review; (State Committee on Ecology, UNDP)	UNDP	2021–2022
8.	Conservation and Sustainable Use of Wetland, Lake and Floodplain Ecosystems of the Aral Sea region; (State Committee on Ecology, UNDP)	GEF	2022–2026
9.	Strengthening the Institutional Capacity of the Republic of Uzbekistan in the Implementation of the Basel and Stockholm Conventions and GHS, as Well as Facilitate the Accession to the Rotterdam and Minamata Conventions; (State Committee on Ecology, UNEP)	UNEP	2022–2024
10.	Climate Risk Management in Central Asia; Regional Project - Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, Kazakhstan; (State Committee on Ecology, GIZ)	BMZ	2022–2026

No.	Project name	Donor	Years of implementation
11.	Master Planning and Innovative Financial Solutions to Support the Yashil Makon Initiative; (State Committee on Ecology, UNDP, UNECE, UNHCR)	UNHCR, State Committee on Ecology	2022–2023
12.	A Project to Rehabilitate Former Uranium Production Sites Located in Tashkent and Namangan regions With Financial Support From the EBRD's Environmental Rehabilitation Account for Central Asia. Regional Project - Uzbekistan, Tajikistan and Kyrgyzstan; (State Committee on Ecology, EBRD)	EBRD	2021–2024
13.	Land Use and Restoration of Degraded Ecosystems and Biodiversity in Uzbekistan; (State Committee on Ecology, FAO)	GEF	2022–2026
14.	Sustainable management of forests in mountain and valley regions; (State Forestry Committee, FAO)	FAO	2018–2024
15.	Rehabilitation of Arid Regions; Regional project: (State Forestry Committee, Ministry of Agriculture of Türkiye, FAO)	FAO	2022–2025
16.	Conservation of Central Asian deserts; (State Forestry Committee, FAO)	FAO	2018–2023
17.	Integrated Land Resources Management in Central Asia; (State Forestry Committee, GIZ)	GIZ	2020–2024
18.	Sustainable Management of Desert Forests and Rangelands; (State Forestry Committee, FAO)	FAO	2022–2026
19.	Integrated Natural Resource Management in Agricultural Production Systems Prone to Drought and Salinity in Central Asia and Türkiye; (State Forestry Committee, FAO)	FAO	2018–2024
20.	Restoration of Tugai Forests and Strengthening of Material and Technical Base of Forestry Farms; (State Forestry Committee, TIKA)	TIKA	2018–2023
21.	Institutional Cooperation Project in Cooperation With the Ministry for Foreign Affairs of Finland and the Finnish Meteorological Institute with the Hydrometeorological Service Centre of the Republic of Uzbekistan	Government of Finland	2022–2025

No.	Project name	Donor	Years of implementation
22.	Creation of a Geoinformation Database for Hydrological Modelling of Dangerous Hydrometeorological Phenomena and river Flows	U.S. Government	2022–2025
23.	Improving Early Warning Systems to Increase the Resilience of Uzbekistan's Communities to Climate Change Risks	EQF	2021–2026
24.	Improving Climate Resilience of Fruit and Vegetable Producers of the Fergana Valley in Uzbekistan	Government of Japan	2022–2023
25.	Capacity Building in the Agriculture and Land Use Sectors in Uzbekistan to Enhance Transparency in Monitoring and Realisation of Uzbekistan's National Contribution in Line with the Paris Agreement	FAO	2021–2023
26.	Development of a National Adaptation Plan Targeting the Most Vulnerable Sectors and Regions of the Economy to Climate Change to Facilitate Medium- and Long-Term Planning of Adaptation Measures and Actions in Uzbekistan	EQF	2022-2023
27.	Climate Change and Sustainable Development in Central Asia	EU	2021–2024
28.	Global Biodiversity Framework Early Support for Action (State Committee on Ecology, UNDP)	GEF	2023–2024
29.	Increasing landscape resilience to zoonotic diseases through consolidation of conservation systems in Central Asia; (State Committee on Ecology, IUCN)	IKI	2024–2027
30.	Construction of Solid Domestic Waste (SDW) Landfills in Jizzakh region; (State Committee on Ecology, KEITI)	Government - Republic of Korea (ODA)	2023–2024
31.	Strengthening Local Capacity to Lead Science-Based Conservation of Saigas in Their Natural Habitat in Kazakhstan and Uzbekistan; Regional Project - Kazakhstan and Uzbekistan (State Committee on Ecology, FFI, AS RUz)	USFW	2023–2025

Source: Ministry of Ecology, 2023.

Table A3. List of international primer grant projects under development in the fields of ecology, environmental protection, and climate change

No.	Project name	Donor	Years of implementation
1.	Supporting the Management of Toxic Chemicals and Hazardous Waste and Fulfilment of Obligations Under the Basel, Stockholm and Rotterdam Conventions (State Committee on Ecology, EU)	EU	2023–2025
2.	Creation of Necessary Conditions for the Formation of a Genetic Bank in Uzbekistan (State Committee on Ecology, FAO)	GEF	2025–2029
3.	Integrated Management of Protection and Restoration of Valuable Landscapes in Uzbekistan; (State Committee on Ecology, UNDP, IUCN)	GEF	2024–2028
4.	Restoration of Forest Landscapes	World Bank	2023–2026
5.	Capacity Building of Human Resources in Forestry and Urban Greening Based on Smart Technologies	KOICA	2023–2028
6.	Development of a Strategy for a Financing Mechanism for Afforestation	UN Forum on Forestry	2023
7.	Phase 2 of the Central Asia Integrated Land Use Project		2024–2025
8.	Enhancing Uzbekistan's Readiness for Green Climate Fund Financing	EQF	2023–2025

Source: Ministry of Ecology.

Table A4. Primary fuel and energy production per capita, thousands of tons per year (2016–2022)

Years	2016	2017	2018	2019	2020	2021
Republic of Uzbekistan	1.6	1.6	1.7	1.6	1.3	1.4
Of these:						
Oil and gas condensate	0.1	0.1	0.1	0.1	0.1	0.1
Natural gas	1.4	1.4	1.5	1.5	1.2	1.3
Coal	0.03	0.03	0.04	0.03	0.03	0.04
Hydroelectricity	0.02	0.02	0.02	0.02	0.01	0.01

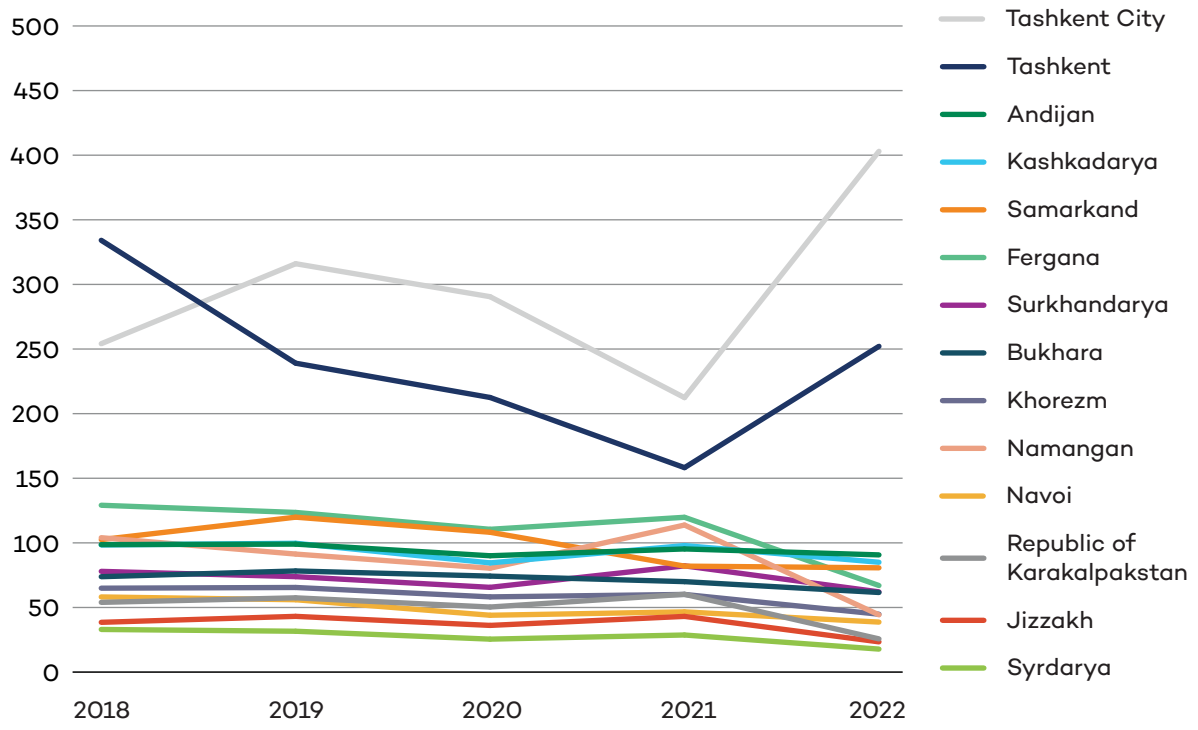
Source: Hydrometeorological Service Agency at the Ministry of Ecology of the Republic of Uzbekistan, 2022.

Table A5. Dynamics of national emissions of main pollutants to atmospheric air (thousand tonnes/year)

Contaminating Substances	Years									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Republic of Uzbekistan	817.6	855.3	1,162.1	975.1	1,008.1	853.5	883.7	952.8	924.4	908.7
Including:										
Solid substances	160.3	181.5	185.0	163.0	148.2	142.1	149.7	205.1	162.6	188.6
Gaseous and liquid	657.4	673.8	977.1	812.1	859.9	711.3	734.0	747.7	761.8	720.1
Of these:										
SO_2 (anhydride sulphate)	245.7	281.4	306.5	296.6	275.2	300.5	291.2	336.5	370.1	342.5
Carbon monoxide	90.7	65.5	71.0	79.7	79.5	79.5	85.9	81.2	68.2	71.0
NO_2	38.6	64.4	72.7	76.1	78.4	72.2	73.7	69.7	65.9	65.8
NO_x	10.3	12.4	13.8	14.3	14.3	14.8	15.8	14.7	13.2	21.2
Hydrocarbons	260.6	237.4	501.5	333.0	392.9	226.4	252.8	233.5	236.8	191.8
Volatile organic compounds (VOCs)	7.1	8.1	6.0	7.6	14.1	11.8	7.1	6.0	4.0	23.4
Others	4.4	4.6	5.5	4.9	5.4	6.0	7.4	6.2	3.7	4.2

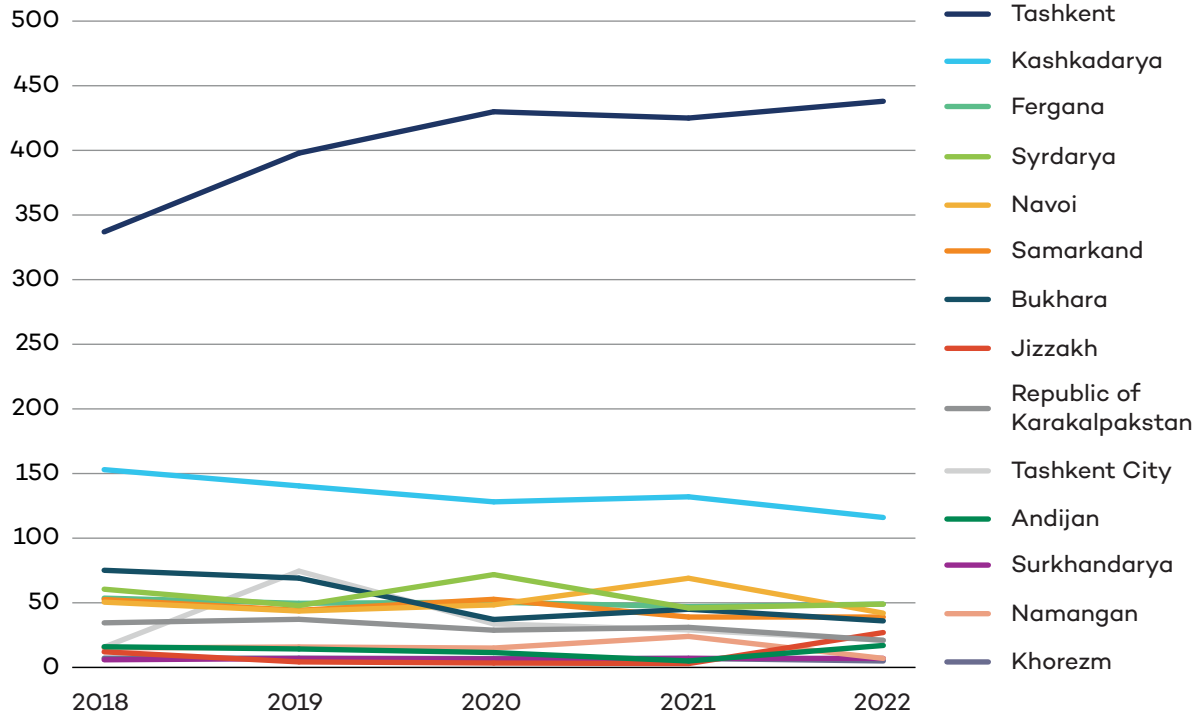
Source: Statistics Agency, 2021.

Figure A1. Pollutant emissions from stationary sources (thousands of tonnes)



Source: Statistics Agency, 2021.

Figure A2. Pollutant emissions from mobile sources (thousands of tonnes)



Source: Ministry of Ecology, 2021.

Table A6. Distribution of land fund of the Republic of Uzbekistan by categories (thousand ha)

Name of land category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Agricultural land	20,473.5	20,481.1	20,469.1	20,417.0	20,388.8	20,174	20,261.6	20,236.3	20,761.6	27,148.5	26,232.3
Settlement land	216.3	214.1	221	219.6	219.2	220.8	221.2	221.4	223.4	224.1	225.8
Industrial and other special purpose land	911.0	914.5	896.2	905.1	909.6	905.3	857.1	866.3	867.4	879.6	767.7
Land designated for nature protection, recreation, and health improvement	75.9	75.9	76.0	76.0	76	704.3	704.4	710.4	731.7	731.6	3222.7
Land of historical and cultural heritage	4.7	6.2	9.2	9.7	13.7	14.1	14.3	14.5	14.6	14.6	14.8
Forest fund land	9,635.9	9,636.9	9,630.0	9,752.3	9,773.0	11,191.9	11,153.3	11,199.5	12,020.8	12,057.3	11,738.1
Water fund land	830.3	831.4	831.4	832.4	833.3	833.6	833.7	836.9	835.2	827	827.2
Reserve lands	12,262.7	12,250.2	12,277.4	12,680.3	12,678.8	10,848.4	10,846.8	10,807.1	9,437.7	3009.6	1863.8
Total land	44,410.3	44,410.3	44,410.3	44,892.4	44,892.4	44,892.4	44,892.4	44,892.4	44,892.4	44892.4	44892.4

Source: Agency for Cadastres under the Ministry of Economy and Finance of the Republic of Uzbekistan, 2023.

Table A7. Useful wild plants of Uzbekistan

Application of plants by group	Families	Number of species
Food	Rosaceae, Amaryllidaceae, Juglandaceae, Rhamnaceae, Apiaceae, Polygonaceae	over 350
Feeding	Poaceae, Fabaceae, Amaranthaceae, Asteraceae	1,700
Medicines	Ranunculaceae, Lamiaceae, Rosaceae, Boraginaceae, Apiaceae, Asteraceae, Nitrariaceae etc.	1,157
Essential oils	Asteraceae, Acoraceae, Lamiaceae, Apiaceae, Rosaceae, Cupressaceae, Geraniaceae, Iridaceae	650
Alkaloids	Amaranthaceae, Solanaceae, Ephedraceae, Ranunculaceae, Berberidaceae, Papaveraceae, Euphorbiaceae	over 200
Dye	Malvaceae, Papaveraceae, Asteraceae	150
Decorative	Liliaceae, Asphodelaceae, Iridaceae, Amaryllidaceae, Rosaceae, Asteraceae	270
Spicy-flavoured	Lamiaceae, Apiaceae, Berberidaceae, Cuprissaceae, Asteraceae	200
Saponiferous	Fabaceae, Caryophyllacea, Solanaceae, Astereceae, Liliaceae	100
Fibre	Urticaceae, Cannabaceae, Malvaceae	6

Source: Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan, 2021.

Table A8. Number of rare and globally threatened animal species in Uzbekistan compared to their abundance in the country

Classes	Total number of species in the class	Number/Fraction of total number of species in the class, %		
		Species listed and recommended in the UzRDB	IUCN species (2017)	CITES
Invertebrates	15,000	83/0.6	5/0.03	1/0.007
Fish	77	18/23.4	11/14.3	4/5.2
Amphibians	3	-	-	-
Reptiles	61	21/34.4	8/13.1	5/8.2
Birds	467	52/11.1	47/10.1	62/13.3

Classes	Total number of species in the class	Number/Fraction of total number of species in the class, %		
		Species listed and recommended in the UzRDB	IUCN species (2017)	CITES
Mammals	107	32/29.9	20/18.7	20/18.7
Total	15,715	206/1.3	91/0.6	92/0.6

Note: UzRDB - Red Data Book of Uzbekistan; IUCN - International Union for Conservation of Nature; CITES - species included in the CITES Appendices

Source: United Nations Development Programme in Uzbekistan et al., 2018.

Table A9. Natural protected areas of Uzbekistan with legal entity status

Natural Protected Areas	Area (ha)	Location
State nature reserves		
Zaamin	26,840	Jizzakh region
Nurata	17,752	Jizzakh region
Hissar	(80,986)78,986	Kashkadarya region
Kyzylkum	10,311	Khorezm and Bukhara region
Surhan	23,802	Surkhandarya region
Chatkal Biosphere Reserve	24,706	Tashkent region
Aktau-Tamdi	40,000	Navoi region
Natural parks		
Zaamin	24,110	Jizzakh region
Ugam-Chatkal	506,941	Tashkent region
Zarafshan	2,426.4	Samarkand region
Khorezm	21,687.5	Khorezm region
Kitab Geology	3,938	Kashkadarya region
South Ustyurt	1,447,143	Republic of Karakalpakstan
Central Kyzylkum	1,200,000	Navoi region
Aralkum	1,000,000	Republic of Karakalpakstan
Pap	10,000	Namangan region

Natural Protected Areas	Area (ha)	Location
Amonkutan	1,500	Samarkand region
Upper Tupalang	27,851	Surkhandarya region
Babatag	12,064	Surkhandarya region
Complex (landscape) nature reserves		
Saiga	628,300	Republic of Karakalpakstan
State wildlife refuges		
Sudochie - Akpetki	280,507	Republic of Karakalpakstan
Barsakelmas	280,000	Republic of Karakalpakstan
State biosphere reserves		
Lower Amu Darya Biosphere Reserve	68,717.8	Republic of Karakalpakstan
Ugam-Chatkal Biosphere Reserve	42,952.81	Tashkent region
Natural nurseries		
Jeyran kennel	16,522	Bukhara region

Source: Ministry of Ecology, 2023.

Table A10. New protected natural areas established in Uzbekistan between 2019 and 2022

№	The names of the OPTs	Year of creation	Square (ha)	Location
1	NPP Khorezm	2019	21,687.5	Khorezm region
2	Central Kyzylkum NPP	2022	1,200,000	Navoi region
3	NPP Aralkum	2022	1,000,000	Republic of Karakalpakstan
4	NPP “Pap”	2022	10,000	Namangan region
5	NPP Amonkutan	2022	1,500	Samarkand region
6	NPP Upper Tupalang	2022	27,851	Surkhandarya region
7	NPP Babatag	2022	12,064	Surkhandarya region

№	The names of the OPTs	Year of creation	Square (ha)	Location
8	South Ustyurt NPP	2020	1,447,143	Republic of Karakalpakstan
9	Aktau-Tamdy State Reserve	2022	400,000	Navoi region
10	Sudochie-Akpetki State Nature Reserve	2021	280,507	Republic of Karakalpakstan
11	Barsakelmas State Nature Reserve	2022	280,000	Republic of Karakalpakstan

Source: Ministry of Ecology, 2023.

Table A11. Existing landfills, their areas and quantities of accumulated waste

Region	Occupied area, ha	Accumulated waste (thousand tonnes)
Republic of Karakalpakstan	150	879.05
Andijan	58	2,606
Bukhara	110	3,681
Jizzakh	122	743.18
Kashkadarya	183	1,386
Navoi	63	1,648
Namangan	39	2,650
Samarkand	160	1,134
Surkhandarya	124	1,094.7
Syrdarya	41	447
Tashkent	198	9,416
Fergana	135	4,908
Khorezm	62	2,940
Total, for the republic	**1,445**	**33,533**

Source: Republican Center for Organization of Sanitary Cleaning Works, 2023.

Table A12. Health and well-being indicators

№	Indicators	Sources of information	2019	2022
Increased life expectancy				
1	Life expectancy at birth (both sexes) (years)	Statistics Agency	75.1	76.4
2	Male life expectancy (years)	Statistics Agency	72.8	74.1
3	Life expectancy for women (in years)	Statistics Agency	77.4	78.7
Promoting healthy lifestyles. including healthy eating habits and disease prevention				
4	Incidence of anemia (per 100,000)	Ministry of Health	5,332.8	4,146,51
5	Incidence of iodine deficiency (per 100,000 inhabitants)	Ministry of Health	902,2	760.5
6	Incidence of intestinal infections (per 100,000 people)	Ministry of Health	116.0	163.7
7	Daily salt intake of the population (g)	UNICEF (2022)	15.1 (2017)	105
8	Proportion of children under 5 years of age who are stunted (%)	UNICEF (2022)	6.5 (MICS 2021–2022)	6.5 (MICS 2021–2022)
9	Proportion of children under 5 years of age who are underweight (%)	UNICEF (2022)	1.8 (MICS 2021–2022)	1.8 (MICS 2021–2022)
10	Proportion of children under 5 years of age who are overweight (%)	UNICEF (2022)	4.5 (MICS 2021-2022)	4.5 (MICS 2021-2022)
11	Proportion of older population who are overweight (BWI≥25kg/m²) (%)	WHO (2019)	56.4	56.4 (growth stop)
12	Proportion of population that is obese (BWI≥30 kg/m²) (%)	WHO (2019)	23.5	23.5 (growth stop)
13	Proportion of population aged 40 and over with a high risk factor for cardiovascular disease (%)	WHO (2019)	20.2	20.2 (conservation)
14	Proportion of cardiovascular disease as a cause of death in the population aged 30–69 years (%)	Statistics Agency	52.8	58.7

№	Indicators	Sources of information	2019	2022
15	Proportion of cancer as a cause of death in the population aged 30–69 years (%)	Statistics Agency	15.1	11.2
16	Share of diabetes mellitus in the causes of death in the population aged 30–69 years (%)	Statistics Agency	5.7	4.1
17	Proportion of chronic respiratory disease as a cause of death in the population aged 30–69 (%)	Statistics Agency	1.1	0.9

Source: Compiled by authors.

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Address

100043; Uzbekistan,
Tashkent city, Chilanzar district,
Bunyodkor ave., 7-A

Tel: (99871) 207-07-70
(ext.: 1117#)
E-mail: info@eco.gov.uz

MINISTRY OF ECOLOGY,
ENVIRONMENTAL PROTECTION
AND CLIMATE CHANGE OF THE
REPUBLIC OF UZBEKISTAN