EU Programme on “Sustainable Management of Water Resources in Rural Areas in Uzbekistan”

Component 1: «National policy framework for water governance and integrated water resources management»

ASSESSMENT OF THE CURRENT SITUATION OF THE AKSU RIVER BASIN IN KASHKADARYA REGION

Analytical Report

Tashkent 2018
CONTENT

ABBREVIATIONS........................................................................................................................................... 8
PREFACE......................................................................................................................................................... 9
INTRODUCTION........................................................................................................................................... 10
THE LEGISLATIVE FRAMEWORK OF WATER RESOURCES MANAGEMENT (RIVER BASIN PLANNING)................................................................................................................................. 11
  a. Legislation of the Republic of Uzbekistan on water resources management (with emphasis on the application of the basin planning approach) ............................................................................. 11
  b. National water allocation obligations in the Aksu River Basin.................................................................... 14
NATIONAL PROGRAMS AND DEVELOPMENT STRATEGIES RELEVANT TO THE TERRITORY OF THE AKSU RIVER BASIN........................................................................................................................... 15
  a. Issues of agricultural development (including the provision of subsidies for agricultural development)........................................................................................................................................................................... 15
  b. Strategies and plans for the development of water resources management (state and local levels)................................................................................................................................................................. 16
WATER RESOURCES IN THE AKSU RIVER BASIN........................................................................................ 20
  a. Hydrology.................................................................................................................................................... 20
  b. Groundwater analysis .................................................................................................................................... 21
  c. Water quality ............................................................................................................................................. 22
THE NATURAL CONDITIONS IN THE BASIN OF THE AKSU RIVER............................................................. 24
  a. Geology and morphology.................................................................................................................................. 24
  b. Climatic conditions (risk analysis of natural disasters and possible preventive measures) ....................... 24
  c. Land reserves ................................................................................................................................................ 27
  d. Natural ecosystems and biodiversity ........................................................................................................... 29
SOCIO-ECONOMIC SITUATION IN THE AKSU RIVER BASIN........................................................................ 32
  a. Employment and income ............................................................................................................................... 32
  b. Social development indicators ....................................................................................................................... 33
  c. Macroeconomic indicators ............................................................................................................................. 33
  d. Stakeholders of the Aksu River Basin ............................................................................................................... 34
CURRENT STATE OF WATER MANAGEMENT............................................................................................ 35
  a. Institutional analysis of water management .................................................................................................. 35
  b. Water infrastructure ...................................................................................................................................... 37
  c. Analysis of water resources use by economic sectors (water needs by types of water use in the basin)................................................................................................................................................................. 40
  d. Recreation ..................................................................................................................................................... 42
SWOT analysis of the Aksu River Basin............................................................................................................ 43
CONCLUSION.................................................................................................................................................. 45
REFERENCES.................................................................................................................................................... 47
Annex 1. Structure of the situational analysis of the Aksu River Basin............................................................... 48
Annex 2. SWOT Analysis .................................................................................................................................... 49
Annex 3. Roles and responsibilities of key stakeholders in the Aksu River Basin.................................................. 50
Annex 4. Register of problems of the Aksu River Basin, which was developed during a workshop conducted on September 10, 2018 in Karshi .................................................................................................................. 54
Table 1. Program of construction and reconstruction of drinking water supply system facilities in Kashkadarya region for 2017-2021
Table 2. Production of organic fertilizers at solid waste landfills in 2017-2021
Table 3. Expansion of the network of observation points for groundwater monitoring for 2018-2021 in Kashkadarya region
Table 4. Intra-annual runoff distributions
Table 5. Chemical composition of the Aksu River water (Khazarnau hydropost)
Table 6. Social indicators for the Aksu River Basin (the table is compiled according to the regional statistical departments for 2017)
Table 7. Water intake and water supply by Aksu subsystem
Table 8. Water availability of irrigated agriculture in the Aksu Basin during the crop season
Table 9. SWOT-Matrix

Figure 1. Aksu River Basin
Figure 2. Distributions of areas by groundwater salinity in the Aksu Basin, 2017
Figure 3. Dynamics of changes in water salinity in the Aksu River
Figure 4. Surface slope map and hydrographic coverage of the Aksu River Basin
Figure 5. Monthly precipitation amounts and average maximum and minimum air temperatures averaged for 2015-2017 at the Shahrisabz station, compared with the average multi-year observational data
Figure 6. Distribution of agricultural crops in 2017, the Aksu basin
Figure 7. Type of soil in the Aksu River Basin
Figure 8. Dynamics of urban and rural population along the Aksu River Basin, according to the data of the Department of statistics of the region
Figure 9. The number of employed in the economy along the Aksu River Basin areas in 2017.
Figure 10. The composition of the Gross Regional Product (GRP) of Kashkadarya region in 2017
Figure 11. Organizational structure of water management in the Amu-Kashkadarya irrigation system
Figure 12. Organizational structure of water management in the Aksu River Basin
Figure 13. Recommended Water Planning and Distribution Scheme
Figure 14. Satellite image of the Gissarak Reservoir, obtained using Google Earth (2018)
Figure 15. Planned and actual water withdrawal at the WCA border in the Aksu River Basin zone
Figure 16. Specific water intake and water supply in the Aksu River Basin
Figure 17. Crop yields in the Aksu River Basin
Figure 18. Water use by economic sectors
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1 The same organizations remain as members of the working group, but some employees may change due to leaving their position.
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### ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>AS</td>
<td>Adaptive strategy</td>
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<tr>
<td>BISA</td>
<td>Basin Irrigation System Authority</td>
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<td>COP</td>
<td>Coefficient of performance</td>
</tr>
<tr>
<td>DID</td>
<td>District Irrigation Divisions</td>
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<td>EU</td>
<td>European Union</td>
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<tr>
<td>GIZ</td>
<td>Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH</td>
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<tr>
<td>GRP</td>
<td>Gross regional product</td>
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<td>GWL</td>
<td>Ground water level</td>
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<td>HS</td>
<td>Hydro technical structure</td>
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<td>SUE</td>
<td>State Unitary Enterprise</td>
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<td>HPP</td>
<td>Hydro Power Plant</td>
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<td>ISD</td>
<td>Irrigation System Department</td>
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<td>ISM</td>
<td>Irrigation Systems Management</td>
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<td>IWMI</td>
<td>International Water Management Institute</td>
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<td>IWRM</td>
<td>Integrated Water Resources Management</td>
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<td>MCA</td>
<td>Main Channel Administration</td>
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<td>MCM</td>
<td>Main channel management</td>
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<td>MMCO</td>
<td>Management of main channel operation</td>
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<tr>
<td>MWR</td>
<td>Ministry of Water Resources</td>
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<tr>
<td>O&amp;M</td>
<td>Operation and maintenance</td>
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<tr>
<td>PS</td>
<td>Pumping station</td>
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<tr>
<td>PTN</td>
<td>Production and technical needs</td>
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<td>PSM</td>
<td>Pumping station management</td>
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<tr>
<td>RE</td>
<td>Reclamation Expedition</td>
</tr>
<tr>
<td>SFC</td>
<td>South Fergana Canal</td>
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<tr>
<td>SWOT Analysis</td>
<td>Data processing technique based on determination of strengths and weaknesses of the analyzed object, as well as opportunities and threats</td>
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<tr>
<td>UBA</td>
<td>Umweltbundesamt Österreich (Austrian Environment Agency) GmbH</td>
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<td>WMO</td>
<td>Water Management Organizations</td>
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<td>WCA</td>
<td>Water Consumer Association</td>
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PREFACE

The responsibilities of the research team of the International Water Management Institute (IWMI) under the 1st Component “National policy framework for water governance and integrated water resources management” of the programme on “Sustainable management of water resources in rural areas in Uzbekistan” funded by the European Union, were to conduct situational analyses for the Aksu River Basin and Shakhrikhansay Irrigation System in Uzbekistan to provide basic information and research results on the development of river basin/irrigation system management plans.

“Situation analysis” is a well-known term that is widely used to study management issues in many sectors, including business, health, education, natural resources management and environment. Therefore, the determination of this term varies depending on the subject and field of research.

Despite the differences, a method, consisting of evaluation, integration and interpretation, is common to each concept. This shapes the understanding of the current state of the river basin. It is important that situational analysis activities help to get better understanding of the processes and conditions occurring in river basins and the causes of one or another state of these basins. Thus, this analysis is the main tool that helps to plan further actions.

It should be recognized that the situational analysis is an important step taken to support the development of the basin plan. The scope of such analysis varies from information on the state of water resources, socio-economic conditions and institutional mechanisms in the basin to a detailed description of the issues included in the strategic actions presented in the last parts of the basin plan documents. Understanding the physical, technical and institutional problems of a particular river basin is crucial for defining appropriate goals and objectives, as well as developing activities that can help to address the challenges and needs of the river basin and other relevant areas of research. The most important observation is that there are some common features, despite the fact that situational analysis for different basin plans are conducted and presented differently.

The literature review did not reveal any specific examples of the situational analysis of river basins in Uzbekistan. However, a previous technical report by the IWMI Office in central Asia, which provides an overview of existing river basins in Uzbekistan, presented an analysis and assessment of the situation in Andijan, Fergana, Namangan, Syrdarya, Kashkadarya, and Surkhandarya regions of Uzbekistan. Brief situational analyses of pilot river basins were conducted in this study in order to examine the current conditions for the development and future implementation of basin management plans. The studies included key social and economic issues, including demography, geography, legislation, regional and local management, climatic and meteorological conditions, water infrastructure, management and water use (for irrigation and drinking), land use, and environmental issues.

Recommended plan for the content of the situational analysis report of the Aksu and Shakhrikhansay river basins was compiled based on the project objectives and the results of the literature review (see Appendix 1).

Given that the situational analysis will be used as the basis for developing a river basin management plan, the plan should be comprehensive and provide both qualitative and quantitative information on the physical, environmental, political, social, and economic conditions in the river basin.
INTRODUCTION

The report on “Assessing the current situation of the Aksu River Basin in Kashkadarya region” was prepared under Component 1: “National policy framework for water governance and integrated water resources management” implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH with financial support from the European Union.

The Aksu River is located in Kashkadarya region in southern part of Uzbekistan on the western slope of the Pamir-Alay Mountains. The Aksu River originates in the northern slope of the Gissar Range and flows into the Kashkadarya River. The river is formed by the confluence of two rivers, Khonaka and Batirbay, which originate from the Severtsov and Batirbay Glaciers. The rivers are filled with streams issuing from glaciers of rivers and snow. In the upper reaches, the river flows among the mountains, and the height of the water distributors is 4100-4300 m. The length of the river is 154 km; the basin area is 1280 km². The river irrigates about 48796 hectares of land in Shakhrisabz, Kitab and Yakkabag districts. 40 percent of the territory is used for wheat-cotton crop rotation; perennial plantations make up 20% of the territory. The annual withdrawal of the Aksu subsystem ranges from 358.4 to 399.2 million m³.

An integrated approach, evaluating the conditions of all processes and features in the Aksu River Basin, was used in this situational analysis. This broad approach provides an overview of the state of the river basin, reveals previously unknown existing problems in the basin, and identifies relationships between various problems and tasks.

It combines a variety of tools and methods for conducting assessments/studies, key informational interviews, site observations, in order to gain a broad understanding of the problems, needs, programs and gaps in the river basins. Both quantitative and qualitative data and information were collected and analyzed to develop the effective action plans. The purpose of the analysis is to get a deep understanding of the underlying technical, cultural, political, legislative, physical and socio-economic factors influencing the management of the Aksu River Basin.

The research included a study of the legislative framework for water resources management, national programs and strategies for the development of pilot basins, water resources, natural conditions, socio-economic situation, including demography, and the current state of water management.

Finally, to effectively support the development of a river basin plan, an analysis was conducted to identify the strengths and weaknesses of existing water resource management mechanisms, and opportunities and threats (SWOT analysis) specific to the basin were considered.
THE LEGISLATIVE FRAMEWORK OF WATER RESOURCES MANAGEMENT (RIVER BASIN PLANNING)

a. Legislation of the Republic of Uzbekistan on water resources management (with emphasis on the application of the basin planning approach)

Water resources management and water relations in the Republic of Uzbekistan are regulated by:

1. The law of the Republic of Uzbekistan No. 837-XII «On water and water use» from May 6, 1993. It ensures rational use of water for the needs of the population and economy sectors, protection of water from pollution, contamination and depletion, prevention and elimination of harmful effects of water, improvement of water bodies, as well as protection of the rights and legitimate interests of enterprises, institutions, organizations, farms, dekhkan farms and citizens in the field of water relations.


3. The law of the Republic of Uzbekistan No. 604-I “On Dekhkan Farm” of April 30, 1998, defining the legal basis for creating, operating and liquidating dekhkan farms, regulating their rights and obligations and regulating relations with other legal entities and individuals.

4. The regulation on water protection zones and other water reservoirs, rivers, main canals and collectors, as well as sources of drinking and domestic water supply, medical, culture and health purposes in the Republic of Uzbekistan, approved by the Resolution of the Cabinet of Ministers No. 174 of April 7, 1992. It defines the procedure for determination of the protective zones of water bodies and sanitary zones of water facilities, as well as establishes the procedure for economic activities to prevent pollution of water resources.

5. The regulation on the procedure for the development and maintenance of the State water cadaster of the Republic of Uzbekistan, approved by the Cabinet of Ministers’ Resolution No. 11 of 7 January 1998. It determines the order of comprehensive study and assessment of natural water resources, their use based on quantitative and qualitative indicators, registration of the right on water use and the regimes of hydro- economic use.

6. The regulation on the procedure for water use and water consumption in the Republic of Uzbekistan, approved by the Resolution of the Cabinet of Ministers No. 82 of March 19, 2013. It defines the procedure for water use and water consumption, water intake and water metering.

7. The regulation on the procedure for issuing permits for special water use or water consumption, approved by the Resolution of the Cabinet of Ministers No. 171 of June 14, 2013. It establishes the procedure for issuing permits for special water use or water consumption when using surface and groundwater in the Republic of Uzbekistan.

8. The regulation on the procedure of state environmental control, approved by the Resolution of the Cabinet of Ministers No. 216 of August 5, 2014. It defines the procedure for state environmental control, as well as the legal framework for the activities of state bodies implementing this type of environmental control.

9. The regulation on the procedure for issuing permits for water drilling, approved by the Resolution of the Cabinet of Ministers No. 430 of June 27, 2017. It defines the procedure for issuing a hydrogeological certification, permitting requirements and conditions and procedures for issuing
permits for water drilling, as well as registration or liquidation of production water wells drilled without permission.

10. The regulation on the state monitoring of groundwater, approved by the Resolution of the Cabinet of Ministers No. 430 of June 27, 2017, which defines the goal, main tasks, facilities and procedures for conducting state monitoring of groundwater in the Republic of Uzbekistan.

11. The Regulation on the work procedures on clearing riverbeds and strengthening their banks approved by the Resolution of the Cabinet of Ministers No. 1009 of December 21, 2017. It defines the procedures of work on clearing river channels, creeks, streams, and strengthening their banks.

12. The Decree of the President of the Republic of Uzbekistan No. UP 5418 of April 17, 2018, “On measures for the radical improvement of the state system on agriculture and water management”, defining the main tasks and activities of the Ministry of Water Resources.

13. Hydraulic Structures Safety Regulations approved by the Order No. 342 of the Minister of Emergency Situations of June 7, 2018. They establish requirements for the safe use of hydraulic structures, their electrical support, communication, alarm and lighting systems, as well as the organization of their control and monitoring.

Specially authorized bodies of state administration in the field of water use are the Ministry of Water Resources of the Republic of Uzbekistan (on surface water), the State Committee of the Republic of Uzbekistan on Geology and Mineral Resources (on groundwater) and the State Inspectorate for Supervision of Geological Study of the Subsoil, the Safe Conduct of Work in the Industry, Mining and Household sectors under the Cabinet of Ministers of the Republic of Uzbekistan (on thermal and mineral waters), which operate within their competency (Article 8 of the Law № 837-XII “On water and water use”).

State control over the use and protection of waters is carried out by the local government bodies, the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection, the State Inspectorate for Supervision of Geological Study of the Subsoil, the Safe Conduct of Work in the Industry, Mining and Household sectors under the Cabinet of Ministers of the Republic of Uzbekistan, the Ministry of Health of the Republic of Uzbekistan, the Ministry of Water Resources of the Republic of Uzbekistan in the manner prescribed by the legislation. Departmental control over the use of waters is carried out by the bodies of the State Committee of the Republic of Uzbekistan for Geology and Mineral Resources (Article 9 of Law No. 837-XII).

Regarding the targeted use, water consumption is divided into drinking, household, medical, resort, recreational, fisheries, industrial, energy, agricultural and other consumption. Depending on the amount of water taken from a water body, water consumption is subdivided into general and special water consumption.

General water consumption is individual water consumption to meet personal drinking, household, recreational, and medical needs, including watering animals and other needs, without the use of special facilities and devices that affect the state of water and water bodies.

Special water consumption is water consumption carried out by legal entities and individuals using special facilities and devices that affect the state of water and water bodies. In some cases, water consumption without the use of special facilities and devices can also be attributed to special water consumption, but it has an impact on the state of water and water bodies. Water resources are provided for consumption in accordance with the requirements and conditions provided by Law (Article 21 1 of the Law No. 837-XII).
Water bodies are provided for use primarily to meet the drinking and household needs of the population (Article 25 of Law No. 837-XII).

Water bodies shall be provided for separate use in whole or in part by the Cabinet of Ministers of the Republic of Uzbekistan or other authorized state body in accordance with the procedure established by the legislation. Water bodies are provided for separate use with the obligatory registration of a permit for special water use or water consumption (Article 26 of Law No. 837-XII).

Permission for special water use or water consumption through intake from natural water bodies is issued by the following authorities: Ecology and Environmental Protection Authorities, in coordination with the Ministries of Agriculture and Water Resources — on surface water bodies; Geology and Mineral Resources Authorities — on groundwater; State Inspectorate for Supervision of Geological Study of the Subsoil, the Safe Conduct of Work in the Industry, Mining and Household sectors — on mineral and thermal waters.

Permission for special water use or water consumption from artificial water bodies is issued by:

- The Ministry of Water Resources of the Republic of Uzbekistan— for basin management of irrigation systems, management of main canals (systems), management of reservoir operation, organizations operating transboundary water bodies, water bodies of inter-regional importance, large and especially important water facilities, pumping stations (PS), energy and communication facilities, land reclamation expeditions, as well as other water users and water consumers — using water from water bodies of national or inter-regional importance;

- Basin management of irrigation systems — for district irrigation departments, as well as other water users and water consumers — using water from water bodies of regional or inter-district importance;

- District irrigation departments, water user associations, as well as other water users and water consumers — using water from water bodies of district importance;

- Water User Associations - for farmer households and dekhkan farms, self-government bodies of citizens and other water consumers located in the area of their service — using water from water bodies for agricultural needs in coordination with the District Department of Agriculture (Article 27 of Law No. 837-XII).

In accordance with the legislation of the Republic of Uzbekistan, water use can be planned for river basins, basin irrigation systems and economic regions. Thus, the provision of Article 108 of Law No. 837-XII allows to plan water use with consideration of the data of the State Water Cadaster, water management balances, schemes for the integrated use and protection of water. The water balances are compiled based on the data on river basins, basin irrigation systems and economic regions (Article 27 of Law No. 837-XII) to assess the availability and extent of water use.

General and basin (territorial) schemes for the integrated use and protection of waters determine the main water management and other measures to be taken to meet future water needs of the population and economic sectors, as well as to protect waters and prevent their harmful effects (Article 111 of Law No. 837-XII).
b. National water allocation obligations in the Aksu River Basin

Water allocation in the Aksu Basin is carried out in accordance with the «Regulations on water use and water consumption in the Republic of Uzbekistan» and the system water use plan.

To conclude this chapter, the following points should be noted:

- A review of the legislative framework for the water resources management in the Republic of Uzbekistan shows that the above-mentioned laws and regulations contribute to promote and provide the opportunity to implement basin planning in Uzbekistan.

- The country’s legislation has elements of IWRM and basin planning, but there are no specific rules and regulations for the preparation of basin planning.

- In Uzbekistan, water resources management at the regional level is carried out on the basis of the hydrographic principle and is regulated by basin irrigation systems authorities (Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 320 of July 21, 2003, “On Improving the Organization of Water Management”). However, it is important to note that at the district level water resources management is carried out based on the administrative-territorial principle (Resolution of the Republic of Uzbekistan No. PP-3172 of August 4, 2017, “On measures for further improvement of the organization of activities of the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan”).

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NATIONAL PROGRAMS AND DEVELOPMENT STRATEGIES RELEVANT TO THE TERRITORY OF THE AKSU RIVER BASIN

a. Agricultural development issues (including the provision of subsidies for agricultural development)

A number of documents that improve the financial and economic conditions, increase profitability and encourage farmers to increase productivity were adopted in 2018. In accordance with the Decree of the President of the Republic of Uzbekistan No. PP-3574 of February 28, 2018 “On measures to fundamentally improve the system of financing the production of raw cotton and cereals” it was established that the final payments for raw cotton and cereals will be carried out fully by the end of harvest year. It has been established that the cost of electricity consumed by pumping units of farmer households and water users associations shall be covered by subsidies from the State budget.

The Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 149 of February 28, 2018 «On measures for the widespread introduction of market mechanisms in agriculture» defines:

- State-guaranteed prices for the purchase of raw cotton and cereals in the context of varieties and classes;
- Approved guaranteed volume of distribution of credit resources by regions, months and types of costs allocated for financing the costs of raw cotton and cereal crops growing in 2018 for public procurement;
- Newly approved “Regulation on the procedure for crediting the costs of growing and carrying out final settlements for raw cotton and cereals”.

In accordance with the above-mentioned resolution, credit lines are provided by regional branches of commercial banks based on applications of lenders, contracts and guaranteed volume of credit resources, approved by the Khokim of the relevant district together with the heads of agricultural producers and the district farmer councils, dekhkan farms and owners of land plots in Uzbekistan. The raw cotton and cereal crops production on the basis of agro-technical measures (cards) are considered taking into account the cost of seeds, supplied by the procurement organization in advance of up to 60 percent (projected) value of the future yields. Payments from loan accounts for the purposes specified above shall be made in non-cash form (except for wages) based on payment orders of the lenders.

The LLC “Tomorka Khizmati” was established in all rural areas of the republic in accordance with the Resolution of the President of the Republic of Uzbekistan No. PP-3680 of April 26, 2018. The main tasks are to provide practical assistance to farmers, dekhkan farms and owners of household lands in growing and selling crops by:

- Delivery of the necessary material resources, including seeds, seedlings, containers, equipment and other means to farmers, dekhkan farms and owners of household lands on a contractual basis;
- Land reclamation and crop sowing;
- Creation and improvement of the water irrigation system, installation of water pumps, drilling of artesian wells and organization of drip irrigation;
- Marketing of manufactured products and crops in the domestic and foreign markets, including their harvesting, storage, processing, and export.
ASSESSMENT OF THE CURRENT SITUATION OF THE AKSU RIVER BASIN IN KASHKADARYA REGION

Analytical Report

The Fund to support farmer households, dekhkan farms and owners of homestead lands under the Council of homestead lands, dekhkan farms and owners of homestead lands of Uzbekistan with the status of a legal entity was established. These funds are used for:

- allocation of resources to the Microcredit bank, the Agro bank and the People’s Bank of the Republic of Uzbekistan for the provision of loans for farmers, dekhkan farms and owners of homestead lands for a period of 3 years, including a grace period of up to 1 year, with an interest rate of 7 percent per annum, taking into account the margin of the bank in the amount of 2 percent;

- provision of loans through commercial banks at the refinancing rate of the Central Bank of the Republic of Uzbekistan, taking into account the bank’s margin of 2 percent, to LLC “Tomorka Khizmati” and other manufacturing, processing, procurement, delivery, trade organizations in the field of agricultural production, as well as leasing organizations to strengthen their financial-technical base, to purchase agricultural machinery and vehicles, materials and components for the installation of greenhouses for farmer households, dekhkan farms and owners of homestead lands;

- maintenance and logistical support of the Fund’s activities;

- formation of authorized funds of LLC «Tomorka Khizmati», which need a working capital, in the amount of not less than 25 percent of the authorized Fund;

- other areas related to the attraction of investments for farmer households, dekhkan farms and the development of homestead land, as well as the implementation of innovative projects.

The volume of additional supplies of agricultural machinery in Kashkadarya region reached 1149 units in 2018, and the volume of supplies of agricultural machinery on a leasing basis – 463 units. This was done in order to further improve the technical capacity of agriculture through the renovation and modernization of the machinery fleet to ensure timely and high-quality performance of agro-technical works in accordance with the resolution of The President of the Republic of Uzbekistan № PP-3712 of May 10, 2018.

b. Strategies and plans for the development of water resources management (state and local levels)

Based on the forecast parameters for the construction and reconstruction of irrigation facilities financed by centralized investments from the State Budget of the Republic of Uzbekistan for the period 2018–2019, approved by the Decree of The President of the Republic of Uzbekistan № PP-3405 of November 27, 2017, the following facilities in the Aksu zone were included into the state Program:

- reconstruction of the “Varganza-1”, “Varganza-2” pumping stations (PS) and the reconstruction of the concrete canal in Kitab district - 3 km;

- construction of the “Okboy” PS on the territory of the K. Rustamov area in Kitab district;

- construction of the “Saroy-1” PS, reconstruction of the “Saroy-2” PS and the flumed canal irrigation in Kitab district - 3.1 km;

- systemic reconstruction of irrigation networks in Kitab district - 5.8 km;

- reconstruction of the upper reach of the Dukhchi and Chorbog canals and facilities construction on the bed of the Aksu River in Shakhrisabz district;

- systemic reconstruction of irrigation networks in Shakhrisabz region - 5.8 km;
• reconstruction of the “Khisor-Beshkutan” canal in Yakkabag district;
• construction of the mudflow basin reservoir across the Guldara River in Yakkabag district.

In accordance with the targeted program of construction and reconstruction of drinking water supply system in Kashkadarya region for 2017-2021 (see table 1), approved by the Decree of the President of the Republic of Uzbekistan № PP-2910 of April 20, 2017, the following works are planned across the Aksu River Basin:

<table>
<thead>
<tr>
<th>Name of districts</th>
<th>Types and objects of work:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water supply networks, km</td>
</tr>
<tr>
<td>Kitab</td>
<td>20.2</td>
</tr>
<tr>
<td>Shakhrisabz</td>
<td>40.4</td>
</tr>
<tr>
<td>Yakkabag</td>
<td>26.5</td>
</tr>
</tbody>
</table>

Table 1. Program of construction and reconstruction of drinking water supply system facilities in Kashkadarya region for 2017-2021

Reconstruction and expansion of sewage systems in Shakhrisabz district, Kashkadarya region (including Kitab district), with the participation of the World Bank: capacity - 10.0 thousand m3 / day, construction period - 2018-2022.

In accordance with the environmental monitoring program in the Republic of Uzbekistan for 2016–2020, approved by the Resolution of the Cabinet of Ministers No. 273 of August 23, 2016 in the Aksu River Basin, monitoring of the water quality in Kashkadarya, Tankhozdarya and Aksu rivers is provided.

According to the forecasted parameters for the production of organic fertilizers at solid domestic waste landfills for 2017-2021, approved by the Decree of the President of the Republic of Uzbekistan No. PP-2916 of April 21, 2017, the “Toza Hudud” State Unitary Enterprise (SUE) produces organic fertilizers in the Aksu Basin in Kashkadarya region (see table 2).

<table>
<thead>
<tr>
<th>Name of territories (location of landfills)</th>
<th>Year of establishment</th>
<th>Object area (ha)</th>
<th>The volume of accumulated waste (t)</th>
<th>Production of organic fertilizers (t), including by years:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2017</td>
</tr>
<tr>
<td>Kitab district</td>
<td>1991</td>
<td>6,0</td>
<td>640</td>
<td>6</td>
</tr>
<tr>
<td>Shahrisabz district</td>
<td>1991</td>
<td>2,5</td>
<td>1000</td>
<td>10</td>
</tr>
<tr>
<td>Yakkabag district</td>
<td>1989</td>
<td>5,4</td>
<td>640</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 2. Production of organic fertilizers at solid waste landfills in 2017-2021

In accordance with the parameters for expanding the network of observation points for groundwater monitoring for 2018–2021, approved by Presidential Decree No. PP-2954 of May 4, 2017, in total 88 wells are to be built in Kashkadarya region (see table 3).
ASSESSMENT OF THE CURRENT SITUATION OF THE AKSU RIVER BASIN IN KASHKADARYA REGION
Analytical Report

<table>
<thead>
<tr>
<th>Objects of observation</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of wells (units)</td>
<td>Drilling (linear m)</td>
<td>Number of wells (units)</td>
<td>Drilling (linear m)</td>
</tr>
<tr>
<td>Totally</td>
<td>97</td>
<td>24</td>
<td>3100</td>
<td>29</td>
</tr>
<tr>
<td>Groundwater deposits</td>
<td>87</td>
<td>10</td>
<td>1600</td>
<td>20</td>
</tr>
<tr>
<td>Sources of pollution</td>
<td>8</td>
<td>5</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>Waterworks, rivers, canals</td>
<td>2</td>
<td>9</td>
<td>1400</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 3. Expansion of the network of observation points for groundwater monitoring for 2018-2021 in Kashkadarya region

In accordance with the list of investment projects for the construction and renovation of new and existing hydroelectric power stations, respectively, of the “Uzbekgidroenergo” JSC on the natural watercourses and water management facilities of the Republic, approved by the Decree of the President of the Republic of Uzbekistan No. PP-2947 of May 2, 2017, the following activities will be carried out:

- Construction of the “Tamshush” Hydroelectric Power Plant (HPP) on the Akdaryo-Aksu River in Shakhrisabz district with a design capacity of hydroelectric power plants up to 11 MW.
- Construction of the “Dectar” HPP on the Tankhozdarya River in Shakhrisabz district with a design capacity of hydro power plants up to 2.5 MW.

In accordance with the Decree of the President of the Republic of Uzbekistan No. PP-2947 of May 2, 2017 “On the program of measures for the further development of hydropower for 2017–2021” the following actions were included in the list of promising investment projects of the “Uzbekgidroenergo” JSC for the construction of new and modernization of existing hydroelectric power plants on natural watercourses and water facilities of the republic:

- Construction of the Chappasuy HPP on the Aksu River in Shakhrisabz district - a design capacity of 11.9 MW.
- Construction of the Rabat HPP on the Aksu River in Shakhrisabz district - design capacity of 11.9 MW.
- Construction of the Tashbulakskaya HPP on the Tankhozdarya River in Shakhrisabz District - design capacity of 3.8 MW.
- Construction of the Shurdjinskaya HPP on the Tankhozdarya River in Shakhrisabz district - design capacity of 3.8 MW.
- Construction of the Khitay HPP on the Tankhozdarya River in Shakhrisabz region - design capacity of 3.0 MW.
- Construction of the Karatut HPP on the Tankhozdarya River in Shakhrisabz region - design capacity of 3.0 MW.
- Construction of the Suvlisai HPP on the Kyzildarya River in Yakkabag district - design capacity of 7.7 MW.
- Construction of the Samak HPP on the Kyzildarya River in Yakkabag district - design capacity of 6.5 MW.
At the end of this Chapter, we can list the following points relevant to the territory of the Aksu River Basin:

- In 2018, a number of documents were adopted and organizational structures were created to improve the financial and economic situation, to increase profitability and to stimulate farmers to increase labor productivity;

- The government has adopted a number of programs in the Aksu River Basin zone, aimed at building and reconstructing irrigation facilities, constructing and reconstructing drinking water supply facilities, modernizing existing hydroelectric power stations of “Uzbekgidroenergo” JSC located on natural watercourses and water management facilities, and adopting promising programs for the further development of hydropower (2017-2021), funded by centralized investment from the State Budget of the Republic of Uzbekistan.
WATER RESOURCES IN THE AKSU RIVER BASIN

a. Hydrology

The Aksu River is located in Kashkadarya region in the southern Uzbekistan on the western slope of the Pamir-Alay Mountains. The length of the river is 154 km, and the basin area is 1280 km². Aksu originates on the northern slope of the Gissar Range (Miraki settlement in Shakhrisabz district) and flows into the Kashkadarya River. It irrigates about 48796 hectares of land in Shakhrisabz, Kitab and Yakkabag districts, and 40% of this territory is under wheat-cotton production, perennial plantations make up 20 percent (Figure 1).

The Aksu River is formed by the confluence of two rivers, the Khonak and Batirbay Rivers, which originate from the Severtsev and Batirbay glaciers, with rivers filled out by streams issuing from glaciers and snow. In the upper reaches, the river flows among the mountains, where the height of the water distributors is 4100-4300 meters. The southern spurs of the river basin are distributed by the deep depressions of the rivers due to this the length of the basin on the left side is 12–24 km and adjoins the Filon, Kizilimchak, Tamshush, and Suvtushar Rivers. The high water falls on the period from March to September with the maximum water flow from May to June. Such unstable and insufficient water supply is regulated with the help of the Gissarak reservoir. Average water flow is 12.3 m³ / s (Khazarnov village). The average flow module of the Aksu River is M = 13.75 l / s / km². The average water flow of suspended sediment load is 12 kg / m³.

Volumes of flood flow are as follows:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Volume (mln. m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01%</td>
<td>928.0</td>
</tr>
<tr>
<td>1.0%</td>
<td>746.0</td>
</tr>
<tr>
<td>5.0%</td>
<td>487.0</td>
</tr>
<tr>
<td>10.0%</td>
<td>428.0</td>
</tr>
</tbody>
</table>
Considering the correlation of urgent and average daily maximum flow, it can be concluded that maximum water flow is formed with the obligatory participation of melting snow and glaciers in June and July. Therefore, the main wave passes within 24 hours. The actual flow of intra-annual distributions for the example of 1969 is given in Table 4.

<table>
<thead>
<tr>
<th>Months</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q m³/s</td>
<td>3.55</td>
<td>3.55</td>
<td>22.8</td>
<td>38.8</td>
<td>36.7</td>
<td>53.3</td>
<td>54.7</td>
<td>33.9</td>
<td>13.2</td>
<td>7.41</td>
<td>5.71</td>
<td>4.64</td>
</tr>
<tr>
<td>%</td>
<td>1.3</td>
<td>1.3</td>
<td>8.3</td>
<td>14.0</td>
<td>13.2</td>
<td>19.0</td>
<td>19.5</td>
<td>12.2</td>
<td>4.7</td>
<td>2.7</td>
<td>2.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Runoff. mln. m³</td>
<td>9.51</td>
<td>8.59</td>
<td>61.07</td>
<td>100.57</td>
<td>98.30</td>
<td>138.15</td>
<td>146.51</td>
<td>90.80</td>
<td>34.21</td>
<td>19.85</td>
<td>14.80</td>
<td>12.43</td>
</tr>
</tbody>
</table>

Thus, up to 85% of the annual runoff occurs during the flood period.

b. Groundwater Analysis

In Kashkadarya region, the groundwater is formed from the flow of the Aksu and Kashkadarya Rivers. There are 107 production wells throughout the region to raise water from underground sources and several water intake facilities have been built in Kitab and Shahrisabz districts and other areas (Usmanov, 2016).

Ground waters in the Aksu River Basin occur depending on the shape of the relief at a depth of 6 meters or more. Water contains hydro carbonate-calcium, average salinity is 200-240 mg/l. Ground waters and waters of the Aksu River are fresh with a mineralization of not more than 0.5 g/l. Irrigated lands with groundwater salinity up to 1 g/l make up 79.9% of total area with mineralization 1-3 g/l - 18.6% (Figure 2). There are no salted soils.
c. Water quality

The long-term chemical composition of water is characterized by average mineralization (180-360 mg/l), as given in Table 5 and Figure 3. The Aksu River water is classified as a bicarbonate calcium group according to the predominant analysis.

<table>
<thead>
<tr>
<th>Sampling date</th>
<th>Dry residue in mg/l</th>
<th>Total hardness mEq/l</th>
<th>Nitrates NO₃ mg/l</th>
<th>Sulfates SO₄ mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.06.2015</td>
<td>180</td>
<td>2,85</td>
<td>4,0</td>
<td>16,0</td>
</tr>
<tr>
<td>03.08.2015</td>
<td>228</td>
<td>2,70</td>
<td>4,0</td>
<td>49,0</td>
</tr>
<tr>
<td>11.11.2015</td>
<td>316</td>
<td>4,10</td>
<td>6</td>
<td>89</td>
</tr>
<tr>
<td>12.05.2016</td>
<td>340</td>
<td>4,15</td>
<td>6</td>
<td>77</td>
</tr>
<tr>
<td>21.06.2016</td>
<td>196</td>
<td>2,50</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>19.09.2016</td>
<td>360</td>
<td>4,30</td>
<td>2</td>
<td>82</td>
</tr>
<tr>
<td>05.05.2017</td>
<td>252</td>
<td>3,55</td>
<td>12</td>
<td>44</td>
</tr>
<tr>
<td>14.08.2017</td>
<td>202</td>
<td>1,90</td>
<td>6</td>
<td>36</td>
</tr>
</tbody>
</table>

Table 5. Chemical composition of the Aksu River water (Khazarnau hydropost)

The formation of water resources is highly dependent on seasonal snow, and this sometimes leads to unstable and inadequate water supply. Due to the development of irrigated agriculture, surface water sources have become unsuitable for household and drinking needs. Therefore, the drinking water supply to the population of the Aksu River Basin (and in the whole Kashkadarya region) is based on underground sources. According to the specialist of hydrological station working on groundwater issues, currently there is a lack of water analysis for chemical and microbiological indicators.

![Figure 3. Dynamics of changes in water salinity in the Aksu River](image-url)
At the end of this Chapter, we can list the following points relevant to the territory of the Aksu River Basin:

- River has national boundaries and is regulated by Gissarak Reservoir.
- Floods occur between March and September, with maximum flow from May to June. The Gissarak Reservoir regulates this unstable and insufficient water availability.
- Taking into account the ratio of urgent and average daily maximum water flow it can be concluded that the maximum water flow are formed with the mandatory participation of melting snow and glaciers in June and July.
- Groundwater and water of the Aksu River are fresh with mineralization of not more than 0.5 g/l. There are no saline soils.
- Groundwater is mainly used for drinking water supply.
NATURAL CONDITIONS IN THE AKSU RIVER BASIN

a. Geology and morphology

Geomorphologically, the Aksu River Basin is located within the North-Western spurs of the Gissar Range, forming the North-Eastern slopes of the Kashkadarya basin.

Rocks of Silurian, Neogene and Quaternary ages take part in the geological structure of the upper part of the river. Silurian rocks are developed on the right bank of the reservoir and are represented by clay slates and lime rocks with a capacity of more than 1,000 m. The geological structure of the basin is represented by sandy loam and clay loam soil. The thickness of the fine-grained cover varies from 0.5 to 1.2 m.

Pebble beds with boulder inclusions on a sand and gravel aggregate, consisting of well and moderately rounded fragments of oval, rounded, eruptive and sedimentary rocks, lie in the base of fine earth. Thick lenses (0.5-1.0 m) of weakly cemented conglomerates are found in the thickness of the gravel. Thin-layered conglomerates lie in calcareous and lime-sandy cement. Pebbles are well rolled, represented mainly by lime rocks, and occasionally pebbles of granitoids, sandstones and slates.

Lenses and interlayers of aleurite, sandstone and clay, as well as conglomerates with weaker sandy-clay and lime-clay cement cause the lamination of conglomerates. Gravel and pebbles mainly from limestone, diorites and marbles. Smaller amounts of porphyry, porphyrite, and granite are found.

b. Climatic conditions (risk analysis of natural disasters and possible preventive measures)

By its location, the Aksu River Basin is in favorable conditions for access to humid Southwestern and Western winds, providing a high water content of the river.

The elevation of meteorological stations varies from 657 to 2,780 m (Figure 4). Annual rainfall within the considered meteorological stations varies from 471 to 700 mm. The mean value of the pool is 610 mm. In the formation of maximum discharges, a significant role is played by intensive rain precipitation. The formation of the main wave of the flood is also affected by the air temperature, which determines the amity of the melting of the snow cover.
The altitude range of the basin determines the temperature regime. According to the Shahrisabz meteorological station, the average annual air temperature is +16.1 °C with an average minimum in January of 2.1 °C and a maximum in July of 36.2 °C. The average annual precipitation is 514 mm with the most precipitation falling between January and April (Figure 5).

The height of the snow cover of the middle and high mountains of the basin can be up to 50-70 cm. The water reserves in the snow can reach 20-25 cm.

The number of days with precipitation exceeding 31 mm for the period of floods (March-June) is 1.3 days, 20 mm - 3.7 days and 10 mm - 9.1 days.

Disaster risk analysis and possible preventive measures

Extreme floods are formed with large accumulations of snow at low temperatures and a subsequent sharp increase in air temperature. Under these conditions, precipitation of rainfall further increases the maximum flow of water.

The Aksu River has a glacier-fed stream. The role of rain is also significant from March to May. The hydrological regime has been studied since 1927 at the Khazarnau station. This water station recorded the regime of the river during these years. A slight decrease in the flow was noted during 1970-1980 due to the low water level.

Figure 5. Monthly precipitation amounts and average maximum and minimum air temperatures averaged for 2015-2017 at the Shahrisabz station, compared with the average multi-year observational data

Maximum flow

Mudflow does not threaten the territory of the waterworks. The constructed dams of the Gissarak reservoir regulate the mudflow formed in the upper reaches of the Aksu River Basin. Subject to the rules of operation of these reservoirs, mudflows cannot cause damage to the waterworks of the Aksu hydroelectric station. Urgent maximum flows of the Aksu River are usually noted in March-June.
Characteristics of the possible flooding zone. Results of determining the flood zone.

An emergency can lead to significant damage. In case of dam destruction, according to the working documentation entitled “Determining the damage to the national economy from the waves of the breakthrough of the Gissarak reservoir and the calculation of the forced discharge mode” (Tashkent, 1984), a part of the Kashkadarya region will be flooded. The width of the flood zone ranges from 1 km to 5 km. The length of the zone is 69.8 km.

Information on possible material, social and environmental consequences of accidents at hydraulic structures (damage)

Damages in case of dam destruction are divided into direct and indirect. The direct damage is the loss of fixed and current assets of the sectors of the national economy. Indirect damage includes losses that occur at facilities and in sectors of the economy located outside the flood zone.

The total damage to national economy objects, in addition to agricultural losses, includes damages from the destruction of road and railroads, communication lines and electricity transmission lines, irrigation and collector-drainage networks, personal property of citizens, fixed assets of agricultural enterprises, other industries and other property. This also includes the cost of evacuating and re-evacuating citizens, the cost of restoring soil fertility.

In the case of an emergency, the employment and living standards of the population living outside the flood zone will decrease due to the destruction of the canals providing water to the adjacent irrigated lands and in the area under the command reservoir.

Possible environmental consequences of a dam failure are as follows:

a) Disrupted microclimate in the surrounding area.
b) The dramatic emptying of the basin can intensify the processes of sliding down the slopes and collapsing the shores.
c) Destruction of fish stocks.

In the downstream of the dam:

- Removal of spatial-territorial land resources from the environment in large areas.

- Emptying the basin will lead to the withdrawal of water resources from the environment. Due to this, irrigated lands will be reduced not only in this basin, but also in the Tankhozdarya and Yakkabagdarya River Basins, because the existing Aksu-Yakkabag water channel flows into these basins.

- Flooding of land and drying of irrigated areas will lead to the destruction of existing fauna and flora.

- Also, the main visual landscapes defining the typical landscapes of the territory (parks, gardens, springs, etc.) will be destroyed.

- Cultural and historical monuments within Kitab and Shahrisabz districts can also be affected.

- The water flow, loaded with a significant amount of sediment, will remove agricultural resources from the crop rotation; destroy the headwater intake facilities.

- The breakthrough wave will destruct fertilizer storage warehouses, fuel, lubricants, and other facilities, which will lead to pollution of water resources.
The Kitab-Shakhrisabz groundwater field is located in this zone, which also replenishes its reserves from the Aksu River. This field is the only source of fresh groundwater for the centralized water supply of the region’s population. Pollution of the surface flow of the Aksu River will entail pollution of underground reserves. According to the degree of environmental impact, reservoirs belong to the first category of exposure (high risk).

The following indicators determine the nature of the impact:

- **Nature of exposure:** direct immediate. The impact on groundwater can occur after a certain period of time (2-3 months).
- **Intensity of impact:** instantaneous, limited by the time interval of reaching the transformed flow.
- **Temporal dynamics – in case of emergencies.**
- **The entire established ecological system will be disrupted.**

### c. Land reserves

The land reserves of the Aksu Basin is 284,812.8 ha, of which 3.4 percent is household land, 32.8 percent is non-agricultural land and 63.8 percent is agricultural land, including arable land (17.3 percent), perennial plantations (4.2 percent), deposits (0.8 percent) and pastures (41.4 percent). The area of irrigated land is 48796 ha.

Despite the decision not to apply the state order for raw cotton and grain on the lands with low soil fertility, the area of cotton and winter cereal crops still occupies the main part of the irrigated arable land: 65.4 percent in the Aksu Basin (Figure 6).

![Figure 6. Distribution of agricultural crops in 2017, the Aksu basin, %](image)

Soil types: brown soils in the mountains, alluvial marsh soils in the fresh-water floodplain, typical brown, gray-brown (dark gray soils) and typical gray soils on the plains. By mechanical composition: 40.9 percent - heavy loam, 50.1 percent - medium loam, 8.8 percent - light loam and 0.1 percent - sandy loam (Figure 7). The area of irrigated land with a depth of groundwater level up to 2 meters from the surface of the earth is only 1.3 percent. 2,313 hectares of deposits can be added to the agricultural production through the relevant measures.
### No | Detailed soil types
--- | ---
1 | Dark brown meadow and clay and coarse-ground, mainly medium eroded
2 | Dark brown meadow and steppe alpine loam soil with patches of swampy meadow and peat soils near the keys and snowfields
3 | Rainfed (sometimes conditionally irrigated) brown slightly calcareous soils of heavy loamy and medium loamy, mainly poorly and medium washed out in places with 0.6-0.7 m of bedrock fragments
4 | Brown slightly calcareous soils (virgin, sometimes rainfed), heavy, medium loamy and clayey and eroded to varying degrees
5 | Brown slightly calcareous and leached soil (virgin, sometimes rain-fed), medium and strongly eroded and often rock outcrops
6 | Rainfed (sometimes conditionally irrigated) dark black soil medium loamy and moderately eroded
7 | Rainfed sierozems dark medium-loamy, weakly skeletal and with lightly
8 | Chernozems dark (virgin lands, fallow, sometimes rain-fed) loamy and medium loamy, medium, medium and strongly eroded
9 | Sierozems dark (of virgin-fallow) medium and strongly eroded
10 | New irrigated chernozems typical medium-loamy, weakly skeletal and sometimes with lightly, sometimes to a depth of 0.5-1 m – gravel
11 | Rainfed chernozems typical medium-loamy, sometimes weakly skeletal, with lightly
12 | Rainfed chernozems typical medium-loamy, sometimes weakly skeletal, medium eroded
13 | Typical chernozem (of virgin-fallow with small plots of rainfed and irrigated conventionally) medium loam, with heavy loam and clay, medium and heavily eroded
14 | Old irrigated chernozems typical medium-loamy, sometimes with 0.5-1 m gravel
15 | New irrigated chernozems typical medium-loamy, with lightly, sometimes with 0.5-1 m gravel
16 | Irrigated chernozem-meadow and meadow-chernozem soils loamy, sometimes sparsely populated and lightly washed
17 | Old irrigated chernozem-meadow and meadow-chernozem soil medium loamy
18 | Old irrigated meadow saz loamy soil, uninhabited, sometimes slightly saline
19 | Old Irrigated meadow saz soil medium loamy, weakly, moderately saline sites
d. Natural Ecosystems and Biodiversity

There are three types of ecosystems in the Aksu River Basin: mountains, foothills and flats. The mountain ecosystem of the Aksu River Basin includes the Gissar ridge with 2,500 meters of high, which is connected to the Karshi steppe plain in the Kashkadarya region (Photo 1). Rivers flowing from the mountains shapes ravines. Mountains provide ecosystem services, which provide the following range of basic goods and services:

- forest products and land for food production for residents;
- protection of watersheds;
- protection of natural habitats of wild fauna and flora of local and global importance;
- disaster risk reduction and elimination of negative impact of changing climate;
- natural recreation areas;
- contribute to the preservation of fresh water and their flow.

The territory of the plains is characterized by a high level of landscape and biological diversity, and has a rich flora and fauna with a large number of rare, endangered endemic species (Photo 3).

Because of economic development, natural ecosystems (mostly flat) were almost completely replaced by anthropogenic landscapes. Land degradation at different levels is observed in foothill and lowland ecosystems. The main environmental problems are increasing soil and water salinity (especially in downstream), wind and water erosion, overgrazing, reduced forest area and biodiversity and decreased arable land productivity. Currently, there is no comprehensive assessment of the decline in yields and volumes of ecosystem services due to the economic effects of land degradation. There are two reserves in the region: the Gissar State Reserve (Photo 2) and the Kitab State Geological Reserve.

Diversity of flora and fauna

The natural flora of the Aksu River Basin includes about 1,200 higher plants (embryophytes). There are about 27,000 hectares of forest. There are two types of forests: coniferous and saxaul. Desert annual plants (ephemera), wormwood, spines, camel thorn, spruce, quinoa, wild and fruit trees, maple, barberry, rose and others grow on the territory of the plains. Coniferous trees, maple, almonds, pistachio, and unabi grow in mountain forests. The foothill areas are covered with shrubs of the maple family. The foothills of the mountains play an important economic role as grazing sites. Therefore, it is extremely important to prevent pasture degradation in this area. The total area of pastures is 117,938 ha.

The fauna of this area is very diverse and has a high economic value. 405 species of vertebrate animals inhabit the Aksu River Basin, 61 of which are mammals, 12 are included in the Red Book of the Republic of Uzbekistan, and 21 species are included in the Red List of the International Union for Conservation of Nature. There are sandy habitats, snakeheads, trout, Asian temples, and other species that belong to the genus of carp fish that live in the rivers. The Aksu River Basin is inhabited by many species of wild animals such as fox, wolf, badger, bear, wild pig, mountain goat, argali (mountain sheep), reptiles, chukar, nightingale, gazelle, gopher, porcupine, rabbit, leopard, deer, monitor lizard, poisonous and non-venomous snakes and rodents. As mentioned above, the mountain ecosystem of the Aksu River Basin is located in the territory of the Gissar State Reserve. It serves to preserve the natural complexes and ecosystems of the Gissar Range, including 870 plant species, 116 bird species and 30 mammal species living on its territory, including the snow leopard, bear and lynx.
ASSESSMENT OF THE CURRENT SITUATION OF THE AKSU RIVER BASIN IN KASHKADARYA REGION
Analytical Report

Photo 1. The Aksu River on the Gelan site
Source:  http://www.hisor.uz/uz/suv_manbalari

Photo 2. Landscape of the Gissar State Nature Reserve

Photo 3. Snow Leopard in the Gissar Reserve
Source:  http://visitkashkadarya.uz/ru-ru/ThingsToDo/ThingsToDoView/1022
In conclusion, we can list the following points relevant to the territory of the Aksu River Basin:

- Due to its location, the Aksu River Basin is located in favorable conditions regarding the access of humid South-Western and Western winds, providing a fairly high water content of the river;

- Despite the state reforms to increase the fruits and vegetables production, cotton and winter wheat, which occupy 23 percent and 42 percent of irrigated land, respectively, are still the main crops in the Aksu basin;

- Extreme floods are formed with large accumulations of snow at low temperatures and a subsequent sharp increase in air temperature. In the foothill and lowland ecosystems, land degradation is observed. Natural disasters can lead to significant damage;

- There is a problem of increasing soil and water salinity (especially in the lower reaches of rivers), wind and water erosion, overgrazing, reduced forest area and biodiversity, and decreased productivity of arable land;

- There are two reserves in the basin: the Gissar State Reserve and the Kitab State Geological Reserve, which allow for the sustainable development of tourism through an ecosystem approach.
SOCIO-ECONOMIC SITUATION IN THE AKSU RIVER BASIN

a. Employment and income

Socio-economic assessment in the Aksu River Basin was carried out based on data from three districts along the basin: Kitab, Shahrisabz and Yakkabag. The population in the Aksu River Basin is 856 thousand people, with a population density of 189.8 people per square kilometer. From 2000 to 2018, the population increased significantly, from 612.7 to 856 thousand people, or by 39.8 percent (data of the Department of Statistics of Kashkadarya region, 2018). The areas with the highest population density are Yakkabag and Shakhrisabz districts. The average age of the region’s population is 26.5 years. The shares of the male and female population are almost the same, with a small difference in favor of the male population. In 2017, more than half (57.5%) of the basin population lived in rural areas (Figure 8).

![Figure 8. Dynamics of urban and rural population along the Aksu River Basin, according to the data of the Department of statistics of the region](image)

According to the Statistics Department of Kashkadarya region, in 2017 the number of employed in the economy amounted to 308.4 thousand people, or 36 percent of the total population (Figure 9).

![Figure 9. The number of employed in the economy along the Aksu River Basin areas in 2017.](image)
Dekhkan farms, small businesses and private entrepreneurship play a special role in the employment of labor resources; today they employ more than 70 percent of the total employed population. In Shakhrisabz, Kitab, and Yakkabag districts, this figure is more than 75-80 percent (Yuldashev, 2016).

b. Social Development Indicators

783 industrial enterprises operate on the territory of the Aksu River Basin. There are 77 pre-school institutions and 277 schools in the basin, where 126,600 children and adolescents under the age of 18 are educated and brought up (Table 6). Statistics show that there are no problems related to gender imbalance, as the number of men and women is almost equal. The population is fully supplied with electricity, but in some areas people use imported water for drinking purposes and part of the population is not provided with natural gas.

<table>
<thead>
<tr>
<th>Children and adolescents under 18</th>
<th>thousand people</th>
<th>126,6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>thousand people</td>
<td>367,3</td>
</tr>
<tr>
<td>Women</td>
<td>thousand people</td>
<td>352,9</td>
</tr>
<tr>
<td>Schools</td>
<td>units</td>
<td>277</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>units</td>
<td>77</td>
</tr>
<tr>
<td>College</td>
<td>units</td>
<td>30</td>
</tr>
<tr>
<td>Hospitals</td>
<td>units</td>
<td>16</td>
</tr>
<tr>
<td>Culture and art centers</td>
<td>units</td>
<td>27</td>
</tr>
<tr>
<td>Water supply</td>
<td></td>
<td>Available</td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td>Available</td>
</tr>
<tr>
<td>Gas supply</td>
<td></td>
<td>Available (partially)</td>
</tr>
</tbody>
</table>

Table 6. Social indicators for the Aksu River Basin (the table is compiled according to the regional statistical departments for 2017)

c. Macroeconomic indicators

According to the State Statistics Committee of the Republic of Uzbekistan, the Gross Regional Product (GRP) of the Kashkadarya region grew by 3.1 percent compared to 2016 and amounted to 17,366.1 billion UZS. The growth of GRP is due to positive growth rates in the main sectors of the region’s economy: in agriculture, forestry and fisheries - 100.8 percent (its share in the structure of GRP - 22.6 percent), industry - 104.1 percent (35.2 percent), construction - 100.4 percent (7.6 percent), services - 104.0 percent (34.6 percent). In 2017, the GRP per capita amounted to 5,568.8 thousand UZS (Figure 10).

Figure 10. The composition of the Gross Regional Product (GRP) of Kashkadarya region in 2017

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3 There is no data on GDP by districts of Kashkadarya region. Macroeconomic indicators are shown for the region as a whole.
d. Stakeholders of the Aksu River Basin

The main stakeholders of the basin include the following organizations:

1. Amu-Kashkadarya BISA
2. Representatives of reservoir operating organizations
3. Representatives of energy organizations (HPP)
4. Representatives of Land Reclamation Expedition
5. Representatives of the Gosvodkhoznadzor (on the technical condition of the facilities)
6. District Irrigation Department
7. Water Consumer Association (WCA)
8. Young professionals in water management and irrigation systems
9. Fishery representatives
10. Local unit of the Hydrometeorological center of the Republic of Uzbekistan
11. Representatives of the hydrological station (on groundwater issues)
12. Regional Khokimiyat and Khokimiyats of three districts
13. Local unit of the State Committee on Ecology and Environmental Protection
14. District Departments of Agriculture
15. District offices of the land Cadaster
16. Representatives of business and industry (industrial plants)
17. Representatives of MES
18. Representatives of the Sanitary and Epidemiological Service
19. Representatives of the housing and utilities sector (on drinking water supply issues)
20. Representatives of the Border Guard Service of the Republic of Uzbekistan
21. Farm Council
22. Elders / Aksakals
23. Chairs of Makhallas
24. Representatives of medical institutions
25. Forestry representatives
26. Non-governmental organizations

The roles and tasks of the main stakeholders are presented in Annex 3.

In conclusion, we can list the following points relevant to the territory of the Aksu River Basin:

- Population along the basin increased dramatically;
- The rural population is larger than the urban population;
- The main role in the employment is played by dekhkan, farms, small businesses and private entrepreneurship;
- There is no problem with gender imbalance as the number of men and women is almost equal;
- Population is fully supplied with electricity, but in some areas people use imported water for drinking purposes and part of the population is not provided with natural gas;
- GRP growth is driven by growth rates in the main sectors of the region’s economy: agriculture, forestry, fisheries, industry, construction and services. In 2017, GRP per capita amounted to 5,568.8 thousand UZS.
- There are enough stakeholders in the basin.
CURRENT STATE OF WATER MANAGEMENT

a. Institutional analysis of water management

The organizational structure of water management in the Amu-Kashkadarya irrigation system is shown in Figure 11.

![Organizational structure of water management in the Amu-Kashkadarya irrigation system](image)

Figure 11. Organizational structure of water management in the Amu-Kashkadarya irrigation system

The Ministry of Water Resources coordinates the water management facilities, which are under the republican subordination (large canals and reservoirs, including the South Fergana Canal, Andijan and Gissarak Reservoirs). The Basin Irrigation System Authorities (BISA) supervise water management facilities of regional subordination (canals and reservoirs for inter-district use). District irrigation departments (DIDs) supervise water management facilities at district level and directly supply water to WCAs and other water users. BISAs and DIDs are planning, distributing, recording and controlling the use of water resources.

Planning and distribution of water resources is the responsibility of the Department of Water Use and the Development of Water-Saving Technologies under the Ministry of Water Resources. The departments of water resources, hydrometry and dispatching services of BISA and the main hydraulic engineers of the District Irrigation Departments also have these responsibilities. Also within the new framework of the Ministry of Agriculture, the departments for determining and planning water consumption in agriculture were created. They operate under the Central Office of the Ministry. In the regional departments of Ministry of Agriculture, a chief specialist is planned to be hired for determination and planning of water consumption in agriculture. They will carry out their activities under the department of planning and determination of water consumption in agriculture and in regional departments of Ministry of Agriculture.

Prior to the reorganization of the Ministry of Water Resources, the operation of inter-district and inter-farm (inter-community) canals and the distribution of water between administrative districts and WCAs were carried out by the Irrigation Systems Department (ISD). Now inter-farm (inter-community) canals and water distribution between WCAs will be coordinated by DIDs (Figure 12). It remains unclear who will exploit inter-district canals and distribute water between administrative districts. At this time, no
provision has been made for operational organizations (BISA, Main Channel Administration (MCA)), Pumping station (PS), Melioration Expedition (ME) and DID) of the Ministry of Water Resources. It is assumed that the distribution of water from inter-district canals by order of the BISA will be carried out by hydro-sites.

![Organizational structure of water management in the Aksu River Basin](image)

In accordance with the «Regulation on water use and water consumption in the Republic of Uzbekistan» before the start of the next irrigation season (vegetation and non-vegetation), WCAs should draw up water consumption plans for farmers and dekhkan farms, self-government bodies of citizens and other water consumers and on the basis of their generalization to draw up water use plans of the Association.

Based on water use plans, WCAs, DIDs and BISA should draw up a water use plan. The water use plan should establish the average decadal consumption in the context of available water consumers, WCAs and districts, as well as the average decadal head consumption for all points of water allocation in WCAs, on economic, distribution, inter-district and main canals. The water use plan should also establish ten-year irrigation tasks, i.e. irrigation areas with planned water consumption in the context of available water consumers, WCAs and districts, as well as on the suspended area of economic, distribution, inter-district and main canals. WCAs’ water consumption and water use plan and system water use plan - a tool for water resources management and the basis for irrigation systems operation (operation mode of hydraulic structures (HS), PS, channels, control of channel gates of different levels, etc.).

In fact, currently most WCAs do not have specialists in hydraulic engineering. Therefore, in practice, WCAs’ water consumption and water use plans are not developed.

Further, water use plans of water consumer associations, as well as other water users, are summarized by the DIDs. The system plans of the districts are summarized by the BISAs.

The drawn up and generalized plans of water use and water consumption are approved as follows:

- for water user associations by DIDs;
- for districts by the basin management of irrigation systems in coordination with the relevant territorial bodies of the Ministry of Agriculture of the Republic of Uzbekistan;
- for the basin irrigation system, large and especially important waterworks by the Ministry of Water Resources of the Republic of Uzbekistan.
Water withdrawal limits. In accordance with **Article 30** of the Law “On Water and Water Use,” water intake limits are set for all water users and consumers. Water withdrawal limits are set in the following order of priority:

1. drinking, medical and household;
2. industry;
3. agriculture;
4. sanitary and environmental needs.

Water distribution. WCAs allocate water based on requests from farmers. Not all WCAs receive written requests for water intake from water users. Requests are received mainly by phone. WCAs do not register requests. It is highly recommended to keep a special logbook. It is necessary to document the date of request, of water user and the actual water supply date (Figure 13). Registration of requests is necessary for the assessment of WCA’s performance in water management. Registration of requests helps to assess the timeliness of water supply. This is also helpful in case of disputes with water consumers in order to prove that the water was delivered on time.

Accounting and reporting in water use and water consumption. Water use agreements stipulate that water intake facilities should be equipped with means for regulating and metering water resources by water users and water consumers according to their affiliation, i.e. water intake points for water users should be equipped by WCAs, WCAs’ water intake points should be equipped by DIDs, and DIDs’ intake points should be equipped by the Main Canal Operation Department

b. Water infrastructure

The Gissarak Reservoir has seasonal regulation; the dam site is located within 1.5 km from the village of Miraki - upstream of the Aksu River (Figure 14).

The reservoir is intended for improvement of water supply of lands on the area of 55,000 hectares and irrigation of new lands on the area of 1,200 hectares, and for transformation and accumulation of mudflows.

The structure of the Gissarak Reservoir includes:

- the reservoir basin with a volume of 170 million m³ and a mirror area of 4.1 km² at a mark of the normal level of 1,118 m.
- composite-type rockfill dam, 138.5 m in height;
- tunnel-type water outlet with bottom water intake to pass water flow of 200 m³ / s, built on the right bank of the Aksu River, 1,072 m in length;
- catastrophic dam outlet, surface with automatic frontal water intake, with a total length of 1,745.7 m. With a design flow rate of 130 m³/s.

![Figure 14. Satellite image of the Gissarak Reservoir, obtained using Google Earth (2018)](image-url)
ASSESSMENT OF THE CURRENT SITUATION OF THE AKSU RIVER BASIN IN KASHKADARYA REGION
Analytical Report

Figure 13. Recommended Water Planning and Distribution Scheme

Required consumption at the main structure of the main canal, m³/s
In 2011, the Gissarak HPP was transferred to commercial operation. The station was attached to the
dam of the Gissarak hydroelectric complex, established in 1988 in order to accumulate irrigation water.
HPP powered by irrigation outflows from the reservoir. The composition of hydroelectric facilities:

- diversion canal;
- ground-type HPP building;
- the outlet canal with a length of 47.5 m;

The capacity of the HPP is 45 MW; the average annual output is 80.9 million kWh. Two hydroelectric
units with vertical radial-axial turbines are installed in the HPP building.

945 hectares of land of the State Fund are allocated for the creation of the complex of the Gissarak
Reservoir. As part of the sanitary protection, water protection zone has a strict regime zone with width
of 500 m from the water edge at a normal level.

The Aksu-Yakkabag, Pravobrejniy and Dam canals carry out the intake from the Aksu River. The head
regulators of the Aksu-Yakkabag and Pravobrejniy are part of the Aksu hydroelectric complex on the
Aksu River, located 15 km below the Gissarak Reservoir (Photo 4). Dam Canal has an independent
water intake structure.

Photo 4. Head part of the Aksu hydroelectric complex (photo: I. Akramov / IWMI)

The length of the Dam canal is 16.5 km, of which 12.7 km is lined with concrete. The maximum flow
rate is 15 m³/s. Command area – 1,894 ha. 29 hydro-technical structures (HTS) and 15 hydro-posts (HP)
were built on the canal.

The length of the Pravoberejniy canal is 14.5 km, of which 13.7 km is lined with concrete. The maximum
flow rate is 12 m³/s. Command area – 4,215 hectares. 32 HTS and 20 HP were built on the canal.

The length of the Aksu-Yakkabag channel is 33.4 km. It is lined with concrete throughout its length. The
maximum flow rate is 60 m³/s. Command area – 12,059 hectares. The canal built 55 HTS and 26 HP.
The large outflow are the Chorshanba canal with a maximum flow rate of 15 m³/s and Muminobod-1
with a maximum flow rate of 15 m³/s. Water distribution is carried out by 71 km of distribution canals,
including 67 km lined with concrete, and 2,422 km used for on-farm irrigation needs, of which 274
km are lined with concrete and present a tray-type network. There are 110 structures on distribution
canals, and 1,679 structures on on-farm irrigation canals.
c. Analysis of water resources use by economic sectors (water needs by types of water use in the basin)

With the actual distribution of the high water in 1969, the flow of the Aksu River was 734.8 million m³. With 5 percent sufficiency, runoff is 478 million m³. With 10 percent sufficiency, runoff is 428 million m³.

The annual water intake for the Aksu subsystem ranges from 358.4 to 399.2 million m³ (Table 7)4.

<table>
<thead>
<tr>
<th>Sources</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gissarak Reservoir</td>
<td>356.84</td>
<td>329.8</td>
<td>366.61</td>
</tr>
<tr>
<td>Underground</td>
<td>21.71</td>
<td>28.63</td>
<td>32.61</td>
</tr>
<tr>
<td>System water intake, m³</td>
<td>378.55</td>
<td>358.39</td>
<td>399.22</td>
</tr>
<tr>
<td>Water supply at the WUA border, m³</td>
<td>306.3</td>
<td>290.0</td>
<td>323.0</td>
</tr>
</tbody>
</table>

Table 7. Water intake and water supply by Aksu subsystem, mln. m³

The actual water availability for irrigated agriculture in recent years was 56.7-65.4 percent (Table 8). Specific water intake in the system is 7,344-8,186 m³/ha per year, and water supply at the WCA border is 5,942-6,623 m³/ha per year (Figure 16).

The Aksu River Basin provides local people and tourists with recreational and religious ecosystem services. There are recreation areas, camps and teahouses along the Aksu system.

As can be seen from figure 15, there are some water losses in the Aksu system.

Loss of water resources occurs not only through the main canals, but also in the on-farm system (see Figure 16).

---

4 Data provided by the Aksu Irrigation System Management
Figure 16. Specific water intake and water supply in the Aksu River Basin

<table>
<thead>
<tr>
<th>Indicators</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>actual irrigated area, ha</td>
<td>48730</td>
<td>48800</td>
<td>48770</td>
</tr>
<tr>
<td>planned water intake, million m³</td>
<td>424,95</td>
<td>424,95</td>
<td>434,7</td>
</tr>
<tr>
<td>actual water intake, million m³</td>
<td>288,6</td>
<td>244,31</td>
<td>304,4</td>
</tr>
<tr>
<td>planned water supply at the WCA border, million m³</td>
<td>354,63</td>
<td>354,63</td>
<td>362,59</td>
</tr>
<tr>
<td>actual water supply at the WCA border, million m³</td>
<td>222,03</td>
<td>200,94</td>
<td>237,15</td>
</tr>
<tr>
<td>water availability, %</td>
<td>62,6</td>
<td>56,7</td>
<td>65,4</td>
</tr>
</tbody>
</table>

Table 8. Water availability of irrigated agriculture in the Aksu Basin during the crop season

Accordingly, with the current level of water availability in the Aksu Basin, the yield of agricultural crops varies from 10 t/ha for forage crops to 40 t/ha for vegetables (Figure 17).

Figure 17. Crop yields in the Aksu River Basin

5 The actual data collected by the authors in the field and analyzes performed.
Water from the Aksu River is supplied mainly for agricultural irrigation and for production and technical needs (PTN) (Figure 18).

There are no large industrial enterprises in the Aksu River Basin. Water supply of small enterprises is carried out from local artesian wells. The population of the areas located in the basin is also provided with groundwater. The level of centralized water supply of the population in the Aksu Basin ranges from 56 percent in the Yakkabag district to 61.2 percent in the Shakhrisabz district. It should be noted that 95 percent of groundwater intake is formed in the Aksu basin.

d. Recreation

The Aksu River Basin provides local people and tourists with recreational and religious ecosystem services. The sanatorium “Miraki” is built next to the Aksu River and the Gissarak reservoir. Attractive nature and fresh air help to improve health. In addition, the Gissarak reservoir, the Suvtushar waterfall and many pilgrimage sites such as Khazrati Sulton Ota, Khodjagul Ota and Bovurchi are of great importance not only for the local population, but also for Muslims around the world.
**SWOT analysis of the Aksu River Basin**

<table>
<thead>
<tr>
<th>STRENGTHS</th>
<th>OPPORTUNITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Geographically favorable location. The basin has national borders and is regulated by the Gissarak reservoir.</td>
<td>- The legislation of the Republic of Uzbekistan has elements of IWRM and basin planning and gives the opportunity to conduct a basin planning.</td>
</tr>
<tr>
<td>- Ground waters and waters of the Aksu River are fresh with a mineralization of not more than 0.5 g/l. There are no salted soils.</td>
<td>- The government adopted a number of programs in the Aksu River Basin, aimed at building and reconstructing irrigation facilities, drinking water supply facilities, modernizing existing hydroelectric power stations of “Uzbekgidroenergo” JSC at natural watercourses and water management facilities, including promising programs for the further development of hydropower system for 2017-2021.</td>
</tr>
<tr>
<td>- The length of the channel is 16.5 km, of which 12.7 km are lined with concrete.</td>
<td></td>
</tr>
<tr>
<td>- Water resources management at the district level is carried out based on hydrographic principle and regulated by basin irrigation systems.</td>
<td>- Increasing crop yields through the creation of intensive gardening and the introduction of modern water-saving technologies.</td>
</tr>
<tr>
<td>- There are two reserves in the basin: the Gissar State Reserve and the Kitab State Geological Reserve, which enable the sustainable development of tourism through an ecosystem approach.</td>
<td>- Improving the culture and worldview of the population on rational water use through various mass events and propaganda.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WEAKNESS</th>
<th>THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- At the district level, water resources are managed according to the administrative-territorial principle.</td>
<td>- Emergency situation during floods.</td>
</tr>
<tr>
<td>- It is not clear who will exploit inter-district canals and distribute water between administrative districts. Reduction in the number of workers operating water management organizations (WMO)</td>
<td>- The threat of flooding of cultural and historical monuments in Kitab and Shakhrisabz districts, removal of spatial and territorial land resources from the environment due to a possible breakthrough of the Gissarak Reservoir.</td>
</tr>
<tr>
<td>- Lack of irrigation networks of WCA water-metering structures</td>
<td>- The deterioration of drinking water quality, the risks of increasing the maximum permissible concentration of chemical elements, the inability to predict the reserves and quality of groundwater for drinking purposes.</td>
</tr>
<tr>
<td>- Water losses in on-farm networks, untimely cleaning and washing of on-farm irrigation networks</td>
<td>- Changes in the river bed, destruction of the banks and territories of population, the risk of emergency due to the extraction of building materials (sand and gravel) from the river bed of Aksu.</td>
</tr>
</tbody>
</table>
**ASSESSMENT OF THE CURRENT SITUATION OF THE AKSU RIVER BASIN IN KASHKADARYA REGION**

**Analytical Report**

- Low personnel capacity of DID and WCA. Most WCAs do not have hydraulic technicians. In practice, water consumption and water use plans of WCAs are not drawn up.

- Outbreaks of infectious diseases among the population in the absence of sewage infrastructure

- Lack of stakeholders in the management of water resources at the level of other districts - representatives of organizations in such sectors as ecology, water supply, energy, etc.

- In foothills and plains ecosystems, land degradation, wind and water erosion, loss of forest area and loss of biodiversity are observed.

- Funding for operation and maintenance (O & M) is limited
CONCLUSION

The commitment of the research team of the International Water Management Institute (IWMI) under the 1st Component: “National Framework Concept for Water Management and Integrated Water Resources Management” of the programme “Sustainable management of water resources in rural areas in Uzbekistan”, funded by the European Union, included conducting a situational analysis of the Aksu River Basin in Uzbekistan to provide basic information and research to develop a management plan for a river basin.

The study included an examination of the legislative framework for water resources management; national development programs and strategies relevant to the territory of the Aksu River Basin; water resources; natural conditions, including information on natural ecosystems and biodiversity; socio-economic situation, including demography; current state of water management and SWOT analysis.

In conclusion, the following points can be mentioned:

1. The climatic and soil-ameliorative conditions of the Aksu Basin make it possible to obtain high crop yields in agricultural production. The basin is located in the zone of typical gray soils, automorphic soils predominate, the sum of effective temperatures is 2,519 °C, the bioclimatic coefficient is 1.02, the duration of frost-free days is 219, and the amount of precipitation is 610 mm/year. Groundwater is fresh, soil salinization is not observed.

2. There are no significant social and environmental problems related to water management and organization. There are mudflows, which in some years cause damage to agriculture. In Aksu, mudflows are characterized by a low concentration of solid runoff (up to 100-150 kg/m3) and a duration of no more than 1-2 days. The flood lasts from February 5 to August 29. The maximum flow rate of 305 m³/s is observed in mid-March.

3. The population density in the Aksu Basin is 186.5 people/km², the level of economically active population to the population of working age is 63.7 percent, and about 36 percent of the economically active population is employed, with 29.2 percent of the economically active population involved in agriculture in some capacity.

4. The level of centralized water supply in the Aksu Basin ranges from 56 percent in the Yakkabag district to 61.2 percent in the Shakhrisabz district. The main source of drinking water in the Aksu Basin is groundwater.

5. With the actual distribution of the high water in 1969, the flow of the Aksu River was 734.8 million m³. With 5 percent sufficiency, runoff is 478 million m³, and with 10 percent sufficiency, runoff is 428 million m³. The required volume of water for irrigation during the crop season exceeds the annual flow of Aksu at 10 percent sufficiency. The actual water availability for irrigated agriculture in recent years was 56.7-65.4 percent, which requires a revision of the crop rotation or the reconstruction of the system, bringing the efficiency to maximum and introducing water-saving technologies.

6. The main consumer of water in the Aksu Basin is agriculture (92.2 percent).

7. Below is the register of problems on water management and water use in pilot basins, which was compiled during a study of the current state of the basin and at seminars in September 2018 with the participation of members of the working group. The list of problems also includes the problems discussed in the reports on “Economic mechanisms / instruments to promote water saving” and “Full cost recovery for the operation and maintenance of irrigation systems in the pilot river basins” prepared by the IWMI team under Component 1 implemented by the GIZ.
Analysis of the SWOT-matrix provides the identification of specific strategies for further action based on the methodology described in Appendix 2.

Future strategy in the Aksu Basin planning based on the SWOT analysis:

- Maintain the technical condition of the irrigation and drainage networks in the basin;
- Ensure the management of water resources on a hydrographic basis. Although the management of irrigation systems has been eliminated, the former border should be left to the basin at the BISA hydro-site;
- Further maintaining a low level of mineralization of water resources and avoiding soil salinization;
- Maintain and support the continued functioning of the Gissar State Reserve and the Kitab State Geological Reserve, which enable sustainable development of tourism through an ecosystem approach;
- Prevent a reduction in the number of employees of operational water management organizations;
- Equip the on-farm WCA network with water-measuring structures and devices, in particular, requesting Component 1 of the EU program in Uzbekistan to equip a pilot WCA with water-measuring devices;
- Develop programs aimed at the elimination of water losses and conduct timely repair of on-farm network;
- Work to improve the qualifications of the staff of the DID and the WCA, prevent loss of personnel and ensure timely preparation of water use plans;
- Involve representatives of rural communities, makhalas, representatives of other sectors, such as drinking water, ecology, tourism, energy, etc., to the management of water resources at the basin level;
- Develop measures to combat land degradation, in particular wind and water erosion, deforestation and biodiversity degradation;
- Use the state programs in the Aksu River Basin zone aimed at building and reconstructing irrigation facilities, drinking water supply facilities, modernizing existing hydroelectric power stations of “Uzbekgidroenergo” JSC at natural water courses and water management facilities, and participating in promising programs for the further development of hydropower in 2017 - 2021;
- Work on the introduction of water- and energy-saving innovative technologies, in particular by creating intensive gardens and fields for vegetable growing, and introducing drip-irrigation technologies, sprinkling and gated pipes for irrigation;
- Development of the tourism industry (the presence of historic buildings and recreational areas) in order to obtain additional income and finance the O & M in the basin, as well as employment of the population living along the basin;
- Attracting more donor projects to solve problems in the basin;
- Provide technically support to the «Gissarak» Reservoir against threats of emergency situations;
- Prevent the deterioration of drinking water quality, the outbreak of infectious diseases among the population.
REFERENCES

1. Agenzia Regionale Per La Protezione Dell'Ambiente (ARPA). (2011). SWOT Analysis and Strategic Water Management Plan for Irminio River Basin. The report was compiled in the framework of the project 1G-MED08-515 WATERinCORE for “Sustainable water resources management through increased overall responsibility in the basins of Mediterranean rivers”. The project is co-financed by the European Regional Development Fund.


Annex 1.
The structure of the situational analysis of the Aksu River Basin

Preamble

Introduction

1. Legal framework for water resources management (basin planning)
   a. Legislation of the Republic of Uzbekistan on water management issues (with a focus on the application of the basin planning approach)
   b. National water allocation obligations in the Aksu River Basin

2. National programs and development strategies relevant to the territory of the Aksu River Basin
   a. On issues of agricultural development (including the provision of subsidies for agricultural development)
   b. Strategies and plans for the development of water management (state and local level)

3. Water resources in the Aksu River Basin
   a. Hydrology
   b. Groundwater Analysis
   c. Water quality

4. Natural conditions in the Aksu River Basin
   a. Geology and morphology
   b. Climatic conditions (risk analysis of natural disasters and possible preventive measures)
   c. Land fund
   d. Natural Ecosystems and Biodiversity

5. Socio-economic situation in the basin
   a. Employment and incomes
   b. Social Development Indicators
   c. Macroeconomic indicators
   d. Basin stakeholders

6. The current state of the organization of water use
   a. Institutional analysis of water management
   b. Water infrastructure
   c. Analysis of water use by sectors of the economy (water demand by type of basin water-use)

7. Opportunities and limitations in the basin (SWOT analysis)

Conclusion
Annex 2. SWOT Analysis

The SWOT analysis was developed to identify strengths and weaknesses (as internal factors), as well as opportunities and threats (as external factors) in the Aksu River Basin (ARPA, 2011). In particular, the strengths and weaknesses are identified based on data and information that were previously assessed in the process of analyzing the situation and a comprehensive study of the situation in the field of water management in the basin. Opportunities and threats are determined on the basis of an analysis of water management, which includes a review of the national legal framework (directives, regulations and laws), national strategic frameworks, development plans and water management principles. The SWOT analysis for the river basin and the conclusions from the application of the SWOT matrix will provide general recommendations that will serve as an initial response to the problems and improvement opportunities observed in the river basin.

Accordingly, based on the results of the SWOT analysis, appropriate water resource management strategies for the river basin can be developed. These strategies are divided into four types: offensive, reactive, defensive and adaptive (ARPA, 2011). Offensive strategies that focus on the strengths of seizing opportunities and lead to policies that accelerate development, and can be implemented in the short term. Reactive strategies aimed at overcoming weaknesses through the use of opportunities lead to structural policies and can be implemented in the medium term. Defensive strategies try to use strengths to prevent threats lead to stabilization policies and can also be implemented in the medium term. Adaptive strategies aim to reduce gaps and avoid threats lead to preventive policies and are expected to take effect in the long term. A visual representation of the SWOT matrix and the resulting strategies is presented in Table 9.

<table>
<thead>
<tr>
<th>OPPORTUNITIES</th>
<th>STRENGTHS</th>
<th>WEAKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Offensive strategies (policies leading to accelerated development)</td>
<td>Reactive Strategies (Structural Policies)</td>
</tr>
<tr>
<td></td>
<td>Elements of a short-term strategy</td>
<td>Elements of the strategy for the medium term</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THREATS</th>
<th>STRENGTHS</th>
<th>WEAKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Defensive strategies (stabilization policy)</td>
<td>Adaptive strategies (preventive policy)</td>
</tr>
<tr>
<td></td>
<td>Elements of the strategy for the medium term</td>
<td>Elements of a long-term strategy</td>
</tr>
</tbody>
</table>

Table 9. SWOT-Matrix
Annex 3. Roles and responsibilities of key stakeholders in the Aksu River Basin

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Roles and responsibilities</th>
</tr>
</thead>
</table>
| Ministry of water resources of Uzbekistan | • Implementation of a unified state policy in the field of water resources management, coordination of activities of state bodies, economic management bodies and other organizations in the field of rational use and protection of water resources, prevention and elimination of the harmful effects of water;  
  • Sustainable and rational delivery of water resources to the territories and sectors of the economy, taking measures to ensure the improvement and sustainability of the land reclamation conditions;  
  • Ensuring reliable operation of the irrigation and land reclamation systems, reservoirs, pumping stations and other water management and hydraulic structures, organization of protection of large and critical water facilities;  
  • Increasing the responsibility of water users and water consumers regarding the careful and rational use of water resources;  
  • Introduction of the achievements of science and technology, modern water-saving technologies and advanced experience in the field of water management, innovative methods of water management system and water use;  
  • Organization of advanced training of specialists in the field of water management;  
  • Development of interstate relations on the management and use of trans-boundary water resources, attraction of foreign investments and technical assistance (grants), as well as active participation in the activities of international organizations in the field of water management. |
| Amu-Kashkadarya BISA | • Ensuring the implementation of a unified water management policy aimed at comprehensive modernization of the industry, the introduction of science and technology, modern water-saving technologies, advanced domestic and foreign experience relevant to the activities of water facilities in the region;  
  • Implementation of measures to attract foreign investments, grants and technical assistance of international financial organizations and foreign countries in the water sector, ensuring their effectiveness in accordance with the principles of project management;  
  • Taking measures to improve the principles and system of water resources management, ensure their careful and rational use, improve the ameliorative status of irrigated land, conduct reconstruction and modernization of water facilities, hydraulic structures;  
  • Improving the work with personnel, ensuring, constant capacity building trainings. |

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7 Since 2018, the Management of irrigation systems (MIS) in the country has been disbanded.
### Aksu Irrigation System Management

- Organization of water supply planning for water users, including WCAs, on the basis of contracts;
- Ensuring targeted and rational use of water resources, compliance with the established procedure for water use in the whole irrigation system;
- Organization of management of the irrigation system, increasing its efficiency and productivity;
- Ensuring the technical reliability of the irrigation system and water facilities;
- Preparation of the irrigation system for reliable operation and keeping it in working condition;
- Maintain accurate records and reports on water intake and water supply;
- Introduction of water-saving technologies, increase of efficiency and targeted use of allocated funds, material and technical resources, machinery and equipment.

### District irrigation departments (Kitab, Shakhrisabz and Yakkabag districts)

- Ensuring the effective implementation of sectorial and regional programs for the development of water management;
- Coordination of work on the introduction of water-saving technologies in different sectors of the economy, including agriculture;
- Ensuring the integrated management and rational use of water resources, increasing their efficiency, introducing innovative technologies and mechanisms for water use and water consumption, organizing and improving their record keeping;
- Conducting methodological and practical assistance in organizing and developing links and other associations of water consumers, coordinating work on technical operation, reconstruction and repair of water management facilities of water user associations;
- Assistance in the implementation of scientifically based irrigation regimes, drip irrigation systems and other water-saving irrigation technologies;
- Maintenance of General coordination of works on repair of on-farm irrigation and drainage systems and their development, as well as the introduction of water-saving technologies;
- Analysis of the use of water resources and making proposals for the establishment of water supply limits for administrative areas, promotion of the economical use of water resources amongst the water users and water consumers;
- Facilitation and coordination of work by associations of water consumers on drawing up contracts for water consumption, equipping the irrigation network with water management and metering tools;
- Participation in the implementation of concepts, strategies and integrated measures, as well as regulatory and legal acts on the development of water facilities of the production infrastructure, strengthening their material and technical base;
- Participation in the implementation of a set of measures to improve economic relations between water consumers and water user associations based on the in-depth analysis of the mechanism of mutual settlements and the causes of debts, proposals for improving the quality and expansion of services;
- Monitoring the enforcement of contracts concluded between water consumers and serving associations;
### Reclamation expedition
- Maintenance and modernization of the main and inter-farm collector network and closed drainage network, as well as equipment on the balance sheet;
- Establishment of operation mode of reclamation pumping stations, vertical drainage wells and control of their performance;
- Monitoring of the reclamation state of irrigated lands, the quality of collector, irrigation and groundwater, as well as the maintenance of relevant reports; information about water and land users, ameliorative condition and necessary measures on their part to achieve ameliorative well-being;
- Maintain an inventory of ameliorative status;
- Development of measures to improve the land reclamation condition, technical improvement and modernization of the land reclamation network;
- Development of recommendations for water users and subsequent monitoring of the use of saline collector-drainage water.

### Local unit of the State Committee on Ecology and Environmental Protection
- State administration in the field of ecology, environmental protection, rational use and reproduction of natural resources;
- Provision of favorable ecological state of the environment, protection of ecological systems, natural complexes and separate objects, improvement of ecological situation;
- State environmental control over compliance with legislation in the field of protection and use of land, subsoil, water, forests, protected natural areas, flora and fauna, protection of atmospheric air;
- Maintenance of the state cadaster in the field of ecology and environmental protection, as well as state registration of nurseries for breeding and keeping wild animals, wild plants, Zoological and Botanical collections;
- Organization of environmental education, propaganda and education;
- Prevention of violations in the field of environmental protection, rational use of natural resources and waste management;
- Ensuring close interaction with the public and civil society institutions on ecological issues and environment protection.

### Gosvodkhoznadzor
- Ensuring the reliability of the technical condition of operation and safety of large and particularly important water facilities;
- Design, construction, commissioning, operation, reconstruction, repair, conservation and liquidation of large and particularly important water facilities, including the organization of project expertise, quality control of construction, reconstruction, commissioning, conservation and liquidation;
- Organization of reliable protection of large and especially important water facilities.
### WCA (41)

- Development of the water use plan of the serviced area in the context of WCA member farms and its coordination with the state water management organization with which WCA is in contractual relations for the purpose of water supply;
- Maintenance and operation of the on-farm irrigation and drainage network managed by WCAs in a technically sound condition;
- Repair and restoration works on on-farm irrigation and drainage network;
- Provision of land reclamation services, water disposal;
- Monitoring the correct operation of water-measuring devices on both irrigation and collector-drainage networks;
- Keeping records of water supply on irrigation networks and channels, and metering of the drainage system of a collector-drainage network under the authority of the WCA;
- Representation of interests and protection of the rights of its members in relations with state, economic, public organizations;
- Economic and operational relationships between the WCA and the water management organization and between WCAs and water consumers - members and non-members of WCAs.

### Farmers (2297)

- Ensure targeted, effective and efficient use of land;
- Comply with environmental requirements and other environmental regulations;
- Carry out measures to improve the reclamation condition of the land plot, preserve and increase fertility, provide funds for these purposes (within the business plan);
- Ensure the supply of agricultural products for state needs in accordance with the concluded agreements within the limits of the provided volumes;
- Use water resources in accordance with the water use agreement, take measures for water saving, targeted and rational use of water resources;
- In accordance with the established procedure, take part in the cleaning and repair of irrigation and collector-drainage networks that are on the balance of the water users association, of which this farm is a member, and also keep them in good technical condition, follow the established operating rules;

### Khokimiyats (Kitab, Shakhrisabz and Yakkabag districts)

- Executive agency
Annex 4. Register of problems of the Aksu River Basin, which was developed during the workshop conducted on September 10, 2018 in Karshi jointly with the National Working Group for developing a river basin management plan

<table>
<thead>
<tr>
<th>Priority</th>
<th>Problem identified</th>
<th>Negative consequences and risks</th>
<th>Reasons</th>
<th>Elements of activity</th>
<th>Indicator</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A,1</td>
<td>Socio-economic issues. Rating (11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Lack of irrigation water during vegetation season</td>
<td>Reduced yields, reduced agricultural areas</td>
<td>Insufficient funding for irrigation network repair</td>
<td>Water management</td>
<td>Yield (kg/ha) areas under agricultural crops</td>
<td>13,6</td>
</tr>
<tr>
<td>1.2</td>
<td>Lack of drinking water</td>
<td>Diseases caused by poor quality of drinking water, social tension</td>
<td>Network fault</td>
<td>Utilities</td>
<td>Number of residents provided with high-quality drinking water, l/day for 1 person</td>
<td>13,6</td>
</tr>
<tr>
<td>1.3</td>
<td>Wasteful use of water resources</td>
<td>Degradation of land reclamation, shortage of water resources for other irrigated lands, reduction of crops areas</td>
<td>Low level of water saving technologies</td>
<td>Agriculture and water resources</td>
<td>Water availability of territories, application of water-saving technologies (ha), non-water-loving crops area (ha)</td>
<td>13</td>
</tr>
<tr>
<td>B,2</td>
<td>Technical condition of irrigation and ameliorative systems. Rating (9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Water losses in on-farm networks</td>
<td>Reduced yields and, consequently, profits due to poor water availability</td>
<td>The lack of coordination among farmers</td>
<td>Water management</td>
<td>The efficiency of the channels, number of water metering devices</td>
<td>12</td>
</tr>
<tr>
<td>2.2</td>
<td>Untimely cleaning / maintenance of on-farm irrigation networks</td>
<td>Difficulties in delivering water to farmers in the last circuits due to the deterioration of canal capacity</td>
<td>Lack of funds</td>
<td>WCAs and farmer households</td>
<td>Level of water supply of land</td>
<td>14,2</td>
</tr>
<tr>
<td>2.3</td>
<td>Legal or illegal mining of construction materials (sand and gravel) from the Aksu riverbed</td>
<td>Changes in the river bed and the flow of water and, consequently, the destruction of the banks and territories inhabited by the population, the risk of emergencies</td>
<td>Need in building materials</td>
<td>Water and construction sector</td>
<td>Awareness on regulatory documents, arrangement of water protection zones and strips</td>
<td>13</td>
</tr>
<tr>
<td>Section</td>
<td>Issue</td>
<td>Description</td>
<td>Cause</td>
<td>Responsibility</td>
<td>Number of Water Distribution Facilities</td>
<td>% Population with Access to Sewage Facilities</td>
</tr>
<tr>
<td>---------</td>
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<td>-------</td>
<td>---------------</td>
<td>-----------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>2.4</td>
<td>Lack of equipment within WCA irrigation networks and water distribution facilities</td>
<td>Irrational distribution of water resources, involvement of external agencies in solving the problem at the local level (which entails non-fulfillment of their direct obligations)</td>
<td>WCAs are not able to effectively manage water resources and properly allocate water resources amongst farmers</td>
<td>WCA</td>
<td>15</td>
<td>12,6</td>
</tr>
<tr>
<td>2.5</td>
<td>Lack or insufficiency of chemical analyses of groundwater quality</td>
<td>Deterioration of drinking water quality, risks of exceeding the maximum permissible concentration of chemical elements, inability to predict the reserves and quality of groundwater for drinking purposes</td>
<td>Lack of funding for chemical laboratories (purchase of reagents and equipment) and for the construction / rehabilitation of underground water intake structures (wells)</td>
<td>• Sanitary-epidemiological services • State unitary enterprise “Suvokov”</td>
<td>12,3</td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>Lack of sewage infrastructure</td>
<td>Outbreaks of infectious diseases among the population</td>
<td>Lack of funding for the construction of sewage facilities</td>
<td>Ecology, medicine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.3</td>
<td>Institutional and legislative issues of water use. Rating (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>The infrastructure of irrigation and drainage systems of the disbanded agricultural enterprises is not entered into the WCA balance sheet.</td>
<td>There are disputes between water consumers, between WCAs and water consumers on the use of individual structures. The plan for operation and maintenance (O &amp; M) includes the repair of fixed assets (structures, canals and collectors, etc.) that are not included in the accounting. No depreciation is made to justify further costs of current and major repairs and their write-off</td>
<td>Non-fulfillment of their duties by commissions regarding the reorganization of agricultural enterprises into farms</td>
<td>Khokimiyat (Administrative Department)</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Unjustified reduction of the number of employees of operational water management organizations according to the staff schedule</td>
<td>• Reduced WMO capacity for long-term planning of water resources management, operation and maintenance (O &amp; M); • Preparation of substandard reports and information; • Insufficient number of specialists; • Complexity of management in an organization</td>
<td>Financial constraints</td>
<td>Economy</td>
<td>12,6</td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td>Details</td>
<td>Sector</td>
<td>Count</td>
<td></td>
<td></td>
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<tr>
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<td>--------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3.3</td>
<td>Most of the water discharge points of water consumers associations (WCAs) and water consumers are not equipped with water regulation and water measurement tools.</td>
<td>Virtually no way to manage water at the lower level of the irrigation system. Organizational water losses occur in large volumes. It is impossible to keep records and analysis of water use efficiency.</td>
<td>Under the conditions of free water use, water consumers have no need to measure and record water. There is no interest in the rational management and use of water and land resources, both at the WMO and water user’s levels.</td>
<td>Economy and water management</td>
<td>Number of water regulating and water measuring facilities</td>
<td>12,4</td>
</tr>
<tr>
<td>3.4</td>
<td>On-farm irrigation infrastructure is ownerless</td>
<td>There is no possibility to maintain and repair the infrastructure, the risk of wear and large water losses.</td>
<td>The irresponsibility of the commissions on the disbanding and misunderstanding of the importance of hydrotechnical infrastructure in agriculture.</td>
<td>Local Administration, Agriculture and Water Management</td>
<td>Number of infrastructure facilities transferred to the balance of water management organizations and / or farmers</td>
<td>13</td>
</tr>
<tr>
<td>3.5</td>
<td>Ineffective operation of WCAs</td>
<td>The possibility of maintaining the technical condition of irrigation and drainage facilities in the territory is lost.</td>
<td>The lack of a sense of ownership for the WCA and lack of qualified professionals.</td>
<td>WCAs and farmer households</td>
<td>Qualified specialists Water availability</td>
<td>13,8</td>
</tr>
</tbody>
</table>