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UNITED NATIONS ECONOMIC COMMISION FOR EUROPE
IN COOPERATION WITH
THE REGIONAL ENVIRONMENTAL CENTRE FOR CENTRAL ASIA (CAREC)

SURFACE WATERS QUALITY MONITORING SYSTEMS IN CENTRAL ASIA: NEEDS ASSESSMENT

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This regional survey was carried out within the frames of the project “Strengthening cooperation on water quality management in Central Asia”, being realized by the United Nations Economic Commission for Europe (UNECE) in cooperation with the Regional Environmental Center for Central Asia (CAREC) and is financed by the Government of Finland within the frames of the FinWaterWEI program.

This document represents analysis and syntheses of national reports materials on assessment of needs of national systems on water resources quality provision in five countries of Central Asia; it also contains regional summary and recommendations. In development of national and regional surveys the following CAREC experts participated: Ruslan Meliyan, Danara Alimbaeva, Vera Bondareva, Bahrom Mamadaliev, Stanislav Aganov, Sergey Myagkov.

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THE LIST OF ACCEPTED ABBREVIATIONS

APL	Approximate Permissible Levels
BAT	The Best Available Technologies
CA	Central Asia
CAREC	The Regional Environmental Centre for Central Asia
CIS	The Commonwealth of Independent States
CWPI	Comprehensive Water Pollution Index
EECCA	Eastern Europe, Caucasus and Central Asia
ECS	Environmental Control Services of the State Committee on Environmental Protection and Land Resources of Turkmenistan
GEF	Global Environmental Facility
GIS	Geo information systems
ICWC	The Interstate Coordination Water Commission
IFAS	The International Fund for Saving the Aral Sea
ISDC	The International Sustainable Development Commission
IWRM	Integrated Water Recourses Management
Kazhydromet	Republican State Enterprise “Kazhydromet” under the Ministry of Energy of the Republic of Kazakhstan
Kyrgyzhydromet	Hydrometeorology Agency under the Ministry of Emergency of Kyrgyz Republic
MAD	Maximum Admissible Discharge
MPC	Maximum Permissible Concentrations
MPHI	Maximum Permissible Harmful Index
RBDMP	River Basin District Management Plan
RWG	Regional Working Group
SAEPF	State Agency on the Environmental Protection and Forestry
SSAS	Synthetic Surface Active Substance
Tajikhydromet	Gidrometeorology Agency of the Environmental Protection Committee under the Government of the Republic of Tajikistan
UNECE	United Nations Economic Commission for Europe
UNDP	United Nations Development Program
Uzhydromet	The Hydrometeorological Service Centre under the Ministry of Emergency of the Republic of Uzbekistan
WMP	Watershed Management Plan
WPI	Water Pollution Index

INTRODUCTION

This survey was prepared within the frames of the project "Strengthening cooperation on water quality management in Central Asia", being realized by the United Nations Economic Commission for Europe (UNECE) in cooperation with the Regional Environmental Center for Central Asia (CAREC). The assessment was made possible thanks to the financial support of the FinWaterWEI program. The purpose of this project is promotion in development of the basin-wide regional cooperation on the water quality.

This regional survey provides assessment of needs of national systems on provision of water resources quality with elements of transboundary cooperation in five states of Central Asia - Republic of Kazakhstan, Kyrgyz Republic, Republic of Tajikistan, Turkmenistan and Republic of Uzbekistan (hereinafter – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan).

The following objectives were determined as essential: (1) actualization (updating) of the Diagnostic Report and of the Cooperation Plan on the Water Quality, developed within the frames of the previous project UNECE/CAREC in 2009-2012 and (2) carrying out the expert assessment of needs of national water quality monitoring systems and of the transboundary cooperation on the water quality management.

The survey was carried out by national experts in close coordination with CAREC, under the guidance of the regional expert Mr.Ruslan Meliyan. The study focused on hydrometeorogical services (the Environmental Control Service in Turkmenistan) as these agencies carry out monitoring of transboundary watercourses quality on the long-term and planned basis and have a mandate for determining the quality of surface waters.

This study is based on the analysis and synthesis of data presented by national experts and contains regional summaries and recommendations. The following experts participated in development of national and regional studies:

from the Republic of Kazakhstan – Ms. Danara Alimbaeva, the Republican State Enterprise "Kazhydromet" under the Ministry of Energy of the Republic of Kazakhstan, Director of the Environmental Monitoring Department;

from the Kyrgyz Republic – Ms. Vera Bondareva, the Hydrometeorological Agency of the Ministry of Emergency of the Kyrgyz Republic, the Administration of Natural Environment Pollution Monitoring, Head of the Department of Land Surface Waters Quality Monitoring;

from the Republic of Tajikistan – Mr. Bahrom Mamadaliev, the Academy of Sciences of the Republic of Tajikistan;

from Turkmenistan – Mr. Stanislav Aganov, the independent expert;

from the Republic of Uzbekistan – Prof. Sergey Myagkov, the Hydrometeorological Service Center under the Ministry of Emergencies of the Republic of Uzbekistan, Deputy Director of Hydrometeorological Research Institute.

CAREC Regional expert – Dr. Ruslan Meliyan, the Centre of Strategic Ecological Researches (ECOS), Director for Sciences, the Republic of Moldova.

The survey consists of two sections, six chapters, and 7 annexes, whereby the first section focuses on actualization (updating) of the Diagnostic Report (2012). The section comprises two chapters, targeting the water resources quality system and the excerpt from the Diagnostic Report, indicating changes occurred in CA countries after its publication.

The second section begins with a comprehensive information on national needs for improving surface water quality monitoring systems. The section consists of four chapters. The survey covers different aspects of planning, organization and monitoring programs in each of CA countries.

The insights emerging from the above-mentioned analysis are complemented by a Conclusion section, whereby key findings from national reports, concerning actual needs of water quality monitoring systems are revealed. It also provides expert arguments and recommendations on how to improve water quality monitoring systems at the national level and in transboundary /regional contexts.

This survey was prepared by the national experts in close consultation with sector stakeholders, who were brought together within the context of a Regional Working Group to act as the CAREC counterpart throughout the assessment. The survey considers the results of the consultative meeting with the Regional Working Group, which was held in Almaty, Kazakhstan on December 2017 to discuss the key findings and recommendations emerging from the assessment.

SECTION 1.
THE WATER RESOURCES QUALITY ASSURANCE SYSTEM IN CENTRAL ASIA AND REGIONAL PRIORITIES

In 2012 the Diagnostic Report provided evaluation of the UN Development Account project on «Water Quality in Central Asia» completed during Feb - June 2012 and implemented in cooperation between UNECE and CAREC.

The goal of the project was to enhance the development of an efficient and coordinated policy on improvement of water quality in the framework of integrated water resources management (IWRM) and the focus was placed on the management of water quality in rivers. The Diagnostic Report reviewed relevance, effectiveness and efficiency of the project and included recommendations for possible further work on water quality cooperation in Central Asia.

The evaluation focused on the key strategic issues to provide assistance on improvement and perspectives of development of the regional cooperation on issues of the water resources quality. During the last five years, certain changes have taken place in CA countries. The synthesis of these changes is given in this section.

CHAPTER 1.1.
THE WATER RESOUCES QIALITY ASSURANCE SYSTEM

This chapter basically is the theoretical development concerning the water resources quality assurance system. It demonstrates how this system is functioning. The water resources quality assurance system is a complex of interrelated legislative regulations, management solutions, instruments, procedures and mechanisms, which in case of being realized holistically, orderly and consequently, will provide this or that quality of water resources.

The concept "water resources quality assurance" is quite new in the CA region, though it includes well-known approaches to water-resources management widely applied in countries of the region. Traditionally, main objectives of natural surface waters management in the context of their quality consist in tracing of the situation. If the quality of waters deviates from normative requirements (the quality of water does not meet requirements of water resources management or water ecosystems maintenance, for example, because of the pollution from anthropogenic sources), then certain measures preventing or reducing the negative influence of such pollution sources (point or diffused) on water resources are taken. This is a kind of "passive" management of natural water resources quality.

At the same time, a concept of "water resources quality assurance" has elements of the "active" management of water resources quality. First of all, it is "planning" of the water object quality that is needed for the sustainable support of water consumption (the current or the planned) and at the same time to provide preservation and safety of the water environment for water eco-systems. In other words, the concept of "water resources quality assurance" is much like the concept "water resources quality management" and to some extent – like the concept "Targeted planning of water resources quality".

INSERTION 1:
BEST PRACTICES «TARGETED PLANNING»

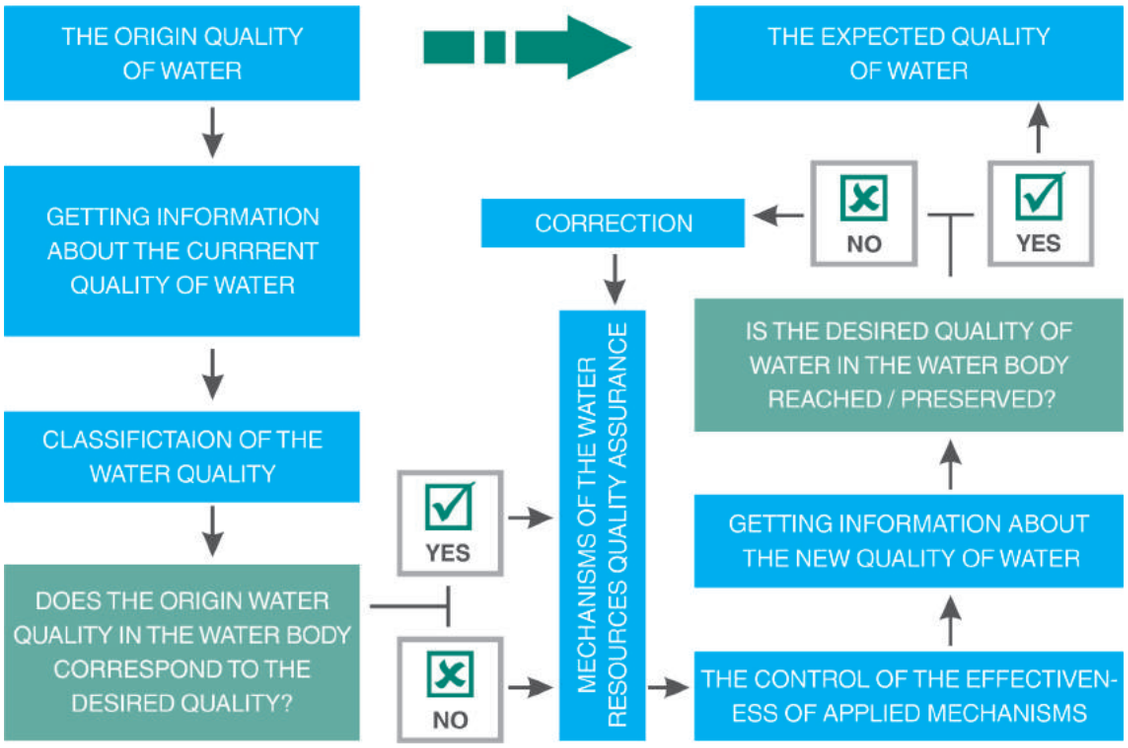
Today the targeted planning of water resources quality is the basis for natural water resources management in the European Union, which is determined on the legislative level for all EU countries in so-called Water Framework Directive. As an example, it can be demonstrated how common objectives of water resources management in EU are formulated: ***«Aim to that all surface waters in EU countries upon expiry of 15 years would correspond to the good status and artificial and heavily modified water bodies would correspond to the good environmental capacity and good chemical status».***

Setting up such an objective, the EU countries actively apply all necessary mechanisms and measures to implement this directive requirement. The concept "Good Status of Surface Waters" includes the combination of three so-called "water quality elements", and namely "good chemical status", "good biological status" and "good hydromorphological status".

For those water bodies, the waters' state of in which already corresponds to "the good status" criteria, measures in supporting the current state and prevention of its worsening are planned. And for those water bodies, the water status of which is worse than a "good status", the measures on its improvement are planned. Measures are determined based on the analysis of reasons of the insufficiently good quality of waters and they are introduced into the plans of water bodies management. The plans determine time limits, finances and parties, responsible for realization of measures. For tracing of that how and to what extend the planned measures promote improvement of the water object quality (in other words, whether the good status is reached) the monitoring network is designed and observation parameters (on physical and chemical elements, on biological elements and on hydromorphological elements), and their periodicity are determined. The monitoring results are used for correction of the plan and confirmation of the reached status of waters.

Thus, in EU countries, the management of water resources is realized on the planned and target basis and it provides all mechanisms, needed for achievement of the set object on water resources management (to bring all water bodies to the "good status").

FIGURE 1
THE SYSTEM OF NATURAL WATER BODIES QUALITY ASSURANCE



To understand how the natural waters quality assurance system works, it is necessary to understand its conceptual aspects, as seen in Figure 1.

The first step in water resources quality assurance is assessing the quality of water in the water body. It can be done through monitoring of the water quality. The monitoring results are compared with classifiers (for example with MPC dimensions, quality classes or with other systems of natural waters quality classification).

Following the monitoring results, a conclusion should be done - if water is acceptable for drinking, sanitation, health, commercial and industrial use, for agriculture and irrigation. Different activities require different levels of water quality (e.g., water quality for drinking and for irrigation have different standards). There are cases where the original (current) quality of water in the water object corresponds to established standards and allows to use water without restrictions (water supply, irrigation, etc.), that is already carried out or is planned to be carried out on the certain water object.

However, certain cases where the current quality does not correspond with water consumption requirements by the quality of water resources are also known. Nevertheless, on the next stage it is necessary to use certain mechanisms for provision of the water quality. In the first case, these mechanisms should be at least sufficient for maintaining the acceptable quality of water and prevention of its worsening. In the second case – the applied mechanisms should result in improvement of the water quality on the water object to such extent, that in the course of time there would be no limitations for water consumption and water ecosystems would be able to exist steadily.

MECHANISMS FOR PROVISION OF THE WATER QUALITY ARE AVAILABLE IN ALL CA COUNTRIES, THOUGH OFTEN THEIR SPECIFIC REALIZATION AND EFFECTIVENESS DEPEND ON NATIONAL CIRCUMSTANCES. NEVERTHELESS, THE COMPLEX OF MECHANISMS ON PROVISION OF NATURAL WATERS QUALITY IS WELL KNOWN IN THE CA REGION AND USUALLY INCLUDES THE FOLLOWING:

- Regulatory mechanisms (permission and/or prohibiting the discharge of untreated waste waters; per• Regulatory mechanisms (permitting and/or prohibiting the discharge of untreated waste waters; permitting or prohibiting disposal of wastes in water areas (aquatoriums) or on the Water fund lands; licensing/certification of the economic activities on the water collecting territory; prohibiting/limiting disposal of toxic compounds (poisons) as a part of wastes waters; prohibiting application of especially dangerous agricultural chemicals (pesticides) etc.).
- Fiscal mechanisms (payment for the discharge of waste waters; payment for the excess of discharge rates; payment for the discharge of waste waters etc.)
- Stimulating mechanisms (benefits, bonuses, tax exemptions, other economic instruments, stimulating the rational natural resources management and reduction of wastes and discharges)
- Preventive mechanisms (implementation of hew infrastructure projects, according to the procedures of the Environmental Impact Assessment; ecological expertise of the project documentation; ecological audit of enterprises etc).

If application of mentioned mechanisms is not enough to preserve or improve the quality of the water object then other, so-called "structural measures" shall be taken. Structural measures and arrangements, of course, are more expensive, for example construction of new or repairing of available waste treatment facilities; changing/improving the process of the discharge treatment; liquidation and carrying over landfill sites; construction of water-blocking buffer strips; cleaning of water reservoirs from sediments and deposits etc.

It is very important to understand that application of planned mechanisms, measures and events should be periodically monitored in the process of their realization and it's necessary to assess their effectiveness. In other words, it is necessary to know whether improvement of the water quality in the water body is seen, whether its quality is not becoming worse, to see how effective are the applied mechanisms and what is the effect from structural measures and arrangements being realized.

And again such understanding can be reached through the regular monitoring of the water quality in the water body and comparing of received data with the expected quality of waters. Finally, in a certain period of time it is necessary to make a following conclusion – is the expected quality of water body reached or not. Here again two scenarios are possible. If applied measures and mechanisms turned out to be effective and the quality of water in the water body corresponds to the expected quality, it is necessary to continue supporting it. And if the required quality of water is not reached, then it is necessary to look for reasons, to assess how effective were the mechanisms and/or to plan new arrangements and measures on improvement of the water quality.

It is obvious that the system of the natural waters quality provision can be effective only in that case when all its elements (the targeted quality, monitoring, decision-making, applied mechanisms and measures, analysis of the effectiveness etc.) are interconnected and "work" in one direction – for preservation and improvement of the quality of a concrete water body. For this purpose the clear and exact plan on the quality assurance of this or that water body is needed. It is necessary to determine the targeted quality of water reservoirs, the time frame for achieving this target, to determine responsible executors, material and financial resources, planning arrangements and structural measures. In accordance with principles of the Integrated Water Resources Management (IWRM) it can be reached through realization of Watershed Management Plan (WMP). In some CA countries, though it has been declared in the legislation, such kind plans practically are not developed or are developed in the limited volume.

INSERTION 2

GOOD PRACTICE

«WATERSHED MANAGEMENT PLAN»

The most illustrative example of water resources management planning, including their quality management, is development of a River Basin District Management Plan in accordance with the EU Water Framework Directive. River Basin District Management Plan (RBDMP) is developed on the basis of the preliminary comprehensive analysis of the catchment area.

All water bodies - surface ones (rivers, natural lakes, sea and transitional waters) and underground ones are subdivided to so-called water bodies, that are elementary management units. For such division a number of criteria is applied, for example for surface waters these include the following: ecoregions boundaries, the type of river or the lake, hydrographic networks, loads from hydraulic structures and loads from contamination sources. Based on the assessment of hydromorphological loads the decision is made – does this or that water body refer to category of Artificial, Heavily Modified or Natural/Quazi-Natural water body?

For every water body, depending on its category the targeted water quality objectives shall be set, for example: ***"to reach good economical status of the water body up to 2020" or "to reach transferring of the water body from the bad ecological status to the moderate status up to 2017" or to provide a high ecological capacity for heavily modified water body (water reservoir) up to 2017".***

Taking into consideration perspectives for reaching the targeted status of the water body and starting from its current status, a complex of measures and arrangements (of the structural and legislative-regulatory character) shall be developed. These measures in case of being effective will allow to reach the expected targeted status for the given water body.

For taking control over effectiveness of planned measures, special monitoring programs shall be set (physical and chemical quality of the water and bedload sediments, hydrobiology, composition of waste waters, effectiveness of sewage treatment, protected territories etc.). Through such monitoring programs the state of the water body shall be monitored and decisions are made – whether additional measures or special arrangements on the water catchment area are needed or not?

RBDMP is developed for the period of 6 years and is corrected after 3 years of its realization. At the same time development of RBDMP for the next planning cycle is started.

CHAPTER 1.2.
ACTUALIZATION OF THE DIAGNOSTIC REPORT

This chapter presents a kind of brief resume of the Diagnostic Report[1], reflecting its main aspects and conclusions. The changes taken place in CA countries from the moment of its publication are mentioned in the boxes below.

1.2.1. LEGISLATIVE FRAMES

The existing legal framework in all countries covers (I) general objectives, principles and mechanisms of water and environmental protection policy (water and environmental legislation), (II) sanitary and epidemiological provision of the population health related to the drinking water (sanitary and epidemiological legislation), (III) mechanisms of water relations regulation, including those that provide the quality of water resources (legislation in the sphere of ecological expertise, permission, prohibitions for the water consumptions and economic activities on water catchment territories and close to water bodies, systems of payment for the use and contamination of water resources, (IV) mechanisms of monitoring and control over compliance with the water and environmental legislation.

CA countries continue developing legal framework for water resources management.

Thus, in Uzbekistan in 2013 the Law “On water and water consumption” was updated.

In Tajikistan, on December 30th, 2015 the Government of Tajikistan adopted the Water Sector Reform Programme, 2016-2025. The water sector reform is about transferring the water management from administrative to hydrological boundaries, separating water policy and regulatory functions from operations, while applying IWRM principle; and on improving provision of clean drinking water supply to the population for the period of 2008-2020. To systematize all water-related goals and objectives of sustainable development, the country is currently drafting its 2030 National Water Strategy. A new draft of the Water Code of the Republic of Tajikistan that accounts for current trends and requirements has been introduced and is currently under consideration. The human right to safe drinking water and sanitation is given priority in these documents. The Law “On water uses associations” which was adopted in 2006 was revised in 2011.

In Kyrgyzstan, it is planned (recommended) to introduce the expanded concept of the Integrated Water Resources Management (IWRM) principle into the Water Code as well as the basin approach with regard to the complex use and protection of surface, underground and return waters, taking into consideration climatic specifics of the region; development of the unified system of water quality classification on water objects; elaboration of standards for Maximum Permissible Harmful Impacts (MPHI) on water objects; more clear division of official functions in the sphere of setting water quality standards. In 2015 with the purpose to regulate issues in the sphere of water resources consumption and protection, “Regulations on protection of underground waters” was approved. These regulations determine the order of use and protection of underground waters.

In Kazakhstan some changes were introduced into the “Environmental Code”. The introduced amendments will allow to exclude additional administrative barriers and to prevent contamination of the environment.

[1] *For development of regional cooperation on water quality assurance in CA. Diagnostic report and plan on the cooperation development, 2012.*

AT THAT THE DIAGNOSTIC REPORT STATES THAT IN CA COUNTRIES:

- Legislative water and environmental norms are elaborated at different pace;
- Legislative norms often have regulations that need to be clarified, complemented or reviewed;
- Legislative norms often are not realized in full because of limited resources.

1.2.2. INSTITUTIONAL STRUCTURES

On the issue of authorities differentiation in the sphere of water resources management, the Diagnostic Report states that, in principle, in CA countries functions and authorities on water resources management, including provision of their quality, have been distributed to different ministries and agencies. Functions on surface water resources management (mainly by qualitative aspects and by water infrastructure) are usually concentrated in Ministries or Committees on water management and agriculture; environmental functions are entrusted to Ministries, Committees and Agencies on the environmental protection. Functions of underground waters management are implemented by executive bodies, regulating natural resources management. Issues concerning sanitary and epidemiological situation and the quality of drinking water are addressed by the Ministries of health. In addition, functions on prevention and liquidation of emergencies after-effects including those connected with technogenic accidents and extreme contamination of water resources are trusted to corresponding Ministries of emergencies or they are the prerogative of the Cabinet of Ministries and of local authorities.

During the last five years, quite significant institutional reforms were realized in countries of the CA region.

Thus in Uzbekistan “Uzhydromet” was moved under the Ministry of Emergencies.

In Tajikistan, the water sector reform resulted in establishment of the Ministry of Energy and Water Resources and the Agency of Melioration and Irrigation, instead of the Ministry of Melioration and Water Resources. It brought significant changes in the institutional structure whereby separating policy and operation functions of water resources management in Tajikistan.

In Kyrgyzstan in 2012 the State Inspection on the ecological and technical safety was formed. It is a specially authorized state executive organ taking control over issues of environmental and technical safety. Previously control functions were assigned to the State agency on the environmental protection and forestry (SAEPF).

In Kazakhstan in 2014 the Ministry of Environment and Water Resources was liquidated, and corresponding functions and authorities were delegated to the Ministry of Energy.

THE DIAGNOSTIC REPORT IN PARTICULAR REFERS THE FOLLOWING PROBLEMS RELATED WITH INSTITUTIONAL ISSUES OF WATER RESOURCES MANAGEMENT AND PROVISION OF THEIR QUALITY AS UNDERLYING PROBLEMS:

- Limited resources (financial, personnel, material and technical) for implementation of managerial decisions;
- Overlapping functions and authorities in the sphere of control and inspectorial activities, of monitoring;
- Application of imperfect procedures in water resources management, in particular (I) insufficient application of a complex approach to planning of water resources consumption and protection, (II) lack or gaps in national strategies, plans and schemes on water resources quality management, (III) fragmentary use of the Integrated Water Resources Management principles and of the basin

approach, (IV) dominating application of managerial methods aimed at removal and liquidation of negative situations, and not at their prevention; imperfect information systems for making decisions based on the objective and reliable information about water resources.

THE FOLLOWING CAN BE ADDED HERE:

- Inadequate awareness on issues of the state division of authorities in the sphere of water resources management both among the population and economic entities;
- Insufficient use of the scientific capacity and engagement of scientific institutions to issues of consulting state authorities in application of managerial decisions;
- Lack of coordination and exchange of information including on parameters of water resources quality and the access to electronic databases.

1.2.3. LEGAL FRAMEWORK AND MECHANISMS

The Diagnostic Report has a section on reviewing mechanisms on water resources quality assurance. Here it is mentioned that in all CA countries the system of permissions/ prohibitions on the discharge of untreated wastewaters and polluters of natural water reservoirs as well as on the discharge of wastes into water bodies and water fund lands is applied. In all countries also the control/ inspection is taken over compliance with water and environmental legislation and the system of penalties for offences and payments for the water delivery is in force. Other mechanisms, for example, licensing and certification of water uses, benefits and economic stimulus are applied only in some countries of the CA region.

During the last several years normative and legal mechanisms on water resources quality assurance in CA countries have not changed significantly. In some countries new by-laws were developed. Thus in Turkmenistan since 2008 "The methodology on assessment of the harm to the environment because of water bodies contamination" is applied. The "Methodology of the tariff calculation for water delivery service" is in the approval process of being endorsed. This methodology in addition to the tariff for the actual delivered water (currently per hectare tariff is in force), also takes into account the quality of water delivered for irrigation is. Also stimulation mechanism for the water saving has been developed.

New "Rules on surface waters protection" adopted in Kyrgyzstan in 2016 have preserved previous requirements to the composition and qualities of water in watercourses and water reservoirs for different types of water consumption by 3 categories (economic-drinking, cultural-domestic and fisheries water consumption). Also national Maximum Permissible Concentrations (MPC) and Approximate Permissible Levels (APL) in the water of water bodies of economic-drinking and cultural-domestic consumption were accepted.

HOWEVER, THE DIAGNOSTIC REPORT STATESTHAT IN CA COUNTRIES:

- Application of regulation norms and mechanisms is often delayed or implemented inconsistently.
- Inspection authorities have limited capacities and technical equipment for the adequate inspection of enterprises, determining sources and causes of ground and surface waters pollution, whereby sanctions are often not sufficiently tangible for those who run afoul of the laws.
- Tariffs for the water consumption, especially in irrigation are low, that is often stipulated by the low paying capacity of farmers, although the incentive mechanism to encourage rational water-consumption in the agriculture is not sufficiently developed.

- Tariffs for the discharge of waste water and contaminating substances into water reservoirs fall critically less than a cost of environmental damage caused and expenses for the consequences liquidation.
- The structure of water resources contamination sources has changed a little, with the increased role of diffusive contamination. Economic units of small and medium-sized businesses began dominating; disordered maintenance of auto transport and discharge of domestic wastes is observed.

1.2.4. STANDARDS

- IN THE SPHERE OF WATER RESOURCES QUALITY STANDARDIZATION SYSTEMS, THE DIAGNOSTIC REPORT STATES THAT IN ALL CA COUNTRIES PERMISSIBLE VALUES OF NATURAL WATERS COMPOSITION AND QUALITIES ARE SET. WITHIN THESE VALUES SAFE CONDITIONS FOR THE POPULATION'S LIFE SUSTENANCE AND FOR THE ECONOMY ARE PROVIDED, AS WELL AS FAVORABLE CONDITIONS FOR THE WATER CONSUMPTION AND FOR THE WATER ECOSYSTEMS STATE. THE LIST OF STANDARDS APPLIED TODAY ON THE NATIONAL LEVEL IN CA COUNTRIES FOR STANDARDIZATION OF WATER RESOURCES QUALITY, AS A RULE, INCLUDES THE FOLLOWING NORMATIVE AND LEGAL REQUIREMENTS:
- Key terminology and definitions.
- The list of water quality indicators and maximum level of contaminating constituents typically collected in water quality sampling standards in natural waters for different types of water consumption (economic-drinking, communal-domestic, irrigation and fisheries).
- The system of natural waters quality norms based on maximum permissible concentrations (MPC) for separate substances and for separate water consumptions that assumes avoiding the excess of these norms;
- Developing of the water quality monitoring network includes methods and procedures, the accuracy of sampling and technical requirements.
- the accuracy of measurements and technical means for it.

Major differences in application and the ways in development of water quality standards have been monitored in CA countries.

Thus, in Turkmenistan over the last 5 years the water quality standards have not been revised.

In Uzbekistan in some cases MPC norms have been revised for approximation the level of water sources quality to real indicators. So if it is impossible to deliver water to consumers with mineralization less than 1 g/l (MPC), then for any specific case the norm is set by the acceptable limits (in accordance with background conditions of the water quality).

In Tajikistan, the norms and rules were updated, including SanPin (Sanitary rules and norms) 2.1.4004-07 "Drinking water, hygienic requirements for the quality of water in centralized systems of drinking water supply. The quality control", SanPin 2.1.4005-07 "Drinking water, hygienic requirements to the quality of water in non-centralized systems of drinking water supply. The quality control", SanPin 2.15.006-07 "Zones of the sanitary protection of water supply sources and water pipes for the domestic-drinking use".

In Kyrgyzstan in 2016 hygienic standards "Maximum Permissible Concentration levels of chemical composition in the water of water bodies for domestic-drinking and cultural-domestic water consumption" and "Approximate Permissible Concentration levels of chemicals in the water of water bodies for domestic-drinking and cultural-domestic water consumption" were reapproved. Despite of formal adoption of new documents in both countries, these standards have basically repeated the old one.

Water quality standards have fallen under more significant reforming in Kazakhstan. The system of natural waters quality norms was revised. This system was based on maximum limited concentrations (MPC) for some substances and for separate water uses that formally assume non-admission of

these norms excess. Normative documents "The unified system of classification of the water quality in water bodies" and "The methodology for development of targeted indicators of the water quality in surface water bodies and arrangements for reaching these indicators" provide for introduction of ecosystem models of regulating water related activities and transferring the current system of assessment of the water quality and of the contamination level in water bodies to new systems of water quality standards. The new approach has been developed taking into consideration the European and international conception, practices, methodology and harmonization results achieved in EECCA countries.

On the initial stage of the environmental legislation reforming, it included two assessment instruments: the first one – the hierarchal five-level classification of water bodies on the basis of requirements to the water quality of essential categories of water consumption such as fisheries, domestic-drinking, recreational (cultural-domestic), irrigation, industry; the second one – numeric values of water quality standards by the list of substances, approved for carrying out the state ecological monitoring.

In the long view, based on results of implemented of ecosystems assessments by each river basin it will be necessary to determine "targeted indicators" that should be approved in relevant water related documents as "the base policy". Currently a number of normative documents on application of "The unified system of classification of the water quality in the water bodies" in the system of state monitoring and assessment of the environment conditions are being developed. In addition, in Kazakhstan the work is continued on improving standards of impact on water bodies such as Maximum Permissible Discharge (MAD) and Maximum Permissible Harmful Impacts (MPHI). The method of technological regulation of the contamination control on the basis of MAD standards will be based on the concept of using the Best Available Techniques (BAT). As one of ways to improve the MPHI standards it is recommended to use the water balance equation.

AT THE SAME TIME, THE DIAGNOSTIC REPORT COVERS THE NATIONAL SYSTEMS OF WATER QUALITY STANDARDIZATION:

- Developed in the USSR in 1960-1970-s regulations are morally obsolete. They do not optimally take into consideration the modern specificity of water resources management and their quality aspects in the region;
- Missing new technologies and technical means of monitoring;
- Have contradictions in the context of the monitoring data interpretation for different water uses that jointly use common water bodies and to a limited extend take into consideration requirements to assurance of the of natural waters quality for water ecosystems;
- Impose excessively hard requirements to indicators of the water quality (any deviation from the standard of natural waters quality is considered to be an offence);
- The list of quality parameters provided for the monitoring often is not typical for some water bodies;
- Insufficient realization of standard requirements, due to the lack in financing, technical equipment and staff capacities of organizations engaged in the monitoring.

1.2.5. CLASSIFIERS

The Diagnostic Report marks some similarity on the issue of water resources classification, but also a number of quite significant differences in applied approaches and principles of natural waters classification by their quality. Traditionally, since the times of the Soviet Union, three categories of water resources consumption have been determined in CA countries – domestic-drinking, communal-domestic and for fisheries, and to each of these categories these or those requirements to the water quality are applied. However, concrete water bodies are not distinguished by these categories and often the same water body serves or is designed for satisfying considerably larger spectrum of water consumption (drinking and industrial water supply, irrigation, fishery and recreation, livestock watering and also for maintaining natural characteristics of different water and semi-aquatic organisms' inhabitation, and as a whole of water and water-wetland ecosystems). Therefore, not always it is clear which of standards should be applied in this or that concrete case.

In countries of the CA region also integral assessments of surface waters are applied (WPI index) which are based on MPC values for fishery water bodies. Usually the essential decision on the water quality in natural water bodies is made by the WPI index. Despite of this, only limited list of water quality parameters is used for the WPI calculation, that consists of six hydro-chemical parameters. This is incomparably less than extensive and officially approved MPC lists.

The water quality assessment by hydro-biological parameters and relevant systems of natural waters classification are applied only in some countries of the region (Kazakhstan and Uzbekistan).

Assessment of natural waters quality in the CA region is still traditionally based on using of the list of substances (water quality parameters) and on values of their Maximum Permissible Concentrations (MPC, APL, quality norms for irrigation waters etc.) in different water reservoirs (fisheries, domestic-drinking and cultural-domestic water consumption). In practice the water quality is usually assessed by the excess of concentrations of different parameters revealed in the water of water reservoirs over standard values (ratio to MPC) and by the number of cases of the MPC excess for the certain period.

For today, from all countries of the region, only Kazakhstan is in the process of transferring to classifiers of natural waters quality based on of the water quality classes. Classification includes numeric values of water quality standards by biogenic elements, organic compounds, main mineralization ions and metals, physical and hydro morphological indexes. Classification includes numeric values of water quality standards by categories (types) of water consumption and characteristics of water consumption classes. From those classifiers, which provide the integral assessment of the water quality in the region, the Water Pollution Index (WPI) is used to a limited extend (in separate countries or in separate agencies). This index is calculated on values of six hydro-chemical indicators.

Since 2015, in the system of state ecological monitoring in Kazakhstan, for assessment of the level of surface waters pollution the complex water pollution index (CWPI) is applied. After determining the CWPI for each group of provisional combinations for the period of year being determined, such, for example, as broken down by months, for the period of spring floods and high waters, for the period of summer-autumn-winter low water season and broken by years (depending on targets and objectives of the complex assessment), the average measured CWPI for the watercourse or the water reservoir as a whole is calculated and the contamination class is determined.

The general conclusion of the Diagnostic Report states that simultaneous application of several classifiers, based on different principles and indexes, hinders procedures of water resources quality regulation.

1.2.6. MONITORING OF WATER RESOURCES QUALITY

In CA countries functions on carrying out the water quality monitoring is formally differentiated among different agencies. Registration of qualitative and quantitative indicators of surface and underground water resources is assigned to hydrometeorology and hydrogeology bodies. Environmental protection authorities are responsible for the control of quality indexes of the aquatic medium and of pollution sources. Drinking water supply sources are controlled by public health authorities, local authorities and water services companies. The quality of irrigation and drainage waters is checked by river authorities. The control of emergencies leading to contamination of water resources is assigned to emergency response authorities.

At that, there are observed serious difficulties in practical realization of numerous ecosystem monitoring programs in the CA region. One of main reasons is the deficiency of budget financing, lack of laboratories in the region and obsolete material and technical base of available laboratories, fluctuation of manpower. In the region, reduction of the number of water quality parameters for taking control is observed, the periodicity of samples collection is reduced, as well as the number of hydrometric and hydro-chemical posts and the number of section lines being controlled.

Over the last year the situation with monitoring in CA countries has not changed significantly. Monitoring of the water quality is carried out by different agencies by their own programs that often are not coordinated by sampling sites, analyzed parameters, measuring frequency. While carrying out control of natural waters quality on the same water reservoirs, each agency applies its own system of standards (fisheries, drinking water supply, recreation, irrigation water consumption etc.) and assessments (MPC, technical standards). All this complicates the interpretation of monitoring data and calculations about targeted quality of water for the water reservoir. It is expected that in Kazakhstan after transferring to ecosystem approaches and introduction of unified system of water quality classification in the water body, these contradictions will be removed.

However, in CA region, the administrative approach is still dominating. At that, this trend towards decreasing of laboratories' capacity is pointed out as very acute (equipment and laboratory basis, personnel, methodologies).

In the majority of CA countries, the monitoring network is not sufficient to cover important water bodies, to assess the impact of pollution sources, to provide information about background or etalon conditions of water resources. For implementation of different departmental monitoring programs on the level of countries, significant capital and operational expenses are required. At that, "the quality" of received data is declining because of the insufficient number of samples collection, reduction of the list of test items due to the obsolete material and technical base and identification methods and because of the personnel problems.

Only in Kazakhstan a number of observation posts over the surface waters quality are gradually restored. In 2013-2015 the hydrochemical monitoring was carried out on 240 section lines located on 105 water bodies, in 2016 - on 392 section lines on 128 water bodies; in 2017 - on 404 section lines on 133 water bodies . The number of parameters to be determined has been increased insignificantly because of the insufficient fitting of test laboratories with technical equipment, insufficient human capacity. Since 2017 "Kazhydromet" is carrying out monitoring of organochlorine pesticides in surface waters of transboundary rivers.

THE DIAGNOSTIC REPORT HAS REVEALED QUITE A CRITICAL SITUATION IN THE CA REGION REGARDING MONITORING OF NATURAL WATERS QUALITY. THE SITUATION AS A WHOLE IS ASSESSED AS UNSATISFACTORY. THE MAIN PROBLEMS ARE IN THE FOLLOWING:

- Reducing the density of observation networks as by hydrological observations and also by hydrochemical indicators;

- Reducing the number of monitoring programs as by the spectrum of control parameters and also by the frequency of samples collection;
- Using of physically and morally obsolete means of measuring, processing, storage and distribution of the information about the quality of water resources;
- Lack of human capacity and lack of programs for advanced training, training of specialists;
- Extremely insufficient volume of financing for carrying out monitoring of water resources quality and supporting observation networks and laboratories.

1.2.7. REGIONAL COOPERATION ON WATER QUALITY

Central Asian countries maintain water cooperation, as their living conditions are largely determined by the access to transboundary water resources. Currently in the region, the interstate cooperation is focused mainly on distribution of water between the countries, maintenance and exploitation of transboundary water infrastructure, general safety of hydrotechnical structures. However, the greatest challenge for CA countries remains in that how to ensure that transboundary waters are used in a reasonable and equitable way, taking into particular account their transboundary character, and all water-dependent ecosystems. The main problem is the conflict between the water consumption for hydro energy and for irrigation needs. Thus, cooperation to a larger extent is focused on division of water resources and their re-distribution. At the same time there is practically no cooperation on the water quality and water related ecosystems[2].

International conventions are the important mechanism for cooperation. At that, each country has its own vision for participation in this or that convention. Therefore, the international law is applied in the CA region still insufficiently and non-uniformly[3]. Regional and bilateral agreements on water resources and environmental protection and participation of countries in interstate coordination bodies – the Executive Committee of International Fund on Saving the Aral See (IFAS), the Interstate Commission for Water Coordination (ICWC), and the International Sustainable Development Commission (ISDC) are also very important elements of the regional cooperation. In addition, supporting of different water and nature protection projects by foreign donors is currently very important for the region as a whole and for countries in particular.

Development of the regional/interstate cooperation on issues of the transboundary water resources quality in the CA region still requires significant efforts and development of the purposeful policy both by countries themselves and also by the international structure. The demonstrative example of specific development of such cooperation is the cooperation between Kazakhstan and Kyrgyzstan on the basin of rivers Chu (Shu)-Talas. Since 2016 the expert working group on the environment protection under the Secretariat of the Commission of the Republic of Kazakhstan and Kyrgyz Republic on the use of interstate water facilities on rivers Chu and Talas was established. The working group included representatives of the number of profile organizations, including those engaged in the monitoring of surface waters quality in both countries. Five working meetings were conducted on issues of the water quality of transboundary rivers, including those with the support of GEF/UNDP/UNECE project “Promotion to the transboundary cooperation and integrated water

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[2] Assessment of the state of transboundary water resources in the UNECE region: assessment and monitoring of the state of transboundary rivers, lakes and underground waters in Central Asia. Materials of the working group on the monitoring and assessment and on the integrated water resources management, ece/MP.WAT/WG.2/2011/4 – ece/MP.WAT/WG1/2011/4

[3] For development of the regional cooperation on assurance of the waterquality of in CA. The diagnostic report and plan on the cooperation development, 2012

resources management in basins of Chu(Shu) and Talas rivers. Experts carried out the joint assessment of the quality of surface waters in the basin. Currently the list of measurable indicators for the further joint collection and analysis of water samples on transboundary watercourses has been agreed.

The priority tasks for joint efforts include harmonization of standards for assessment of surface waters quality; development and introduction of the unified monitoring program; joint collection and analysis of water samples and exchange of the monitoring information.

THE DIAGNOSTIC REPORT POINTS OUT THAT DESPITE OF THE QUITE DEVELOPED INTERNATIONAL LEGISLATIVE FRAMEWORK FOR COOPERATION BETWEEN COUNTRIES OF THE REGION ON WATER ISSUES:

- Priority and key directions of cooperation between CA countries are issues of water resources distribution, the regime of water reservoirs exploitation and maintenance of the water management infrastructure.
- Though issues of joint water resources quality were periodically specified in declarations of Heads of states and governments and in relevant agreements, no scaled joint activities for addressing problems of water resources quality were undertaken.
- Most commitments undertaken by countries on issues of transboundary waters quality, the information exchange and harmonization of normative, technical and information background, for example on the line of ecological monitoring and hydrometeorology on the level of CIS countries by and large were not realized.

As a whole, the Diagnostic Report states that the current level of regional cooperation in the context of water quality assurance is not efficient enough, though intentions of countries for the further development of these relations on the parity basis are obvious.

AFTER IDENTIFYING THE ACTUAL SITUATION ON ISSUES OF THE REGIONAL COOPERATION, ASSURANCE OF THE WATER QUALITY, AFTER DETERMINING EXISTING SHORTAGES AND DIFFICULTIES THE DIAGNOSTIC REPORT HAS OUTLINED THE MAIN REGIONAL LEVEL PRIORITIES ON COOPERATION OF COUNTRIES OF THE REGION IN THE CONTEXT OF THE QUALITY OF JOINT WATER RESOURCES. THESE PRIORITIES ON THE FIRST STAGE SUGGEST THE UNIFICATION (HARMONIZATION) OF THE NORMATIVE-LEGAL BASIS ON THE WATER QUALITY REGULATION, AND NAMELY:

- Coordinated classifiers of water resources quality for basins of transboundary rivers;
- The agreed list of water quality indicators for monitoring of transboundary watercourses and especially dangerous sources of pollution.
- Agreed values of maximum admissible concentrations (quality standards) for the region or for basins of transboundary rivers;
- Unified methods and provision of the equipment (instrumentation) for measuring indicators of the quality of transboundary natural waters;
- The agreed methodology on processing of the monitoring information;
- Coordinated procedures for the regular exchange of data on water resources quality, including prompt notification criteria and procedures in case of volley contamination of transboundary rivers.

In future it is recommended to focus the regional cooperation on development of regional standards and basin agreements and also on realization of joint projects on rehabilitation and modernization of monitoring networks, joint monitoring of the quality of water bodies, inventory of transboundary sources of pollution, training and retraining of the personnel, formation of regional information systems, etc.

THE DIAGNOSTIC REPORT IS ACCOMPANIED BY THE PLAN OF REGIONAL COOPERATION ON ASSURANCE OF THE QUALITY OF SURFACE WATERS IN COUNTRIES OF THE CA REGION. THIS PLAN IS BASED ON THREE STRATEGIC DIRECTIONS:

- Regional harmonization of directions on reforming the system of assurance of water resources

quality ("conservative" or "dynamic" scenario);
- Coordination of activities on development of monitoring of the quality of transboundary watercourses and procedures of the regular data exchange; and
- Development of the legal status of regional cooperation in the sphere of regulation of natural waters quality and establishment of the effective regional expert structure.

1.2.8. RELEVANCE OF THE DIAGNOSTIC REPORT

The Diagnostic Report developed in 2012 is still an actual document deterring main strategic directions on improvement of the cooperation between CA countries in the context of joint surface water resources quality. Over the last five years, in the number of countries of the region certain steps were taken on the national level on improvement of mechanisms on maintaining the natural waters quality. These changes mainly concerned the redefinition of functions of ministries/agencies responsible for these or those aspects of waters quality management and also for modification of national legislative acts and normative legal documents.

However it should be noted that changes in the institutional and legislative-normative sphere in the number of CA countries that have taken place over the last years not always fully reflect the need in complete reforms on issues of water resources quality. Often, while developing new national acts the available customary normative-legal basis is used without due analysis of its effectiveness in new social and economic conditions, without due consideration of structures of this or that country. Old but customary approaches are used (in particular application of the system of MPC of substances for different water reservoirs).

THE FOLLOWING COORDINATED EFFORTS ARE NEEDED ON THE NATIONAL LEVEL FOR PROVISION OF THE EFFECTIVE IMPROVEMENT/MODERNIZATION OF THE SYSTEM OF NATURAL WATER RESOURCES QUALITY MANAGEMENT IN COUNTRIES OF THE REGION BASED ON THE IWRM PRINCIPLE. CURRENTLY IT IS RECOMMENDED TO CONCENTRATE THESE EFFORTS ON PRACTICAL ASPECTS OF DEVELOPMENT AND INTRODUCTION OF THE IWRM PRINCIPLES IN EACH COUNTRY OF THE REGION, IN PARTICULAR:

- Giving due attention to water resources quality on the national level and linking water quality with quantitative indicators of water resources accessibility for different water consumers;
- Reconsidering principles of rating, standardization and classification of the water quality taking into consideration new social and economic realities and their impact on the sustainable development of natural, social and economical environment;
- Determining functions of the quality water monitoring as the instrument for target-oriented assessment of water resources conditions and as the basis for taking managerial decisions on attaining the desired quality of water bodies;

On the regional level, essential recommendations of the Diagnostic Report and realization of the regional cooperation plan on assurance of surface waters quality are remaining actual to the full extent as no significant changes have taken place in this issue over the last years.

In the next section (Section 2), the regional analysis of monitoring systems being carried out currently in five CA countries on transboundary watercourses is presented. This analysis is dedicated to assessment of the need to improve water resources quality monitoring on the national and regional levels. In this section, assessment of current conditions on different aspects of water resources quality monitoring is given, main causes for reduction of monitoring programs are revealed as well as limitations with which countries are facing at realization of these programs. In this section, concrete and specific recommendations are given which if realized can help countries to restore monitoring networks and expand quality control programs taking into consideration new realities, challenges and current requirements to water resources quality monitoring.

SECTION 2.
SURFACE WATER QUALITY MONITORING SYSTEMS IN CENTRAL ASIA: NEEDS ASSESSMENT

This section presents the summary submitted by national experts on the issue of studying national requirements for improvement of surface water resources quality monitoring systems. This section covers issues of importance of the information about the surface waters quality determined by the national legislation and mandates of different organizations engaged in the quality monitoring. Here also the review of available observation networks on the quality of surface waters on main transboundary rivers (more than 100 km in length) in the region is given, as well as the expert assessment of needs of surface water quality monitoring systems on examples of agencies ("Kazhydromet", "Kyrgyzhydromet", "Tajikhydromet", "Uzhydromet", accordingly in Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan and Turkmenistan and of the Ecological Control Service in Turkmenistan) engaged in realization of the control over water resources quality. The survey includes different aspects of planning, organization and realization of monitoring programs in each counties of the region as well specifics of laboratory management, management of the monitoring data, of information flows and using of the information about the quality of water bodies and about the international cooperation of hydrometeorogical services in CA.

CHAPTER 2.1.
IMPORTANCE OF THE INFORMATION ABOUT SURFACE WATERS QUALITY

The quality and quantity of both surface and also of underground water resources is always interconnected. Exhaustion of water resources, lack and deficit of water are fundamental problems for the life sustenance of the population, for the social and economic well-being of states and for maintenance of due ecological balance of territories. Understanding of the importance of the water quality and of the access to water resources is a prior and this paradigm (model) is widely spread in the Central Asia region.

But water as any other natural resource has also a qualitative aspect. Water of improper quality cannot be considered as a sustainable resource. In other words, the water of bad quality is equated with the limitedness or even with the lack of the resource. Even having water in sufficient quality, it cannot be used if it is contaminated or it can be used very limitedly with the risk for water users. Moreover, natural water of bad quality poses a threat for water ecosystems, breaks the ecological balance of water reservoirs, causes degradation of the natural component of water bodies that in turn inevitably leads to greater worsening of the water quality in water reservoirs.

In view of this, the information about the quality of water resources is an important constituent part of the modern society, economics and natural protection in all CA countries. Understanding of the importance of such information is becoming more and more obvious in the region with aggravated water problems. The need for the data about the quality of water bodies, rivers and lakes, about the impact of sources of pollution on qualitative characteristics of water and about acceptability of the water quality for different types of water consumption is postulated on different levels.

Thus for example on the level of institutions and

state management structures, the information about the quality of water resources is important for formulation of the state policy in the sphere of water resources, for provision of healthy and safe conditions for the population dwelling, for elaboration of models and schemes of territorial and economical development of territories, for maintenance of social and economic well-being of the country, for protection of the environment as a whole, for planning of water consumption schemes, for the interstate cooperation.

On the level of economic entities the importance of the information about the quality of water resources being used is determined by the safety and marketability of their products or rendered services, by understanding of the need to compensate the society losses/exhaustion of the resource caused by industrial activities and by pollution.

On the level of the civil society and the population, the need to be aware about the quality of water is connected with their right for clean and safe environment, qualitative drinking water and safe food products.

The reliable information about the quality of water resources is of great importance for making managerial decisions and for the adequate management of water bodies. First of all it is connected with the need to duly regulate economic activities on water catchment areas and regulate the water consumption. It should be regulated in such a way that the economical development would not cause degradation and exhaustion of natural resources. Managerial decisions should lead to establishment of adequate compensation mechanisms for the use of the water resource and to application of regulation instruments (payment for water, payment for pollution, permission for water consumption, permissible discharge standards and for other negative impacts on water bodies).

The timely and operational information about the water quality is extremely needed for informing and taking measures in cases of extraordinary, extreme, emergency contamination of water bodies with the purpose to provide safety of both economic activities and also of people's life and health.

Multi-year data about the natural waters quality is important for the scientific society and for state structures engaged in the long-term planning for doing analysis of trends in changing qualitative characteristics of water reservoirs, for development of strategies and plans, for responding to current challenges and threats (climate changes, for example).

The data about the quality of water bodies is needed for the purposes of nature protection, preservation and conservation of valuable biotopes, habitats, ecosystems, rare and endangered species.

Information about the quality of joint water resources is also important in the regional-transboundary context for development of basin approaches to joint water resources quality management, development of coordinated water policy and measures on the international cooperation.

In the long view, the need in the information about the qualitative characteristics of water bodies will only increase. The information can be obtained only through the monitoring – systems of the control, assessment and prognosis of the quality of natural environment including observations over the impact of people on this environment.

Currently the existing legislation in all CA countries provides the legal basis for the monitoring of water resources quality. Each country develops its legal framework in the context of providing monitoring based on national needs and specifics. In the majority of cases these are Water Codes, basic ecological and water management legislation, legislation about sub-surface resources, legislation on the sanitary and epidemiological well-being of the population. Annex 1 provides the digest of basic laws and sub-law acts that currently form the legal framework for carrying out monitoring of water resources quality on the national level in five countries of the region.

The water quality monitoring in natural water bodies always was an important constituent constituent of the general management of water resources in all CA countries. Development of water resources quality monitoring systems in CA countries started in 70-es of the last century with organization of services of observation and control over the environment state on the basis of stations of hydrometeorological services. During this time, CA countries developed their national monitoring systems, gained experience and developed approaches, accumulated data and submitted the information. Gradually other agencies (water, environmental protection,

sanitary and epidemiological agencies) were also involved into the process of natural waters monitoring. Over the last years, due to a number of reasons reflected in the Diagnostic Report[4] and in the Section 1, the capacity of national of water resources quality monitoring systems on providing the qualitative and timely information started to decrease.

Nevertheless, as a whole several types of monitoring of water resources quality carried out by different agencies in each of countries can be identified (annex 2)

- Monitoring of the water quality in surface natural water reservoirs (rivers and lakes)
- Monitoring of the impact of sources of pollution on the quality of water resources
- Monitoring of the water quality on entrance ranges of water bodies, designed for the utility and drinking water supply.
- Monitoring of the water quality for irrigation
- Monitoring of underground waters quality

In spite of that different types of monitoring are being realized in CA countries, over the last years, as a whole, in the region decreasing of the effectiveness of systems of control over the qualitative state of water resources is observed. It was revealed at the development and also at actualization of the Diagnostic Report. The Diagnostic Report especially underlines that the nature of water quality monitoring currently is unsatisfactory, because at present in CA countries, actually the limited number of water quality indicators is monitored by reduced monitoring programs, often without observing time limits for samples selection. The monitoring data is not used effectively enough.

Therefore, studying of the current state of monitoring systems in CA countries is crucial for making decisions on reanimation and restoration of national water quality monitoring systems, as the need in qualitative and adequate monitoring information will only increase. The next chapters show the main needs of monitoring system over the quality of surface natural water reservoirs in CA region, revealed on the national and regional levels.

[4] *For development of the regional cooperation on provision of the quality of waters in CA, Diagnostic report and plan on the cooperation development, 2012*

CHAPTER 2.2.
OBSERVATION NETWORKS OVER THE QUALITY OF SURFACE WATERS ON MAIN TRANSBOUNDARY RIVERS IN THE REGION

This Chapter provides analysis of monitoring networks over the water quality of surface transboundary watercourses in the CA region. This material gives a brief information about location of monitoring posts over surface transboundary watercourses quality and about monitoring programs.

As the hydrographic network of the region As the hydrographic network of the region is vast, this study was limited only by transboundary watercourses (criteria – the common length of watercourse more than 100 km). National monitoring systems have been reviewed in the context of three main river basins in the region:

The basin of Amudarya river, including the main course and transboundary tributaries:

- Kyzylsu-Vakhsh
- Kafirnigan
- Karatag-Surkhandarya
- Zeravshan
- Amudarya (the main course)

The basin of the river Syr-darya, including the main course and transboundary tributaries:

- Naryn
- Karadarya
- Keles
- Isfara
- Syr-darya (the main course)

River system Chu (Shu) – Talas – Asy (Assa)

2.2.1. OBSERVATION NETWORKS OVER THE SURFACE WATERS QUALITY IN THE BASIN OF AMUDARYA RIVER

TRANSBOUNDARY RIVER SYSTEM «KYZYLSU-VAKHSH»

River system of the Vakhsh River is a large transboundary watercourse between Kyrgyzstan and Tajikistan. It is formed at junction of rivers Kyzylsu and Mukhsu and flows under the name Surkhob; after accepting river Obihingou from the left side it receives the name Vakhsh. After joining with river Pyanj on the territory of Tajikistan, Amudarya river is formed. The total length of river Vakhsh itself is 786 km, the area of the basin — 39,1 thousand km^2, the average flow rate — 156 m^3/s. In the Vakhsh river system Kyzylsu river is a transboundary one that originates on the territory of Kyrgyzstan, then flows through the territory of Tajikistan until joining with river Mukhsu forming a watercourse with the length of 235 km. The length of river on the territory of Kyrgyzstan is 146 km, and on the territory of Tajikistan - 192 km.

"Kyrgyzhydromet" did not conduct monitoring of the water quality in river Kyzylsu on the territory of **Kyrgyzstan** previously and is not conducting it currently.

On the territory of **Tajikistan** there are 2 points for observation over the water quality.

The first one is located on river Kyzylsu within boundaries of kishlak Dombrachi, on the border with Kyrgyzstan and is combined with the gauging station. The «Tajikhydromet» post for monitoring of the water quality has been functioning since 1962. Currently it is not functioning because of difficulties with transportation of samples and absence of the local laboratory. There is no data about the water quality for the last five years.

The second observation post of "Tajikhydromet" is located on the water course of river Vakhsh, on the border with the natural reserve "Tigrovaya Balka" (Palvontugai) in the range of the stream gauge, approximately in 60 km from the place where Vaksh river joins to Amudarya. This post

was functioning since 1983. Currently it is not functioning to the full extend because of difficulties with transportation of samples and absence of the local laboratory. Whenever possible, measurements are done only by temperature regime and by some physical qualities of the water. The periodicity of measurements varies from 1 up to 9 times in a year.

KAFIRNIGAN RIVER

Kafirnigan river is the transboundary watercourse between Tajikistan and Uzbekistan with the general length - 387 km. River originates in Tajikistan and mainly flows on the territory of this country, partially forming a border with Uzbekistan in its mid-stream on the length of 32, 5 km. It joins to Amudarya. Kafirnigan starts on a slope of Hissar mountain range, where waters of rivers Sardai-Miyona and Sorbon merge and run together. The total length of river is 387 km, the area of the basin — 11, 6 thousand km^2, the average flow rate — 164 м^3/s. The length of river on the territory of Tajikistan is 387 km, on the territory of Uzbekistan – 32, 5 km. The border with Uzbekistan passes by river watercourse. The left riverside belongs to Tajikistan and the right one - to Uzbekistan.

The monitoring of the water quality in Kafirnigan river in Tajikistan is conducted by «Tajikhydromet» on one observation post. The observation post is combined with the gauging station Tartki (kishlak Tartki, about 100 km from the place of joining to Amudarya river). The observation post over the water quality functioned since 1952 up to 1991. Currently it is not functioning because of difficulties with transportation of samples and absence of the local laboratory, There is no data for the last 5 years.

In Uzbekistan monitoring over the water quality of Kafirnigan river is not done.

TRANSBOUNDARY RIVER SYSTEM «KARATAG-SURKHANDARYA»

Surkhandarya river is formed at junction of Tupalangdarya and Karatag rivers, flowing from the south slope of the Hissar range. It flows into Amudarya. The length of Surkhandarya river flowing on the territory of Tajikistan is 175 km (from the headstream of Karatag river — 287 km), the area of the basin -13 500 km^2. The average flow rate in the mouth of river is 65,8 м^3/s. Karatag river forms the transboundary watercourse between Tajikistan and Uzbekistan , with the length of 112 km.

In Tajikistan, monitoring of the water quality in the main watercourse of Surkhandarya river is not done. But there are two «Tajikhydromet» posts for observation over the water quality on tributaries which form Surkhandarya river. One of them is located on the tributary Shirkent (the village Asbob, approximately in 30 km of the place of inflowing to the main watercourse of Surkhandarya river) and the second one on the tributary Karatag (near kishlak Karatag; it is joined with the stream gauge), not far from the place of joining to Surkhandarya). The post on Shirkent river is functioning since 1956, and on Karatag river - since 1964.

Currently, as there is no local laboratory, on both posts the first-day analysis is not done. Only temperature and physical parameters of water are analyzed. Since 2003, analysis of biogenic elements and of some non-organic microelements has been renewed. Currently, because of the lack of chemicals and of the instrumental basis the analyses number has been reduced. During the last years the number of selected water samples varied from 3 up to 12in a year on each point .

In **Uzbekistan** there is one «Uzhydromet» post for observation over the water quality on the main watercourse of Surkhandarya river, not far from the kishlak Shurchi. The observation post was established for getting information about the water quality upstream the Yuzhnosurkhanski water reservoir in the area of the post with organized disposal of wastewaters. Observations have been

conducted since 1938. The section line is joined with the gauging station and the hydrological information has been provided since 1970. As a rule, samples are selected every month, temperature and physical qualities of water are analyzed, as well as oxygen conditions, mineralization and salt conditions, biogens and heavy metals, oil products, SSAS, phenols and organochlorine pesticides.

ZERAVSHAN RIVER

Zeravshan river originates in Tajikistan, it stems from the Zeravshan glacier in the Koksu joint formed by junction of Turkestan and Zeravshan ranges. The initial section of the watercourse with the length about 200 km is named Matcha. From the left south side it accepts significant tributaries of Fandarya, Kshtut and Mogiendarya. After joining to Mogiendarya, it takes the name Zeravshan. After Penjikent, Zeravshan river crosses the border with Uzbekistan. The present length of river — 877 км, and the length up to Karakul oasis, where Zerafshan is divided into river arms is 803 km. The total area of the basin is 41 860 km^2. The average annual flow of the water measured downstream the mouth of river Mogiendarya is 162 m^3/s. The length of river on the territory of Tajikistan is 301 km, on the territory of Uzbekistan - 576 km.

On the territory of **Tajikistan** there is one "Tajikhydromet" post for observation over the water quality, located on the distance of 584 km from the mouth of river downstream Penjikent. The observation post has been designed for taking control over the water quality in river on the transboundary section line with Uzbekistan. The observation post functioned since 1979. Currently because of the lack of local laboratory the samples selection is not done.

On the territory of **Uzbekistan** monitoring of the water quality of in Zeravshan river was not done.

AMUDARYA RIVER (THE MAIN WATERCOURSE)

The main watercourse of Amudarya river itself is formed by junction of Pyanj and Vakhsh rivers on the territory of Tajikistan. Amudarya enters the Aral Sea, forming delta of river. The length of river is 1415 km, the area of the basin is 309 thousand km^2 (up to city Atamurat), the average discharge of water near Atamurat is about 2000 m^3/s. In the upper and lower stream, three large right tributaries (Kafirnigan, Surkhandarya, Sherabad) and one left tributary (Kundus) join to Amudarya. Further, up to the Aral sea no other tributaries join to Amudarya. The main runoff of Amudarya is formed on the territory of Tajikistan (80 %) and partially in the north Afghanistan. River flows along the border of Afghanistan with Uzbekistan, crosses Turkmenistan, again returns to Uzbekistan and then enters the Aral sea. On the territory of Tajikistan the length of river is about 80 km, on the territory of Uzbekistan – more than 300 km and on the territory of Turkmenistan - about 1000 km.

On the territory of Tajikistan there is one observation post on Amudarya river. The Tajikhydromet post for observation over the water quality is joined with the stream gauge near kishlak Aivaj, approximately In 20 km upstream the state border with Uzbekistan. The observation post has been joined with the stream flow measuring station, but because of destruction of the hydrometric equipment the measurements of flow rates are not done currently. The post of observation over the water quality was established in 2013. Currently, as there is no local laboratory, selection of water samples and the first data analysis is not done regularly. One-two water samples are selected per year. The limited spectrum of water quality parameters is analyzed – physical qualities and temperature regime, biogens and some metals. The number of analysis during the last years has reduced because of the lack of chemicals and of the relevant instrumental basis.

In Turkmenistan the control over the water

quality in the main course of Amudarya river is realised by the Ecological Control Service of the State Committee on the Environmental Protection and Land Resources. The National Hydrometeorology Committee "Turkmenhydromet" does only direct measurements of the flow rate on river. The control over the water quality in the main course of river is done on 3 monitoring posts. The monitoring program has been unified: physical and chemical parameters of water, temperature conditions, oxygen conditions and the level of general organic pollution, mineralization and contents of salt and biogenic elements are analyzed. On some observation posts oil products and SSAS are analyzed. Heavy metals and non-organic micro pollutant (pesticides) are not analyzed because of the lack of necessary materials and of the instrumental basis.

The first control section line is located in Kerki. The observation point was organized in 1952 for studying the global river flow and contamination from agricultural fields. It is joined with the stream gauge. From 4 up to 7 water samples are selected per year. Up to 2013, the pesticides were also included into the analysis, but now they are not analyzed. The second observation post is located near the town Darganata and it is located on the distance of 640 km upstream river mouth. The observation post was established in 1975. It is joined with the stream gauge. The monitoring station is aimed at identification of longstanding tendencies. Over the last years 3 -5 water samples are selected per year. Analysis of pesticides in the water is done. The third post for the water quality monitoring is located near the town Lebap (519 km upstream of river mouth). It is functioning since 1986 as a transboundary observation post. It is joined with the stream gauge. During the last years 3-7 water samples per year are selected. The presence of pesticides in the water is analyzed.

In Uzbekistan there are 3 posts of observation over the quality of water in the Amudarya river. The quality control is done by "Uzhydromet". The first observation post is located downstream the dam of Tuyamuyun water storage basin and downstream the town Druzhba and is joined with the stream gauge. Observations are done since 1953. During the last years the number of selected samples on this observation post varied from 3 to 6 samples. The second observation point is located near the town Kipchak and in 175 km downstream the dam of Tuyamuyun water storage basin for receiving the hydrochemical information about the water quality in the zone of irrigated arable farming. It is functioning since 1977 and it is joined with the stream gauge. During the last years from 6 to 10 samples are selected per year. The third observation post was organized in 1974 as a transboundary point within boundaries of the town Termez and 2,5 km downstream the mouth of Surkhandarya river. It is joined with the stream gauge. Every year from 10 up to 12 water samples are selected. On all 3 observation posts the unified program of observation is realized , including control over the temperature and physical qualities of water, oxygen conditions, mineralization and salt composition, biogens and heavy metals, oil products, SSAS, phenols and organochlorine pesticides.

2.2.2. OBSERVATION NETWORKS OVER THE QUALITY OF SURFACE WATERS IN THE BASIN OF SYR-DARYA RIVER

NARYN RIVER

Naryn river is an important transboundary watercourse. River originates on the territory of Kyrgyzstan and is formed by junction of rivers Large Naryn and Small Naryn, stemming from glaciers of the Central Tyan-Shan. It flows on the territory of Kyrgyzstan and then on the territory of Uzbekistan. After joining with Karadarya river it forms Syrdarya river. The length of Naryn river is 877km, the area of river basin is 59.9 thousand km. The average flow rate upstream the town Uchkurgan is 480 м^3/s. The length of river on the territory of Kyrgyzstan is 535 km, on the territory of Uzbekistan – 272 km.

In **Kyrgyzstan** up to 1992 the monitoring of the water quality in Naryn river was done by "Kyrgyzhydromet". Currently because of the insufficient budget financing, observations over the water quality on this watercourse are not carried out.

In **Uzbekistan** there is one observation post of "Uzhydromet" in the river outlet near kishlak Shamsikul. It is functioning since 1984. 5-8 water samples are selected in a year. Analysis are done by the standard scheme of "Uzhydromet" – temperature and physical properties of water, oxygen conditions, mineralization and salt composition, heavy metals, oil products, SSAS, phenols. Analysis of pesticides presence in the water is not done.

KARADARYA RIVER

Karadarya river with the overall length of 180 km (together with the left component of Tar - 318 km) is a transboundary watercourse between Kyrgyzstan and Uzbekistan. Karadarya river is formed by junction of rivers Tar and Kara-Kulja, which stem from the south-eastern slope of Fergana mountain range and from the north slope of Alai mountain range in Kyrgyzstan. The area of the basin is 30 100 km^2. The average annual flow rate near the community Uchtepa - 136 m^3/s. Karadarya river in its upstream flows on the territory of Kyrgyzstan, comes out to Fergana valley and passes to the territory of Uzbekistan. It joins with Naryn river, forming Syr-darya river.

In **Kyrgyzstan** up to 1992 the monitoring of the water quality in Karadarya river was done by "Kyrgyzhydromet". Currently observations over the water quality in Kyrgyzstan by this watercourse are not done.

In Uzbekistan since 1974 of the Uzhydromet observation post is functioning. It is located downstream kishlak Saray on the distance of 59 km to the mouth of Karadarya river. The observation post was organized for receiving information about the water quality in the area of the discharge of waste waters of industrial enterprises in the town Andijan. Selection of water samples is done every month. Here are analyzed temperature and physical qualities of water, oxygen conditions, mineralization and salt composition, biogens and heavy metals, oil products, SSAS and phenols.

KELES RIVER

Keles river is a transboundary river between Kazakhstan and Uzbekistan. The length of river is 241 km, the area of water basin is 3310 km^2. The flow rate in the mouth of river is makes up 6,5 m^3/s. River originates on the mountain range Karjantau. Near kishlak Kaplanbek Keles river comes out to the state border between Kazakhstan and Uzbekistan. Further the border partially passes by its watercourse. Then Keles river again passes to the territory of Kazakhstan lands and falls into the Syrdarya river. The length of river on the territory Kazakhstan is 102 km, on the territory of Uzbekistan - 139 km.

There is one observation post over the water quality on the territory of Kazakhstan. The observation post was organized on the gauging station Keles on the distance of 1,2 km from the place of joining of Keles river to the main watercourse of Syrdarya river, The monitoring is carried out by "Kazhydromet" (by its branch office on the south of Kazakhstan oblast). Hydrological observations are carried out since 1970. It is functioning up to present. Up to 12 samples are selected per year for analyzing the large spectrum of water quality, except for organic micro pollutants (pesticides).

In **Uzbekistan** monitoring of the water quality in Keles river is not carried out.

ISFARA RIVER

Isfara river a transboundary watercourse with the length of 107 km. Three countries are located in the basin of this river – Kyrgyzstan, Tajikistan and Uzbekistan. The area of the basin is 3240 km^2. River named Ak-Suu originates in Kyrgyzstan (near the border with Tajikistan) from the glacier Ak-Suu on the north slope of Turkestan mountain range. On the state border it flows together with river Kshemish (Kshemish-Say) and further it is named Isfara.

Monitoring of the water quality in **Kyrgyzstan** and **Uzbekistan** was not carried out.

On the territory of Tajikistan there is one observation point over the water quality. Observations are done on the stream gauge Tash-Kurgan (500 m downstream of kishlak Voruh), approximately on the distance of 6 km upstream the watercourse from the state border with Kyrgyzstan. The observation post of "Tajikhydromet" was established in 1926 for observation over the hydrological regime, observation over the water level, measuring the water temperature, measuring the flow rate, measuring solid discharges and taking samples for determining water silt content, taking samples for chemical analysis. The transboundary water distribution is carried out based on the data received on this station. The water sample is complex, two sub-samples are selected from the right and from the left bank, from the surface. Then the general mixed sample is prepared which is then delivered to the laboratory for doing analysis. Selection of samples (12 samples per year) for the chemical analysis was renewed in 2015. There are analyzed physical qualities of water, temperature, oxygenic regime, acidification regime and general organic contamination, salt composition, biogens and some non-organic microelements (metals).

SYR-DARYA RIVER (THE MAIN COURSE)

It is formed by junction of rivers Naryn and Karadarya in the eastern part of Fergana valley. The length of river - 2212 km, the area of the Syr-darya basin - 219 000 km^2, the average flow rate - 703 m^3/s. Previously Syr-darya fell into the Aral sea, but now, because of the catastrophic recession of the water level and breakup of the sea into 2 parts (in 1989), river falls into the northern part of the sea (so-called "Small sea"). It flows on the territory of Uzbekistan, Tajikistan and Kazakhstan.

The monitoring of the water quality on the main course of Syr-darya river on the territory of Tajikistan is done by «Tajikhydromet» on two observation posts.

The first observation post is located approximately in 10 km upstream of river flow from the state border with the Republic of Uzbekistan and is joined with the stream gauge Kzylkishlak (the village Kzylkishlak). The observation post was organized in 1953 for doing hydrometric measurements (hydrological regime, water level, measuring of the water temperature, measuring the flow rate, measuring solid discharges and taking samples for identifying the water turbidity, taking samples for the chemical analysis). The water sample is complex, 2 subsamples are selected from the surface from the right and from the left bank. Then on the spot the general mixed sample is prepared and then delivered to the laboratory for doing analysis. Physical properties of the water, temperature, oxygenic regime and the general organic contamination, acidification conditions, salt content and biogens are analyzed. Up to 1990 analyses of non-organic microelements were done, but now these parameters are not studied because of lack of the instrumental basis. Selection of samples is done every month.

The second observation post over the water quality is located on the stream gauge Akjar near the village Kalam, approximately on the distance of 149 km upstream the water course from the state border with Uzbekistan. It is a transboundary post because the state border between Tajikistan and Uzbekistan runs by the watercourse of river. The right bank of river belongs to Tajikistan and the left bank - to

Uzbekistan. The observation post is functioning since 1953. The water sample is complex, 2 sub samples are taken from the surface from the right and from the left bank, then on the spot the general mixed sample is prepared and then delivered to the laboratory for doing analysis. There physical qualities of water, temperature, oxygenic regime and general organic contamination, salt composition, biogens and some non-organic microelements (metals) are analyzed. Selection of samples is done on the monthly basis.

On the territory of Kazakhstan there are posts for observation over the water quality. Monitoring is done by "Kazhydromet" (branch office for the South-Kazakhstan region). The observation post over the water quality is joined with the stream gauge Kokbulak on the border with Uzbekistan. Observations are done since 1987. It is functioning till present. The wide spectrum of parameters is analyzed in water samples, including organoleptical and physical-chemical qualities, mineralization and main ions, biogens and metals, toxic and poisonous substances, organic pollutants. Since 2017 once a year in August water samples for pesticides analysis are sent to the laboratory of the branch office on the North-Kazakhstan region. Radionuclides and microelements are analyzed in the institute of Nuclear Physics under the Ministry of Energy. 14 water samples are selected per year.

The second post for observation of the water quality is located near the town Shardara, 2 km downstream the dam of the water storage basin Shardara in the section line of the gauging station. This water reservoir regulates the outflow of Syr-darya river and is located near the state border with Uzbekistan.

In **Uzbekistan** two «Uzhydromet» points for the water quality control on the main course of river are functioning. The first one is located upstream of the town Bekabad, and downstream of Shirinsay river mouth. The observation post was organized in 1937 for receiving the hydrochemical information about the water quality in the region of Bekabad city with the organized discharge of wastewaters. It has been providing the hydrological information since 1948. The second observation post is located downstream the mouth of the drainage collector for taking control over the impact of drainage irrigation waters on the quality of water in the receiving watercourse. It is joined with the gauging station of the Ministry of Agriculture and Water Resources. 12 water samples per year are selected on each of points. Temperature and physical qualities of water, oxygenic conditions, mineralization and salt composition, biogens, heavy metals, oil products, SSAS , phenols and organochlorine pesticides are analyzed.

2.2.3. OBSERVATION NETWORKS OVER THE QUALITY OF SURFACE WATERS IN THE BASIN OF THE RIVER SYSTEM CHU(SHU) – TALAS – ASI(ASSA)

CHU (SHU) RIVER

Chu (Shu) river originates in glaciers of Teskey-Ala-Too and Kyrgyz mountain range. In the beginning river flows on mountainous regions of Kyrgyzstan, further it flows on Chui valley and forms a border between Kyrgyzstan and Kazakhstan and finally is gets lost in sands of Moyinkum desert in the South Kazakhstan. The length of river - 1186 km. The area of the basin watershed - 67 500 km^2. The average annual flow rate at the time of outflow from mountains – about 130 m^3/s. The length of river on the territory of Kyrgyzstan – 386 km, on the territory of Kazakhstan – 800 km.

On the territory of Kyrgyzstan there are 9 observation posts located along the main watercourse of Chu river. The control over the water quality is carried out by "Kyrgyzhydromet". The monitoring program is unified on all monitoring points. Organoleptical and physical qualities of the water, temperature and oxygenic conditions, general organic contamination, mineralization and salt content, biogens, contamination substances of non-

organic origin are analyzed.

Up to 2016 the monitoring program included salts of heavy metals, oil products, phenols and SSAS. Currently they are not monitored because of the lack of the instrumental basis and because of obsolete methodologies. Organic micro pollutants (pesticides, polyaromatics) are not analyzed because of the lack of the instrumental basis. Selection of water samples is done in accordance with observation program 4 times a year, taking into consideration hydrological phases.

The first observation post is located near the Burulday bridge, approximately on the distance of 1079 km from river mouth. The post was opened in 2008 for determining the background state of the water quality in Chu river on the territory not exposed to direct anthropogenic impacts.

The second and third monitoring posts are located upstream and downstream of the town Tokmak for monitoring the impact of the organized discharge of waste waters from the town. Both points are functioning since 1966.

The fourth and fifth posts for monitoring the quality of water have been established near the village Mylianfan, upstream and downstream of the drainage collector entrance for monitoring of the organized discharge of waste waters from the Kant industrial hub. Both points are functioning since 1966. Up to 1992 the section line was joined with the stream gauge, but the stream gauge is not functioning now.

The sixth and seventh posts for the water quality monitoring have been designed for keeping track of the impact of organized discharge of waste waters from treatment facilities in Bishkek city on the quality of water. Posts for monitoring of the water quality have been located upstream and downstream of the place of waste waters discharge from canalization system of Bishkek city. They have been functioning since 1966.

The eighth and the ninth posts are interconnected with the place of waste waters discharge from the Novotroitsk collector. The posts are located downstream and upstream of the place of waste waters discharge near the village Nizhne-Chuisk. They have been functioning since 1966. Up to 1992 the section line downstream the village was joined with the hydrological post, but now the hydrological post is not functioning.

On the territory of **Kazakhstan** the monitoring over the quality of water in river Shu is done by «Kazhydromet» branch office of Zhambyl oblast (province). The observation post, transboundary with Kyrgyzstan, for monitoring of the water quality in river was organized near the village Blagoveshenskoye (Kainar) – on the distance of 846 km from the mouth of river. The hydrological measurements are done. Observations have been done since 1981. It has been functioning up to present. During the last 5 years up to 6 samples are selected per year.

RIVER TALAS

Talas is river flowing on the territory of Kyrgyzstan and Kazakhstan. The length of river — 661 km, the area of its drainage basin - 52 700 km^2. It originates from glaciers of the Talas mountain range on the territory of Kyrgyzstan. In the lower course river is lost in Moyinkum sands. On the territory of Kyrgyzstan the length of river is about 200 km, on the territory of Kazakhstan – more than 450 km.

Since 1992, the monitoring of the water quality in **Kyrgyzstan**, because of limited budget financial capacity, is not carried out on the regular basis.

In **Kazakhstan** the transboundary (with Kyrgyzstan) post for monitoring of the water quality in river was established near the village Zhasorken (458 km from the mouth of river). Hydrological measurements are done. Observations are done since 2008. The post for monitoring of the water quality of «Kazhydromet» branch office in Zhambyl oblast has been functioning till present. During the last 5 years up to 36 samples are selected in a year.

RIVER ASY (ASSA)

River Asy (Assa) belongs to the class of transboundary rivers of Central Asia. It is formed by the confluence of rivers Teris (Ters) и Kurkireusu (Kukureusu) on the border of Kyrgyzstan and Kazakhstan. It is considered to be the left tributary of river Talas, though the mouth of river is lost in sands westward of river Talas. The water drainage area is about 9 thousand km^2. The average annual flow rate (near the aul Akkol) is 4,45 m^3/s.

Monitoring of the water quality is not done in **Kyrgyzstan**.

On the territory of **Kazakhstan** the transboundary with Kyrgyzstan post for monitoring of the water quality of in river, has been organized near the railway station Maymak (on the distance of 254 km from the mouth of river). The observation post of «Kazhydromet» branch office on Zhambyl oblast is designed for getting information about the water in the area of irrigated farming. Hydrological measurements are done. Observations have been conducted since 2008. It is functioning until present. During the last five years up to 12 samples per year are selected.

2.2.4. ANALYSIS OF MONITORING NETWORKS ON TRANSBOUNDARY WATER COURSES

Here the brief analysis of monitoring networks on basic transboundary rivers in CA region is given. The table 1 provides the summary information about points for monitoring of the water quality.

TABLE 1

OBSERVATION POINTS ON TRANSBOUNDARY WATER COURSES IN THE REGION OF CENTRAL ASIA

TRANSBOUNDARY WATER COURSE	COUNTRIES	THE NUMBER OF POINTS FOR THE WATER QUALITY MONITORING	POINTS PER THE RIVER KILOMETER, KM	FROM THEM, THE ACTIVE ONES (THE NUMBER OF SAMPLES PER YEAR, 2012-2016)
THE BASIN OF THE RIVER AMUDARIYA				
Kyzylsu-Vahsh	Kyrgyzstan	0	117	-
	Tajikistan	2		1 (1-9)
Kafirnigan	Tajikistan	1	387	0
	Uzbekistan	0		-
Karatag-Surkhandarya	Tajikistan	1	144	1 (3-12)
	Uzbekistan	1		1 (11-12)
Zeravshan	Tajikistan	1	877	0
	Uzbekistan	0		-
Amudariya (the main course)	Tajikistan	1	202	1 (1-2)
	Uzbekistan	3		3 (3-12)
	Turkmenistan	3		2 (4)

TRANSBOUNDARY WATER COURSE	COUNTRIES	THE NUMBER OF POINTS FOR THE WATER QUALITY MONITORING	POINTS PER THE RIVER KILOMETER, KM	FROM THEM, THE ACTIVE ONES (THE NUMBER OF SAMPLES PER YEAR, 2012-2016)
THE BASIN OF THE RIVER SYRDARIYA				
Naryn	Kyrgyzstan	0	807	-
	Uzbekistan	1		1 (5-8)
Karadarya	Kyrgyzstan	0	180	-
	Uzbekistan	1		1 (12)
Keles	Kazakhstan	1	241	1 (12)
	Uzbekistan	0		-
Isfara	Kyrgyzstan	0	107	-
	Tajikistan	1		1 (12)
	Uzbekistan	0		-
Syrdariya (the main course)	Uzbekistan	2	442	2 (12)
	Tajikistan	2		2 (12)
	Kazakhstan	1		1 (14)
THE BASIN OF THE RIVER CHU-TALAS-ASY				
Chu (Shu)	Kyrgyzstan	9	119	9 (4)
	Kazakhstan	1		1 (36)
Talas	Kyrgyzstan	0	661	-
	Kazakhstan	1		1 (36)
Asy (Assa)	Kyrgyzstan	0	253	-
	Kazakhstan	1		1 (12)

As it is seen from the table, all main transboundary watercourses in the CA region are studied for the water quality. But as a rule (on 9 from 13 transboundary watercourses) the control of the water quality in the watercourse is carried out only by one of bordering countries, while another country (countries) don't have the necessary information about the water quality, because the monitoring is not carried out on their territory. We can speak about the transboundary character of monitoring in the region of CA only on four rivers (Karatag-Surkhandarya, Amudariya, Syrdariya and Chu (Shu)), where monitoring is carried out in all countries of river basin.

As a whole it is typical for the region that there is not much observation points for monitoring of the quality of transboundary rivers. On the majority of rivers one observation point falls per 200-800 km of river course.

Moreover, the periodicity of taking water samples depends on possibilities of this or that country to implement national monitoring programs and it varies very significantly. Not all observation posts in the region can be determined as effective, because some of them provide information fragmentarily, with the low periodicity and by the limited spectrum of quality parameters.

Further a brief summarized analysis on CA countries in the context of monitoring of transboundary watercourses is given.

In **Kazakhstan** all basic transboundary water courses are covered by monitoring that is carried out by 2 oblast branch offices of «Kazhydromet» by Jambyl and South Kazakhstan oblast. There is at least 1 point for the water quality monitoring on each of rivers. All posts are active, every year prom 12 up to 36 samples are selected on them. The wide spectrum of contaminants and quality parameters is analyzed, including organoleptic and physical and chemical qualities, mineralization and main ions, biogens and metals, toxic and poisonous substances,

organic contaminants by the standardized scheme. On some points pesticides are studied (once a year), as well radionuclides and micro-macro elements in the water (2 times a year).

Apart from «Kazhydromet», the monitoring of surface waters quality in the region is carried out by territorial subdivisions of the Committee of Ecological Regulation and Control by Jhambyl and South Kazakhstan oblastsoblastunder the Ministry of Energy. This agency is engaged in selection and analysis of water samples as and when necessary (in accordance with the internal plan of territorial subdivisions, in case of occurrence of high and extremely high contaminations in surface waters they carry out selection of water samples jointly with concerned state authorities in the sphere of the environmental protection).

In addition, the Sanitary and Epidemiological Service of the Ministry of Health carries out monitoring on objects of centralized and non-centralized systems of drinking and utility-drinking water supply and in places of cultural and domestic water consumption. The epidemiological safety of drinking water is determined by compliance with microbiological and parasitological indicators of the drinking water quality. Based on carried out analysis the sanitary and epidemiological characteristics of the concrete water supply source by microbiological indicators and by the chemical composition is prepared.

In K**yrgyzstan** the water quality monitoring is carried out by «Kyrgyzhydromet» only in the basin of Chu river. On this transboundary watercourse and its basin a well-planned and developed network of observation posts is functioning mainly since 1966. All posts are active, selection of samples is done on the quarterly basis. At the same time other transboundary rivers are not covered by the quality monitoring due to different reasons. One of reasons is absence of the laboratory in Osh that previously supplemented the research program of the central laboratory in Bishkek. The analytical programs on all posts have been unified. Organoleptic and physical qualities of water, temperature and oxygenic conditions, the general organic contamination, mineralization and salt content, biogens are analyzed. Because of the lack of instrumental basis such important parameters as metals, oil products, phenols, SSAS and pesticides are not included into the monitoring program. The laboratory building of the in Bishkek city is not in good technical conditions and construction of a new building is needed.

Apart from «Kyrgyzhydromet», the monitoring on Chu river is carried out by the State Agency of Protection of Environment and Forestry (SAEPF) on 6 section lines by 17 indicators including heavy metals. The SAEPF program is aimed at monitoring of the impact of sources of pollution on water resources quality, but currently it is carried out only on Chu river.

In addition, the Department of diseases prevention and of the State sanitary and epidemiological inspectorate of the Ministry of Health keeps control over the water quality on drinking water intake structures.

In **Tajikistan** all basic transboundary watercourses are covered by «Tajikhydromet» water quality monitoring system. Its structure includes 3 laboratories in Dushanbe, Kairakkum and Kurgan-Tube (the latter is not working because of the lack of relevant instruments and specialists). The laboratory for surface waters and radiation level monitoring is located in Dushanbe (the central laboratory). Its building was constructed in 30-s of the last century and now it is in a dilapidated condition. The laboratory in Kairakkum serves the basin of Syrdariya river and determines the water quality by 23 parameters. There are difficulties with instruments and with the laboratory equipment. The instruments and equipment currently available have mainly depleted their resources. There are no spare parts for their restoration and repairs. Because of insufficient funds the new equipment is not delivered and purchased.

Because of the listed above limitations, over the last years, the intensity of observations on the majority of transboundary rivers has reduced and on some rivers observations are not done. Thus, from 9 observation points only 6 were more or less active during the last years. At that, on some posts 1-3 samples are selected every year that is obviously insufficient for receiving the reliable information about the watercourse quality. Among others complications occur because of difficulties with samples transportation of and absence of regional laboratories. The list of analyzed parameters also differs very much on different control posts. On remote posts the first day analysis is not done and as a whole the observation program is quite limited (temperature, some physical qualities of water).

On some posts physical qualities of water, temperature, oxygenic regime and general organic contamination, acidification conditions, the salt content (salinity), biogens are analyzed. Laboratories have difficulties because of the lack of modern laboratory basis, chemical reagents, qualified personnel.

Apart from «Tajikhydromet», the control of safety parameters of drinking water and monitoring of the water quality in centralized and non-centralized water supply systems is carried out by the State Sanitary and Epidemiological Inspectorate. Laboratories in Dushanbe, Khujand, Kurgan-Tube, Kulyab and GBAO periodically do analysis of drinking water samples and of the water for swimming in basins with determination of physical and chemical, virusological ad bacteriological indicators. Because of the financial and personnel problems, not more than 60% of control objects are covered.

In **Turkmenistan**, on the main transboundary watercourse – Amudariya river, three monitoring posts provide information about the water quality. The monitoring is carried out by the Ecological Control Service of the State Committee on Protection of the Environment and Land Resources, because «Turkmenhydromet» is engaged only in hydrological measurements. The monitoring program is unified. Physical and chemical parameters of water, temperature conditions, oxygenic conditions and general organic contamination, mineralization and salt content, biogenic elements are analyzed. On some posts oil products and SSAS are analyzed. Because of the lack of necessary material and of the instrumental basis, heavy metals and non-organic micro contaminants are not analyzed.

In **Uzbekistan** the monitoring of the quality of water in main transboundary rivers is carried out by the Centre of hydrometeorological service under the Ministry of Emergency - «Uzhydromet». Currently, not all large transboundary watercourses are covered by the monitoring network. From 8 observation points on transboundary rivers 3 posts have been established on river Amudariya and 2 posts - on the Syr-darya river. Water samples are selected as scheduled and their number depends on the category of this or that observation point. Water samples are analyzed by standardized list of quality parameters, including temperature and physical qualities of water, oxygenic conditions, mineralization and salt content, biogens and heavy metals, oil products, SSAS, phenols. On some posts, organochlorine pesticides are also analysed.

CHAPTER 2.3.
WATER RESOURCES QUALITY MONITORING SYSTEMS: NEEDS ASSESMENT

THE PURPOSE OF THIS CHAPTER IS TO CLARIFY THE CURRENT SITUATION ON DIFFERENT ASPECTS OF SURFACE WATERS QUALITY MONITORING, REVEALING DIFFICULTIES, PROBLEMS, LIMITATIONS AND DETERMINING NEEDS FOR IMPROVEMENT. THIS SURVEY COVERS BASIC ASPECTS OF SURFACE WATERS QUALITY MONITORING IN CA COUNTRIES, INCLUDING:

- Planning of monitoring programs;
- The water quality indicators being monitored;
- Procedures of samples selection, conservation and transportation ;
- Assessment of the waters quality of and their classification;
- Capacity of laboratories (instrumental, methodological, personnel);
- The system of the data storage and processing, analysis and distribution of the information;
- Procedures of the control and quality assurance, accreditation of laboratories;
- Using information about the quality of surface waters in making decisions on water resources management;
- Hydrobiological monitoring and control over pollution of bedload sediments.

In this chapter the emphasis was placed on hydrometeorological services of Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, engaged in primary monitoring of water resources quality in their own countries and on transboundary rivers. In Turkmenistan the hydrometeorological service carries out only hydrological monitoring and is not engaged in issues of surface waters quality. Needs for this country are studied by the Environmental Control Service (ECS) of the State Committee on Protection of the Environment and Land Resources.

In addition to the analysis of problems, bottlenecks, complications and recommendations on different issues of water resources quality monitoring set forth in national reports, this chapter provides the summarized analysis of bottlenecks typical for the region. Here also recommendations of a regional midterm character on overcoming these bottlenecks are given.

2.3.1. MONITORING PROGRAMS (PLANNING)

CURRENT SITUATION:

Development of monitoring programs is the most important element of activities of organizations and agencies engaged in monitoring of water resources quality. Approved monitoring programs are the basis for carrying out studies on water resources quality. In the system of hydrometeorological services in CA countries, a certain and quite similar practice of planning observations over surface water resources quality has been formed.

Monitoring programs are developed directly by departments responsible for carrying out such monitoring. After that, the program is submitted to higher instances for approval. Thus in Kazakhstan, the program is approved by the governing body of «Kazhydromet» after coordination with the supervising Department of Environmental Monitoring and Information of the Ministry of Energy; in Kyrgyzstan the monitoring program is approved by the Chief of the «Kyrgyzhydromet» Department of observations over pollution of the natural environment; in Tajikistan – by the Director of the Agency on Hydrometeorology, in Turkmenistan – by the State Committee on Protection of the Environment and Land Resources.

The current practice shows that monitoring programs as a rule are developed and approved within one agency. It is typical not only for

hydrometeorological services, but also for other agencies (ecological, sanitary-epidemiological, aquicultural) that carry out monitoring of the water quality by their own departmental programs. Currently such situation is defined by the national legislation of CA countries. This legislation does not stipulate for the obvious need for the interdepartmental coordination. At the same time in Uzbekistan there has been established and is functioning the system of the State monitoring of the environment and the draft of the monitoring program is coordinated with all Ministries engaged in its implementation.

Monitoring programs of hydrometeorological services are developed as a rule for one year (Kazakhstan, Tajikistan, Turkmenistan). In Kyrgyzstan and Uzbekistan programs on monitoring of surface waters quality are oriented for the midterm period – for 5 years with possible corrections on the annual basis. It should be noted that the time interval for planning the water resources monitoring is a very important parameter. The international experience shows that the state monitoring network should be planned in the midterm perspective and correlated with water bodies management plans. Thus, for example, in countries of Euro Union the planning period is determined as 6 years - the period defined by the law for realization of the basin management plan.

MONITORING PROGRAMS IN ALL CA COUNTRIES AS A WHOLE ARE BUILT ON IDENTICAL PRINCIPLES, THOUGH AT PLANNING DIFFERENT NORMATIVE DOCUMENTS ARE USED:

- Thus, in Kazakhstan both soviet standards are used (GOST /State All-Union standard/) 17.1.3.07-82 «Nature protection. Hydrosphere. Rules of of the water quality monitoring in water reservoirs and water courses»; GOST 17.1.1.02-77 «Water bodies classification»), and also national documents («Methodical instructions on organization and functioning of the subsystem on monitoring of transboundary surface waters state in Kazakhstan»; «Environmental monitoring rules», «Methodical recommendations on carrying out complex examinations and assessment of natural environment contamination in districts exposed to the intensive anthropogenic impact», PR of the RK 52.5.06-03.).
- In Kyrgyzstan principles of monitoring programs planning are based on regulations 52.24.309-92 «Methodical instructions. Nature protection. Hydrosphere. Organization and carrying out regime observation over contamination of surface ground waters on the network» and on the GOST regulations 17.1.3.07-82 «Nature protection. Hydrosphere. Rules of water quality monitoring in water reservoirs and water courses».
- In Tajikistan planning is based on the document «Instruction to hydrometeostations and posts, issue 6, part 1».

Despite of that at planning of monitoring programs in CA countries different normative and legal acts are used, it should be specially noted that the normative base that currently serves as a basis for planning monitoring in CA countries, is mainly based on soviet standards established 25-35 ago. As a rule, a principle of “categorization” of observation posts (4 categories) and observation programs (full or shortened) is used.

Despite of that at development of new plans of state monitoring systems the experience of previous years is certainly taken into account. As a whole monitoring programs remain quite conservative, based on previous programs or are developed “by inertia”, and not “proactively”. As a rule, the program is developed on the basis of previous programs with the purpose to preserve a number of observations and more rarely - with consideration of emerging realities.

Monitoring programs in CA countries as a rule include the following standard information – purposes of monitoring, periodicity of observations, hydrochemical posts, list of parameters to be measured and analyzed, the time for selection of samples, the place of samples selection, analyses methods. At the same time, such needs of monitoring systems, like regular procedures of the quality control and provision of the data quality, as well as scheduled calibration, changeover and modernization of the equipment, conducting intercalibration and comparative tests, regular renewal of reagents, standards, expendable materials with expired period of validity, changing of the analytical determination method, carrying out scheduled training of the personnel and advanced training of employees, introduction of new software

for processing and interpretation of data, accreditation of laboratories and methods, etc., are not included into the monitoring programs or are taken into account with few exceptions.

These expenditure items are usually included into the departmental yearly plans and are requested whenever necessary also through other budget lines, but as a rule they remain underfinanced or are simply ignored because of the lack of financial resources, allocated to hydrometeorogical services. As a result, the quality of information about the hydrochemical state of water resources delivered by hydrometeorogical services (by spectrum of parameters being analyzed and by researches periodicity) of , , is falling down. The instrumentation pool becomes physically worn down and morally obsolete. New methods of analytical control and new program products are not duly introduced, laboratories cannot purchase necessary components.

As a whole, monitoring programs of hydrometeorological services in CA countries are developed by the principle "as possible" and not by the principle "as necessary". «Kazhydromet" can be an exclusion. It has 15 branch offices in each of oblasts and also in Almaty and Astana cities. At present «Kazhydromet» has 307 hydrological posts, where water samples for the chemical analysis are selected, calculations of the water balance for river and lakes are done and hydrochemical analysis for more than 17 types of contaminating elements is done in laboratory conditions. Of course, it does not mean that the system of monitoring planning in this country does not require improvement, but as a whole, it looks like the most successful.

To some extent this situation is also good in Uzbekistan, where the monitoring program includes 53 parameters of the water quality and currently 84 posts for the water quality monitoring are functioning (from 134 points that were functioning before).

For remaining national hydrometeorological services of CA countries significant changes and adequate financing is required for implementation of water resources quality monitoring programs.

Thus, for example, in Kyrgyzstan the "Kyrgyzhydromet" monitoring program covers only basin of Chu river (23 section lines, 3 of them are located on the main river course; 27 indicators are analyzed). On other watercourses, including those of the international importance, the quality control is not carried out because of the insufficient financing. Previously, up to 1992 in this country observations over the surface waters quality were carried out on 54 water bodies (80 posts), among others - on transboundary rivers Naryn, Karadarya, Chu, Talas. Thirty eight parameters were analyzed.

In Tajikistan, currently even approved monitoring programs of «Tajikhydromet» in fact are being implemented only by 40-50%. Previously in the country 92 posts for samples selection were functioning and the research program covered 41 parameters of the water quality.

In Turkmenistan, the situation is much the same and the program of ECS activities is not realized to the full extend, because of the general underfinancing of services engaged in water bodies quality monitoring.

ANALYSIS AND DETERMINATION OF BASIC NEED FOR IMPROVEMENT OF THE SITUATION:

THE SPHERE WHERE IMPROVEMENTS ARE REQUIRED	EXPLICATION
Preominating of the departmental approach in planning systems of observation over the quality of natural resources; lack of the due coordination between agencies	In CA countries, to this or that extent in the water resources management the IWRM principles are applied, but in the context of planning the monitoring of surface waters quality they are not still duly applied in practice. Partially it is related to that targets and objectives of water resources quality monitoring carried out by hydrometeorological services, in the national legislation in regulations of such services are determined only in general terms. With the lack of specific plans and objectives of management of water bodies quality, water resources region and river basins, it is difficult to expect the adapted planning of monitoring systems oriented at concrete targets – for example, for confirmation / establishment of the target class of water reservoir quality or monitoring of the effectiveness of applied measures on reaching target objectives on the

	quality of this or that water reservoir. It is possible to overcome departmental barriers only with the major review of national water policies. More clear and concrete tasks should be assigned to agencies in the context of water resources quality monitoring.
Underfinancing of works on carrying out monitoring of water resources quality.	General funding shortages of monitoring programs in the number of CA countries (Kyrgyzstan, Tajikistan, Turkmenistan) is currently the main factor constraining the adequate planning of monitoring programs and receiving solid and reliable data about the quality of surface water bodies.
Related conditions for carrying out monitoring are considered as marginal tasks and are not a part of the process of providing effectiveness of efforts of services on observation of the quality of waters.	Currently in the majority of CA courtiers, the important operational needs of laboratories, such as a need of the equipment reolacement, procedures of the quality assurance, the need of laboratories intercalibration, professional development programs, etc., are not included into monitoring programs. These needs are often satisfied "whenever possible" also from other articles of the departmental budget, though just they are the prerequisite for the qualitative implementation of monitoring programs. In view of this, it is recommended to reconsider development of monitoring programs for the midterm period and include into programs also the issue of financing of all necessary elements (personnel training, quality control, equipment replacement, purchasing expendable materials, etc.). It will allow to realize monitoring programs reliably.

ON THE REGIONAL LEVEL, FOR SYNCHRONIZATION OF COUNTRIES' EFFORTS ON THIS ISSUE IT IS RECOMMENDED:

- To carry out analysis of the national legislation, by-laws, Services' rules and regulations and of the regulatory framework related to surface waters quality monitoring with the purpose to set more clear and exact tasks for surface waters monitoring, division of agencies' functions and improvement of coordination of their activities on water bodies quality monitoring.
- To develop the regional guidance manual on monitoring programs planning in the IWRM context of.
- To realize the pilot project on the design of monitoring networks and monitoring programs in the context of target oriented and basin principles.
- To organize training courses on issues of monitoring systems and programs planning.
- To revise existing national monitoring networks and programs on transboundary watercourses and to suggest ways of regional harmonization of surface transboundary rivers quality monitoring systems.

2.3.2. INDICATORS OF SURFACE WATERS QUALITY (THE LIST OF ANALYZED PARAMETERS)

THE CURRENT SITUATION:

Today analytical laboratories of Hydro-meteorological Services of CA countries are able to analyze a certain list of parameters of the water environment quality. Basically, the spectrum of studied parameters depends on the technical and staff capacities of analytical laboratories and of their financing terms.

Thus, capacities of «Kazhydromet» allow to monitor bout 70 parameters of the water quality. Usually «Kazhydromet» branch offices by their own forces carry out assessment of the quality of surface waters on 47-49 physical and chemical indicators, including the temperature, suspended substances, coloration, transparency, pH, dissolved oxygen, standard biochemical oxygen demand, mineralization, chemical oxygen demand, main elements of the salt composition, biogenic elements and main polluting substance: oil products, phenols, heavy metals, pesticides and others.

The central laboratory of «Uzhydromet» in Tashkent can analyze a significant spectrum of ingredients (up to 53 parameters of the water quality), including heavy metals and organochlorine pesticides. However, the laboratory in Fergana does monitoring of the water quality by the reduced list.

In other countries of the region, the spectrum of studied parameters is significantly low. So, currently, the monitoring program of «Kyrgyzhydromet» includes 27 indicators, though previously the monitoring program included 33 parameters. Because of the obsolete methodology and shortage of instruments and equipment in laboratories, the spectrum of observed parameters has reduced. The monitoring of surface waters carried out by «Tajikhydromet» and ECS in Turkmenistan today is limited by 20 and 26 parameters accordingly. Currently in these countries laboratories study the quality of water resources by those parameters which they can do, but not by the real need. As a rule, for all monitoring posts the standard list of parameters is established.

Annex 3 gives lists of main indicators of surface waters quality currently analyzed on transboundary watercourses in each of countries. The spectrum of analyzed water quality parameters is different for countries, but a number of parameters is analyzed in all countries. These are suspended matters, transparency, hardness, temperature, pH of water. Also all countries do analysis of the salt composition of water and determine the general mineralization. All countries of the region determine the nitro-group (nitrates, nitrites, ammonium) and general content of nitrogen (except for «Tajikhydromet» and «Uzhydromet») by the content of biogens in the water. Orthophosphates are monitored by all hydrometeorological services, except for ECS in Turkmenistan.

In «Tajikhydromet» such important parameters as dissolved oxygen, the biological oxygen demand (BOD) and chemical oxygen demand (COD), are not determined. In «Kyrgyzhydromet» the COD is not determined. As to the group of non-organic micro contaminants and heavy metals, monitoring programs by these parameters in different countries considerably vary very much. Only total iron content is analyzed in all laboratories. In «Kazhydromet» the large spectrum of metal salts is monitored and in «Uzhydromet» the list of analyzed metals is less. «Kyrgyzhydromet» has capacity to analyze only chrome[5] content and «Tajikhydromet» can analyze only the aluminum content in the water. In Turkmenistan analysis of this group of contaminants is not done. Kyrgyzhydromet» and «Tajikhydromet» because of the lack of necessary instrumentation does not carry out analysis of oil products, phenols and SSAS«.

Currently the content of pesticides in the water can be determined only by «Uzhydromet» (the organochlorine line) and by «Kazhydromet». Other countries do not have instruments and methods for doing such analyses.

[5] In Kyrgyzstan, the SAEPF laboratory, equipped by modern equipment, is able to determine the presence of heavy metals and other polluting substances.

FOR DEVELOPMENT OF THE MONITORING PROGRAM AND SELECTION OF PARAMETERS BY WHICH IT IS NECESSARY TO MONITOR THE NATURAL SURFACE WATERS QUALITY IN CA COURTIERS, DIFFERENT NORMATIVE ACTS ARE USED.

- So «Kazhydromet» builds on the GOST 17.1.3.07-82. «Nature protection. Hydrosphere. Rules for water quality monitoring in water reservoirs and watercourses».
- In «Kyrgyzhydromet» the list of determined indicators has been established in accordance with the monitoring program based on the DD (Directive document) 52.24.309-92 «Methodical instructions. Nature protection. Hydrosphere. Organization and carrying out monitoring observations over pollution of surface ground waters on the network» and on the GOST 17.1.3.07-82 «Nature protection. Hydrosphere. Rules for the water quality monitoring in water reservoirs and watercourses».
- In «Tajikhydromet» - the Semenov's manual on determination of chemical elements in composition of water is used.

Sometimes it becomes necessary to review indicators included into the monitoring programs mainly for reducing the spectrum of controlled parameters of water resources quality because of the lack of necessary instrumentation pool, break-down of old instruments, lack of modern methodology, etc. And only in «Kazhydromet», during the last years, a tendency on increasing the spectrum of analytical capacities of laboratories is observed.

Thus, in Turkmenistan parameters of the water quality monitoring have not been reviewed for many years, though every year the State Committee of Turkmenistan on the Environment Protection and Land Resources approves «Turkmenhydromet»'s monitoring program of. In Tajikistan, the list of controlled parameters sometimes is changed, depending on the necessity and real capacity of laboratories and also because of changing of economic activities on the water catchment area or in case of emergencies. In Kyrgyzstan, only the Republican state organ on protection of the environment (SAEPF) has a prerogative for formation of requirements to water quality parameters , but no serious revision of quality standards was done. In Uzbekistan revision of the water quality parameters was not done either, they were approved still by soviet methodologies. At the same time in Kazakhstan within the legislative-normative frames, the list of controlled indicators of of surface waters quality was reviewed and the normative document "The unified system of water quality classification on water bodies" was developed and approved. The list of "priority substances" recommended for Kazakhstan (based on the EU Water Framework Directive) has to be discussed, coordinated and approved in the established order.

ANALYSIS AND DETERMINATION OF BASIC NEEDS FOR IMPROVEMENT OF THE SITUATION:

THE SPHERE WHERE IMPROVEMENT IS REQUIRED	EXPLICATION
Dependence of the spectrum of analyzed parameters of the water quality on material and technical capacities of laboratories, but not on the real need to get information about the quality of water in water bodies for making managerial decisions.	Currently in CA countries, laboratories take control over the quality of water bodies mainly by standardized list of parameters determined in monitoring programs, which in term depends on the material-technical and financial support of laboratories. It means that on all monitoring points mainly the same parameters are analyzed. However, the practice of real situations on water reservoirs shows that it is not always justified. So, for example, if the state of the water body, mainly used for the drinking water supply, is assessed then the long-term study of hardly varying salt composition may be not so critical and monitoring of toxic contaminants, just on the contrary, may be very important. Differentiation of observation posts and of the spectrum of analyzed parameters on these posts will allow to optimize efforts and to make monitoring prog-

rams more practical and more justified for making decisions on the management of water bodies quality. In the long view, it is recommended to differentiate monitoring programs on surveillance, operational and investigative monitoring programs (on the analogy with IRD – surveillance, operational and investigative monitoring). It means monitoring of different quality parameters with different periodicity and different duration of observations.

In view of this, it is important to consider the river basin from the point of view of its natural qualities and sources of potential substandard quality. National lists of contamination objects and characteristics of their impact on the quality of natural waters can become essential for planning monitoring programs and selection of control parameters for different observation points.

ON THE REGIONAL LEVEL FOR SYNCHRONIZATION OF COUNTRIES' EFFORTS ON THIS ISSUE IT IS RECOMMENDED:

- To develop the regional, methodological manual on differentiation of observation posts over water resources quality
- To implement the pilot project on optimization of water quality parameters for the monitoring.

2.3.3. SAMPLES SELECTION, METHODS AND EQUIPMENT FOR SAMPLES SELECTION, CONSERVATION AND TRANSPORTATION

THE CURRENT SITUATION:

PROCEDURES AND METHODS OF SAMPLES SELECTION, AS WELL AS METHODS OF THEIR CONSERVATION AND TRANSPORTATION HAVE BEEN STANDARDIZED IN HYDROMETEOROLOGICAL SERVICES OF CA COUNTRIES IN ACCORDANCE WITH THE FOLLOWING NORMATIVE DOCUMENTS:

- In Kazakhstan – by national standard ST RK GOST P 51592-2003 «General requirements to samples selection».
- In Kyrgyzstan – by GOST 31861-2012 "Water. General requirements to samples selection" and also in accordance with intra-departmental methodology of the department of observation over contamination of land surface waters.
- In Tajikistan – by «The manual on chemical analysis of the land surface waters»
- In Turkmenistan – by the DD 52.24.309-92 «Methodological instructions. Nature protection. Hydrosphere. Organization and carrying out monitoring observations over contamination of surface waters» and «Manual on performing chemical analysis of land surface waters».

Despite of application of different normative documents, as a whole, the samples selection of in all countries is performed in a similar way. Water samples for the chemical analysis, whenever possible, are selected on midstream of the water course and usually from the surface (0,1–0,3 m). Samples are selected either from riverside, or by entering into the water or from hydrological bridges (if hydrological and hydrochemical posts coincide). There are no special sample cans (sample containers), samples are taken with enameled or plastic buckets. Containers for transportation of samples and their conservation, for oxygen fixation are filled on the site.

If the necessary equipment is available, some parameters are measured directly on the place of samples selection (usually it is temperature, pH, and with availability of a conductometer

– the electrical conductivity). Expeditionary groups of «Kazhydromet» are the best equipped with express analysis instruments, though still it is needed to expand the list of express methods. The situation is worse in other countries. Thus «Kyrgyzhydromet» does not have a conductometer. And «Tajikhydromet» does not have express analysis instruments at all and it has serious difficulties with chemicals for conservation of samples and for oxygen fixation. In Turkmenistan, ECS laboratory is not equipped with instruments for measuring the water quality in field conditions. «Uzhydromet» does not have instruments for performing an express analysis.

Usually for transportation of samples the usual auto transport is used and only «Kazhydromet» has mobile specialized laboratories. Almost all expeditionary groups do not have cool chambers or they are in short supply.

Samples are selected directly by expeditionary groups (as a rule 2-3 persons) with necessary skills. Special training for samples selection groups on procedures of selection, conservation, transportation and analysis of samples in field conditions is usually conducted 1-2 times per year. In the majorly of cases it is a formal training rather than a training on standard procedures on samples selection.

Briefing on safety and health regulations for expeditionary groups is provided in accordance with national standards requirements for this category of work, both at hiring and also further - periodically (each quarter). In some organizations these training are combined with trainings on providing the first medical aid. Nevertheless expeditionary groups not always are adequately provided with means of personal and collective safety. Only in rare cases selection of samples is done in life-jackets.

ANALYSIS AND DETERMINING MAIN NEEDS FOR IMPROVEMENT:

THE SPHERE WHERE IMPROVEMENT IS REQUIRED	EXPLICATION
Insufficient equipping of expedition groups with express analysis instruments in the field conditions or a total absence of such instruments.	Such equipment is needed for determining some rapidly changing parameters of the water quality on-site. Moreover, analysis of some parameters of the water quality directly on the sampling site can provide a preliminary information about the water quality and will allow to expeditionary group to address a number of issues, for example, whether additional volumes of samples are needed or not. If such instruments are available, the expeditionary group being directly in the sampling site can first signal about a sharp deviation of the water quality and start procedures of warning about potentially dangerous contamination. Availability of such instruments is especially needed also for tracing the process of emergencies, when it is needed to fix rapidly the quality of water, at that at several points and in different periods of time.
Lack of specialized auto transport and scarcely ever acceptable conditions for transportation of samples	Currently in a number of CA countries expedition groups have available only usual auto transport mean. It does not allow to carry out express analysis duly, and doesn't guarantee delivery of samples for long distances without changing their physical and chemical composition. Safety of samples at their transportation is an important aspect. As a minimum, it is necessary to provide the temperature regime for conservation of samples till the moment of their delivery to laboratories. Observation of these terms is very important in the hot climate of the region and also for providing the reliability of results. Cool chambers in the necessary volume should be provided to expedition groups.
Insufficient maintaining of the professional qualification of specialist on samples selection	Maintaining the necessary qualification of expedition group members is an important task. Conducting regular practical trainings (tests) should become a mandatory procedure. The role of trainings will increase if expeditionary groups are provided by express analysis instruments. Also it is very important to provide a special training on selection of

	samples on the pollution content which is determined in microquantities (pesticides, polyaromatics, other high-toxic compounds), and also for prevention of cross-contamination of samples and containers for transportation.
The need to provide safety conditions at samples selection.	Improvement of the human life safety at samples selection is not only necessary, but also mandatory. Especially taking into consideration that many water quality observation posts are not maintained or cannot be maintained from the engineering point of view. In conditions of high-velocity flows, complex bottoms of water reservoirs, changing the bank line contours in time of different hydrological events, the maintenance of expedition groups is an important element. Expedition groups should not only be provided with necessary equipment (portable folding stairs, ropes, carabines, life-jackets, watertight suits, warning devices (signaling means), etc.) but they should also regularly pass practical tests and trainings, including on the first aid treatment.

ON THE REGIONAL LEVEL FOR SYNCHRONIZATION OF EFFORTS OF COUNTRIES ON THIS ISSUE, IT IS RECOMMENDED:

- To realize a regional project on increasing capacity of monitoring services on issues of sample selection, including development of the plan on fitting out expeditionary groups with necessary equipment and conducting trainings for expeditionary groups.
- To purchase necessary equipment and conduct trainings.
- To develop regional methodological manual on samples selection and on doing field measurements.

2.3.4. METHODS OF THE QUALITY ASSESSMENT AND SURFACE WATERS CLASSIFICATION

CURRENT SITUATION:

In all CA countries of the surface waters quality is assessed on the basis of the MPC system, developed still in the USSR. Soviet normative documents are still used.

- Thus in Kazakhstan «The generalized list of maximum permissible concentrations (MPC) of harmful substances in fishery water bodies (1990)» is used.
- In Kyrgyzstan in 2016 new national standards were adopted, such as «Rules on the surface water protection», where the list of MPC for fishery water bodies and hygienic standards are given: «Maximum permissible concentrations of chemical substances in the water of water bodies of household and cultural-social water use» and «Provisional permissible levels of chemical substances in the water of water bodies of household and cultural-social water use». However, adoption of these documents has not changed much in the system of quality waters assessments, as they have mainly duplicated old regulations and standards of the soviet period.
- In Tajikistan the quality of surface water is assessed in accordance with the DD 52.08.23-84 «Organization and carrying out monitoring observations over contamination of surface waters" and DD 52.24.309.92 «Manual on doing chemical analysis of land surface waters».
- In Turkmenistan assessment of surface waters quality is performed in accordance with DD 52.08.23-84 «Organization and carrying out monitoring observations over contamination of surface waters », DD 52.24.309.92 «Manual on performing chemical analysis of land surface waters», «Sanitary rules and norms for protection of surface waters from contamination» and the national standard SNT 2.09.04-09.
- In Uzbekistan for assessment of natural waters quality, the generalized list of MPC and approximately safe impact level (ASIL) of harmful substances for the water of fishery water bodies is used.

Currently in CA countries for interpretation of results of waters quality monitoring the value of real concentrations excess over MPC values and the number of cases of such excess for the certain period of time, (for example for a year) is used. MPC values for fishery water reservoirs that are currently applied in CA countries, are given in the annex 4.

In addition to the direct comparison of substances concentrations, determined in the water of natural water reservoirs, with individual standards for each of these substances (MPC in fisheries), in the CA region also integrated indicators are used that allow to give more generalized assessment of water conditions quality in water reservoirs. Thus in Kyrgyzstan, Turkmenistan and Uzbekistan the so-called Water Reservoir Pollution Index (WPI) is used. In Tajikistan WPI is not used in practice of water reservoirs quality assessment, though previously it was used.

WPI is a relative indicator of the water pollution characterized by the cumulative availability of largest concentration of 6 measured parameters, including dissolved oxygen and BOD. For presentation of waters quality as a unified assessment, the remaining 4 indicators are selected regardless of the LHI (Limiting Harmful Index). If concentrations are equal, the preference is given to substances that have toxicological criterion of harmfulness. Such system of classification allows to differentiate waters by 7 quality classes:

CLASS	CHARACTERISTICS OF THE CLASS	THE WPI VALUE
I	Very clean waters	0,3 and less
II	Clean waters	0,31-1,0
III	Moderately contaminated waters	1,1-2,5
IV	Contaminated waters	2,51-4,0
V	Dirty waters	4,1-6,0
VI	Very dirty waters	6,1-10,0
VII	Extremely dirty waters	More than 10,0

In contrast to other countries of the region that apply standards of the soviet period, in Kazakhstan over the last years the national system of complex assessment of the water quality was developed. It was finally fixed in 2012 in the document «Methodical recommendations on complex assessment of surface waters quality by hydrochemical indicators». It is also based on WPI principles, but it is suggested that it reflects the complexity of water conditions more adequately. For CWPI calculation, based on the homogeneity of ingredients being determined, substances are united into separate provisional groups: main ions, biogenic elements, heavy metals, poisonous substances, organic and chlor-organic compounds. CWPI is calculated separately by dissolved oxygen and biochemical oxygen consumption and also with consideration of the hazard class of this or that pollutant. Such system implies 4 classes by the level of contamination.

CONTAMINATION LEVEL	ASSESSMENT INDICATORS OF WATER BODIES CONTAMINATION			
	BY CWPI	BY CWPI WITH CONSIDERA-TION OF THE HAZARD CLASS	BY O2, MG/DC3	BY BOD5, MG/DM3
Normatively clean	⩽ 1,0	⩾ 2,0	⩾ 4,0	⩽ 3,0
The moderate level of contamination	1,1 – 3,0	2,1-6,0	3,1-3,9	3,1-7,0
High level of contamination	3,1 – 10,0	6,1-10,0	1,1-3,0	7,1-8,0
The extremely high level of contamination	⩾10,1	⩽ 10,1	⩽ 1,0	⩾ 8,1

Today in Kazakhstan, this system of complex assessment of water reservoirs' state is mandatory for «Kazhydromet» subdivisions. It should be mentioned that in Kazakhstan soon the reform on determining the unified system of water resources classification by their quality will start. Thus, Committee on Water Resources of the Ministry of agriculture has approved the new normative document - «The unified system of water quality classification in water bodies» and by the joint decree «The methodology on development of target indicators of the water quality in surface water bodies and measures on their achievement» was approved. The national classification of water bodies as well as specification of water consumption classes and their class gradation will be gradually introduced into the state ecological monitoring system of «Kazhydromet».

In Turkmenistan as an integral indicator of the water quality also quality classes are used, that are regularized by following indicators.

INDICATORS	CLASSES OF THE WATER QUALITY					
	I	II	III	IV	V	VI
GENERAL PHYSICAL INDICATORS AND INDICATORS OF NON-ORGANIC SUBSTANCES						
Temperature, °C	<20	25	25	30	30	>30
pH values	6,5	6,5	6,5	6,0	6,0	6,0
Dissolved oxygen, mg/l	>8	6	5	4	2	<2
Oxygen intensity, %	>90	75	60	40	20	<20
Specific electrical conduction, мх	<400	700	1100	1300	1600	>1600
The general amount of dissolved substances, mg/l	<300	500	800	1000	1200	>1200
The general amount of dissolved substances, mg/l1	<20	30	50	100	200	>200
General hardness, n°	<15	20	30	40	50	>50
Chlorides, mg/l	<50	150	200	300	500	>500
Sulfates, mg/l	<50	150	200	300	400	>400
Ferrum (general amount), mg/l	<0,5	1	1	5	10	>10
Manganese (general amount), mg/l	<0,05	0,1	0,3	0,8	1,5	>1,5
Ammonium, mg/l	<0,1	0,2	0,5	2,0	5,0	>5,0
Nitrites, mg/l	<0,002	0,005	0,02	0,05	0,1	>0,1
Nitrates, mg/l	<1	3	5	10	20	>20
Phosphates FO4, mg/l	<0,025	0,2	0,5	1,0	2,0	>2,0
General phosporus FO4 , mg/l	0,05	0,4	1,0	2,0	3,0	>3,0
GENERAL INDICATORS OF ORGANIC SUBSTANCES						
COD (permanganate), mg O2/l	<5	10	20	30	40	>40
COD (bichromatic), mg O2/l	<15	25	50	70	100	>100
BOD5, mg O2/l	<2	4	8	15	25	>25
Organic carbonium, mg/l	<3	5	8	12	20	>20
Extractable substances, mg/l	<0,2	0,5	1,0	3,0	5,0	>5,0
Organic azote, mg/l	<0.5	1,0	2,0	5,0	10,0	>10,0
INDICATORS OF NON-ORGANIC INDUSTRIAL CONTAMINANTS						
Mercury, mg/l	<0,1	0,2	0,5	1	5	>5
Cadmium, mg/l	<3	5	10	20	30	>30
Lead, mg/l	<10	20	50	100	200	>200
Arsenic, mg/l	<10	20	50	100	200	>200
Cuprum, mg/l	<20	50	100	200	500	>500
Chrome, mg/l (general amount)	<20	50	100	200	500	>500
Chrome, (3+), mg/l	<20	100	200	500	1000	>1000
Chrome, (5+), mg/l	<0	20	20	50	100	>100
Kobalt, mg/l	<10	20	50	100	500	>500
Nickel, mg/l	<20	50	100	200	500	>500

INDICATORS	CLASSES OF THE WATER QUALITY					
	I	II	III	IV	V	VI
Zink, mg/l	<0,2	1,0	2,0	5,0	10,0	>10,0
Easily released cyanides, mg/l	0,0	0,0	<0,05	0,1	0,2	>0,2
The general amount of cyanides	0,0	0,0	<0,5	1,0	2,0	>2,0
Fluoride, mg/l	<0,2	0,5	1,0	1,5	3,0	>3,0
Chlorine, mg/l	0,0	0,0	0,0	<0,05	0,1	>0,1
Sulfates, mg/l	0,0	0.0	0,0	<0,01	0,02	>0,02
INDICATORS OF ORGANIC INDUSTRIAL CONTAMINANTS						
Active detergents, mg/l	0,0	<0,5	1,0	2,0	3,0	>3,0
Volatile phenol, mg/l	<0,002	0,01	0,05	0,1	1,0	>1,0
Petroleum derivatives, kg/l	0,00	<0,05	0,10	0,30	1,0	>1,0

In addition to enumerated above approaches to assessment of water bodies'state by hydrochemical indicators, for assessment of the level of natural waters contamination also other criteria are used, such as – «high contamination» and «extremely high contamination». Thus in Kazakhstan it is determined by «Kazhydromet» normative documents, in Kyrgyzstan recommendations of the Russian Federation[6] R52.24.756-2011 «Criteria for evaluation of the danger of toxic contamination of land surface waters at emergencies (in cases of contamination)» are used, in other countries it is determined by similar normative documents of the Soviet period. In any case threshold values of high and extremal contamination are defined by the level of MPC values excess (10-100 times) taking into consideration the hazard class of this or that contaminant or changing of the water quality parameter (oxygen, BOD).

ANALYSIS AND DETERMINING MAIN NEEDS FOR IMPROVEMENT:

THE SPHERE WHERE IMPROVEMENT IS REQUIRED	EXPLICATION
Standards for the water environment quality have not been reviewed for new social and economic conditions	In CA countries standards (normatives) of the quality of natural surface waters have been used still since the soviet period times. They are based on the system of individual MPC or requirement to the water quality by some parameters. Assessment of water resources quality by hydrometeorological services in all countries of the region is done by comparison with MPC developed for fishery water reservoirs, unofficially accepted as MPC of ecological character in contrast to sanitary hygienic MPC, which are assigned for protection of human health. Calculated integral indexes WPI and CWPI are also based on values of the same fishery MPC. The MPC system being applied for several decades in countries of the former USSR was repeatedly analyzed and criticized. It was developed for social and economic conditions of a large country and does not reflect regional aspects of the toxicity of substances and sensibility / sustainability of local types of hydrobionts (aquatic organisms), that are exposed to toxic effect. First of all, it suggests quite hard (strict) normalization and any deviation from the norm is already considered as violation of standards. MPC values are very low, sometimes even beyond the margin of instrumental detection of substances in the water. It doesn't

[6] *In Kyrgyzstan using of the normative-legal base of Russian Federation is allowed by law*

allow to judge about the quality of water bodies for other water consumptions which are usually carried out jointly. It is difficult to use the MPC system for regulation and planning of measured on gradual (step by step) achievement of the desired quality of water resources. In Kazakhstan these standards are currently reviewed for applying the system of water consumption classes (OECD) and introduction of the term of ecological status. On the level of specialists, the need to review the system of standards on natural waters quality is also understood in other countries of the region.

ON THE REGIONAL LEVEL FOR SYNCHRONIZATION OF EFFORTS OF COUNTRIES ON THIS ISSUE IT IS RECOMMENDED:

- To carry out analysis of the national legislation and of the regulatory framework on issues of natural water quality standards and suggest ways on reforming the system of waters quality regulation mechanisms, taking into account current realities in the region.
- To realize a pilot project on testing different approaches and assessment of water resources quality (MPC, WPI , CWPI , water quality status, quality classes, water consumption classes, etc.) and their application in the regulation system.

2.3.5. LABORATORY CAPACITY

CURRENT SITUATION:

Currently the laboratory capacity for monitoring of the surface water resources quality in CA countries considerably varies. So in Kazakhstan, «Kazhydromet» has 16 accredited complex laboratories. Two of these laboratories, located in South Kazakhstan and Jambyl oblasts, are engaged in monitoring of transboundary water bodies in Kyrgyzstan and Uzbekistan. These complex laboratories have all necessary instruments and equipment for implementation of works on monitoring of surface waters quality. Laboratories in Jambyl and South Kazakhstan oblasts select water samples for determining organochlorine pesticides, but samples are delivered to the laboratory in the North Kazakhstan oblast, where the analysis is directly done. For determining mentioned pesticides by their own and expansion of accreditation spheres of laboratories for determination of such indicators as dicophol, hexachlorobenzene, hexachlorocyclohexane, xanthoginates, DDD (dichlorodiphenyldichloroethane) it is necessary to purchase highly precise modern equipment, for installation of which a separate premise is needed. Currently the working space of laboratories does not allow to purchase such equipment.

In Kyrgyzstan, monitoring of surface waters quality is carried out mainly by 2 state bodies: the hydrometeorology agencies under the Ministry of Emergencies («Kyrgyzhydromet») and by the State Agency on the Environmental Protection and Forestry (SAEPF). At that, SAEPF functions imply monitoring of the environmental state of surface water bodies, i.e. determining sources of pollution and the level of their impact to this or that object in result of discharging polluters into water bodies, including treated sewage waters. «Kyrgyzhydromet» functions include monitoring of the natural environment. Both agencies have one central laboratory each. «Kyrgyzhydromet» currently doesn't have any regional laboratories. SAEPF has been fully equipped by the modern equipment. Since 2016 «Kyrgyzhydromet» has stopped observations over such important pollutants as heavy metals, oil products (petroleum products), phenols and SSAS, because of the obsolete and insufficient material and technical basis and obsolete methodologies. As a whole in «Kyrgyzhydromet» the instrumentation pool is obsolete, it is necessary to equip it with modern apparatus for increasing the number of ingredients to be determined. For determining heavy metals, the atomic absorption spectrophotometer is required.

In Tajikistan, currently 3 laboratories are functioning under «Tajikhydromet» - in Dushanbe, Kairakkum and Kurgan-Tube. The latter is not functioning because of the lack of apparatus and specialists. In all laboratories, an acute shortage of the equipment is observed. Available instruments and equipment have exhausted their capacity. There are no spare parts for restoration and repairs of the equipment. The new equipment is not delivered and is not purchased because of the lack of funds. For the central laboratory in Dushanbe it is important to set going the process of analyzing the content of metals in water, but because of the lack of atomic absorption spectrophotometer, it is not possible so far.

In Turkmenistan, monitoring of surface waters quality is performed by the ECS laboratory under the State Committee on Protection of the Environment and Land Resources. In addition, monitoring of waters is also performed by other Ministries and agencies in accordance with their regulations. The National Hydrometeorology Committee «Turkmenhydromet» carries out the monitoring of hydrological indicators on all watercourses of the country, provides servicing and technical equipping of its gauging stations, but it does not carry out monitoring of water resources quality. Practically all instruments and laboratory equipment is obsolete and needs to be renewed.

There are two hydrochemical laboratories in the structure of «Uzhydromet», one is located in Tashkent, and the second one on Fergana, The equipment of laboratories is morally obsolete; the acute deficit of budget means for its modernization is observed. For this reason, it is difficult to do the analysis of samples for heavy metals, in particular for mercurium.

The important aspect is the methodological basis for organization of monitoring and also specialized manuals for carrying out analysis.

As of today, among countries of CA region only in Kazakhstan the methodological support of laboratories is arranged and laboratories are provided with necessary literature, instructions, guidelines and methodologies.

At the same time, in Kyrgyzstan, the shortage of methodological literature is observed, because previously all materials were delivered from Rostov hydrochemical institute, and currently such links have been lost. There are no scientific-research institutions in the sphere of hydrochemistry and hydrobiology in the country. Therefore, old training aids are used. The situation is similar in Tajikistan and Turkmenistan – there are no national centers on development of methodological technical guides and instructions for carrying out monitoring of surface waters quality, there is not enough specialized literature, old teaching guides and instructions are used. In Uzbekistan, there is also a problem in revision of soviet guideline documents, taking into consideration specifics of the country and introducing them into the national register.

One of serious problems of the CA region countries is staffing of analytical laboratories with the qualified personnel. Thus, the staff of «Kazhydromet» laboratories is in the whole completed with qualified specialists, in «Kyrgyzhydromet» the personnel is gradually renewed on the account of young specialists with quite high level of theoretical knowledge, but in other countries the situation is not so good. Thus, in «Tajikhydromet», because of the number of reasons (salary, work conditions) selection of the qualified personnel on the competitive basis is difficult and the turnover of employees is high. An acute shortage of qualified personnel in laboratories engaged in monitoring of water quality is observed also in Turkmenistan. In «Uzhydromet», there are not enough specialists with high chemical education.

In all countries of the region, the mechanism of re-attestation of laboratories employees is applied. Specialists pass the procedure of re-attestation for the job competence and for confirmation of a qualification (as a rule once in 3 years). In addition, employees of laboratories as a rule attend specialized qualification upgrading courses. However, the content and effectiveness of these training significantly vary in countries of the region.

Thus, in Turkmenistan over the last 5 years training of employees was limited to courses on emergencies; in Tajikistan 6 specialists attended general training on surface waters monitoring, but two of these specialist have already quit the job. “Uzhydromet” employees participate in trainings and qualification courses (advanced training courses). In 2017, two employees of the

laboratory attended distant (remote) qualification courses in Roshydromet. Specialists of "Kyrgyzhydromet" and SAEPF (usually from 1 up to 3 employees) regularly participate in professional courses, mainly within the frames of international projects under the donors' support[7].

The most orderly (in the planned manner) training of specialists is carried out in Kazakhstan. Every year specialists of laboratories of South-Kazakhstan and Jambyl oblasts attend specialized qualification upgrading courses. Over the last 5 years, both general and also specialized issues were included into the program of these trainings[8]. Specialists of "Kazhydromet" also participate in international trainings and in practical trainings (on-the-job training). In Kazakhstan, there is a number of training centers for the professional development, including for managers of the quality management systems in the sphere of ecology, for specialists-chemists in the sphere of assimilation of modern analytical equipment and new methodologies for doing measurements. In Kyrgyzstan, there are no such centers yet, but it is expected that in the "Kyrgyzhydromet" structure the training center for the professional development in the sphere of hydrometeorology will be opened. In the long view, it is planned to suggest it as a regional center for the professional development. In Tajikistan previously employees of hydrometeorological laboratories attended advanced qualification courses in Central Asian Research Hydrometeorological Institute, but now they don't. The situation is similar in Turkmenistan and Uzbekistan, there are no specialized training centers in these countries for specialist In the sphere of hydro-chemistry and hydro-biology.

In all countries of the Central Asia region, the practice of cooperation between laboratories engaged in monitoring of water resources quality with educational institutions is set going. Students of these educational institutions have their practical training on the basis of these laboratories.

ANALYSIS AND DETERMINING MAIN NEEDS FOR IMPROVEMENT OF THE SITUATION:

THE SPHERE WHERE IMPROVEMENT IS REQUIRED	EXPLICATION
The obsolete instrumentation pool and equipment of laboratories, engaged in the monitoring of the quality of transboundary rivers	It is urgently necessary to reequip laboratories of hydrometeorological services in CA countries with the basic equipment and instruments. This concerns Kazakhstan to a less extent, because province (district) laboratories engaged in the monitoring of the quality of waters on transboundary rivers in the region are quite well equipped, though they also need to expand their instrumentation pool for doing analysis (atomic absorption spectrophotometer, mass spectrometers). The instrumental basis for determining the presence of metals in water and also of some priority pollutants is extremely needed for Kyrgyzstan, Tajikistan, Uzbekistan. In many laboratories, it is also important to address the issue with premises, either it is needed to extend their areas (Kazakhstan) or to do the

[7] The training course on the monitoring of the water quality, JICA, Japan; Training tour on monitoring of surface waters, Finland; Training in the Training center of the Institute of Environment and Meteorology in Finland by Finkmet project, Finland; Professional development courses on "Requirements on ИЛ by ГОСТР ИСО/МЭК 170255 on control of Shukhar maps»; Training on the work with software application MUkit – instrument for calculation of the uncertainty of measurements, FinWater WEL

[8] Advanced training on issues of occupational health and safety; ISO 14001-2015 «The system of environmental management», ISO 22004:2014 «The system of food products safety»; GOS ISO/МЭК 17025; Training and professional development in the sphere of technical regulation, metrology and management system; Uncertainty of measurement results; training of experts-auditors on confirmation of chemical products; Internal audit of the system of management of testing and calibration laboratories in accordance with requirements of СТ РК ИСО/МЭК 17025-2007 and СТ РК ИСО 19011; Adoption of the methodology on doing measurements of metals by atomic-absorption method on spectrophotometer MGA-915; Training course on issues of industrial safety; Briefing on exploitation of the liquid chromatograph «Lumachrom»; «Improvement of water resources management in CA»; Training course on the water quality; «Procedures on accreditation of testing laboratories».

	major repairs (Kyrgyzstan, Tajikistan) and bring laboratory premises into compliance with required standards of premises.
Lack (inefficiency) of regional (district) laboratories	In Kazakhstan, the monitoring of surface waters quality is organized on the regional (district) level, that allows monitoring of the quality of transboundary rivers in the region. However, for other countries, the remoteness of central laboratories of hydrometeorological services from the watercourses and lack of regional (district) laboratories does not allow to carry out the adequate monitoring in remote districts of the country. In Tajikistan only one of 3 available laboratories carries out monitoring on the planned basis, one laboratory practically is not functioning, and the third one is not able to do monitoring to the full extent. The state of such laboratories and their supply with the equipment and employees is significantly worse than in central laboratories. At the same time, the delivery of samples to central laboratories of this or that country is quite difficult because of large distances, hard-to-reach areas and remoteness of monitoring points. In the long view, establishment of new regional laboratories or strengthening capacity of available regional laboratories certainly should become the objective of services engaged in the control of waters quality. As a temporary solution, it may be suggested to form regional expedition groups, that will engage in selection of samples, in doing initial analysis, conservation, marking and packing of samples. The delivery of samples to central laboratories may be organized on the basis of contract with transport companies, for example with air-travel companies.
Problems with reagents, expandable materials, inadequate methodological support.	In Tajikistan and Turkmenistan, one of restrictions for carrying out monitoring of transboundary water bodies is the lack of chemical reagents for conservation of samples and analytical definition. Also the methodological support of services, engaged in the monitoring is important. It may concern specialized methods for carrying out analytical works, but also general issues of monitoring, for example, methodical instruction on planning of the observation network, methods and principles of water resources quality assessment, selection of samples, management of the quality control, etc.
Need for the regular professional development program	The professional development of the personnel on the planned basis is an important aspect and this issue can be improved, especially in Kyrgyzstan, Tajikistan and Turkmenistan.

ON THE REGIONAL LEVEL FOR SYNCHRONIZATION OF EFFORTS OF COUNTRIES ON THIS ISSUE, IT IS RECOMMENDED:

- To implement a regional project on increasing the capacity of monitoring services on issues of analytical capacities of laboratories, including development of the plan on fitting out laboratories with necessary equipment and training of the personnel.
- To purchase the necessary equipment and carry out trainings. .
- To consider the issue about establishment of a regional training center on issues of water resources quality monitoring.

2.3.6. SYSTEM OF DATA STORAGE, PROCESSING AND ANALYSIS

THE CURRENT SITUATION:

The data obtained about the quality of surface waters is stored in CA countries in different ways. As a rule, initially the information is introduced into primary laboratory log-books, and afterwards it is issued in the form of hydrochemical bulletins and yearbooks (catalogues).

In «Kazhydromet» the initial information is also introduced into the Excel format and into the SQL database (by transboundary rivers – since 2008-2009). The archive information for previous years is available still only in hard copies.

In «Kyrgyzhydromet» the information, including the archive one, is stored in the Excel format. All the information about the quality of waters, starting since 1938 (except for the data on Issyk-Kul lake) has been already transferred into the electronic table formats and currently the process of scanning of archive logbooks, bulletins and yearbooks has been started.

In «Tajikhydromet», the information since 2003 is also stored in the Excel format. The archive historic information has been already transferred into the electronic format and currently the process of documents scanning is going on.

In Turkmenistan, though it was attempted to transfer the data into the electronic format, currently because of the lack of sufficient financial means this work has been stopped.

In «Uzhydromet» the data of the surface waters quality monitoring is stored in the paper format (hard copy) in Hydrometfund (hydrometeorological fund), and also in the electronic version DOS. The data since 2003, has been also transferred into the Excel format. There are not yet any plans for transferring the entire archive information to the electronic carriers.

Usually the employee of the laboratory or of the information department transfers the data to electronic carriersdone by. Often the entered information is only visually checked for the accuracy of all records. At that, only in «Kazhydromet» there is a normative document, that establishes requirements to checking the compliance of the information quality to set standards, checking the accuracy of records and transformation of the observation data, calculations, coding and entering of the information into technical carriers, checking the observation data for any deviations from established methods of doing measurements and data processing and also for rough casual mistakes (miscounts) at doing measurements, checking the availability and accuracy of records of the year, month, name of the post, its coordinate number, records in columns “date”, “time”, etc..

The access to electronic database in agencies is limited; there are duplicate recording carriers and copies. Archive materials in all countries are stored in special funds, where the access mode has been established and storage conditions are maintained.

As a rule, at processing and summarization of the data received in result of the monitoring, simple methods are used, such as: graphs of water quality variance by monitoring posts, diagrams on exceedance of observed values over the MPC values, the frequency of such exceedance and calculation of integral indexes (WPI, CWPI) in those countries where they are applied. In «Kyrgyzhydromet» with the support of the Finnish part, currently the information system DigiLab on management of the laboratory data and information is introduced. In «Tajikhydromet» with the support of the Finnish University within the frames of the investment project the information system on the laboratory data management is introduced.

More complicated mathematical and statistical methods (for example, such as – analysis of multi-year variation series, regression and correlation analysis, prediction models, trends analysis , calculation of samplings statistical values, sampling variation, determining statistical reliability of differences etc.) currently are not applied for the data analysis, as it is not within direct responsibilities of Services on natural waters quality monitoring.

In addition, the Geo information systems (GIS) have not been as yet introduced into the practice of Services on natural waters quality monitoring, as an instrument for spatial reflection of data and for carrying out multifactor analyses, and also as an instrument for visualization of data about natural waters quality.

ANALYSIS AND DETERMINATION OF ESSENTIAL NEEDS FOR IMPROVEMENT:

THE SPHERE WHERE IMPROVEMENT IS REQUIRED	EXPLICATION
The need to keep the archive information preserved, transferring the data about the quality of water resources to electronic carriers	Currently in CA countries (Kazakhstan, Kyrgyzstan, Turkmenistan), the data received at monitoring of the quality of water resources, along with the paper form is entered into Excel tables, that of course is a correct step towards provision preservation of data and possibility for their improved analysis. In Kyrgyzstan and Turkmenistan, the historical archive information has been entered into the electronic format. It should be noted that the Excel format really allows to preserve and analyze pools of data, but it is not the database by itself. Such database is available only in Kazakhstan. It is organized on the SQL platform. In the long view, it is necessary to introduce modern information systems into the practice of data management. These systems include specialized databases integrated with the instruments of processing, analysis and visualization of information, including GIS.
The need to check the accuracy of archive data, transferred to electronic formats	Of course in CA countries at entering the new received data about the quality of water resources into the electronic format, it is checked for mechanical mistakes. However, the practice shows that the main reason of mechanical mistakes is a human factor, especially at entering of large data pools, archives into the electronic format. Therefore it is necessary to introduce the ways of verification of the accuracy of introduced information, using methods of detection of strongly deviating values, violation of correlation link between parameters, etc. It will allow not only to check the accuracy of data entering into registries, but also to take control over results of analysis for occurrence of "rough" mistakes at taking samples and carrying out analytical procedures.
Expanding of the informational content of monitoring programs and monitoring data	Currently, the services engaged in the monitoring of the quality of water objects gather significant volumes of information, but their informational content, as a rule, is limited only by several indicators (excess over MPC, pollution indexes). Taking into consideration that there are already available multi-year historical series of observations, the volume of available information is huge. With due application of modern information systems, this information pool can be transformed into the valuable information that is needed for assessment of water resources state in the retrospective and in the prospect (in the long view). This will increase the informational content of the received data, and the information will become more adapted for bodies making managerial decisions, it will become more understandable and clear, also for water users and for the civil society. The capacity of monitoring services in CA countries in this aspect can be strengthened through establishment of special information departments or groups in the structure of agencies, which will be engaged in processing, analysis, interpretation and visualization of the monitoring information. Of course, for this purpose there are needed modern databases, development of GIS layers, formation of the instrument for the request and analysis of the information.

ON THE REGIONAL LEVEL, FOR SYNCHRONIZATION OF EFFORTS OF COUNTRIES ON THIS ISSUE IT IS RECOMMENDED:

- To develop and introduce the regional program document (database and GIS analytical block) for information systems about the quality of transboundary water resources.
- To develop a regional methodological guidance on the analysis, processing and visualization of data about the quality of water resources and to carry out training for information groups.
- To introduce methods of verification of multi-year datasets transferred to electronic carriers.

2.3.7. CONTROL AND QUALITY ASSURANCE, CERTIFICATION OF METHODS AND MATERIALS AND ACCREDITATION OF LABORATORIES

THE CURRENT SITUATION:

On the stage of getting ready for going out for samples and directly at samples selection, services engaged in the monitoring in CA region, take control over marking containers, utensils, flasks. At that, either the field logbook or the protocol of samples selections or the talon-stab is filled out, to which on the sampling site the necessary information is introduced (the number, water object, post /section line, data and time of the sample selection, the volume of the sample etc., and also results of measurements in field conditions are introduced). But as a rule, at delivery of samples to the laboratory the special verification act is not filled out, though all necessary measures are taken to avoid mistakes. Also, with few exceptions, in the usual practice of surface waters quality monitoring, there are not applied such methods of checking the sampling quality as “blank samples”, “duplicate samples” and “split samples”, though their share in analysis should usually reach 10-20%. In Turkmenistan such methods are applied usually when the sample raises doubts or water turbidity is high.

Concerning provision of the quality of analytical works, the most favorable practice is observed in laboratories of «Kazhydromet» and «Kyrgyzhydromet».

«Kazhydromet» laboratories have been accredited for the compliance with GOST ISO/IEC 17025-2009 «General requirements to the competency of testing and calibration laboratories». The internal laboratory control of results quality in «Kazhydromet» is carried out in accordance with requirements of GOST ISO 5725-6-2003, ISR (Interstate Standartization Recommendations)76-2004, GOST 27384-2002, other guidance documents. A wide range of methods is applied, such as: the accuracy operational control of with application of the sample dilution method; application of test samples; standard addition method; control methodology of analysis, control of the repletion rate and of the internal laboratory reproducibility. State standard samples are applied. All measuring tools of laboratories undergo the instrument standardization (calibration) in accordance with the periodicity of calibration. «Kazhydromet» laboratories regularly participate in comparative tests in accordance with GOST ISO/IEC 17025-2009 and in accordance with the plan of interlaboratory comparative tests. The quality control in laboratories is carried out by the senior chemical engineer.

In «Kyrgyzhydromet» methods of internal control in accordance with the DD 52.24.66-86 «System of control over accuracy of measurement results of the controlled environment pollution indexes» are also applied. The operating control of the reproducibility and correctness for volumetric research methods (sulfates, chlorides etc.) is applied. Control measurements are done regularly during the entire controlled period. State standards samples are used. Results are entered into the logbook “The internal accuracy control”, then at the end of the year the assessment of indicators is done. Control Stewhart charts are on the implementation stage. Moreover, in the SAEPF laboratory the internal control is carried out in accordance with accreditation requirements by GOST ISO/IEC17025, and among others, also Stewhart charts are used. Every year in «Kyrgyzhydromet» the state calibration of analytical instruments and equipment by specially authorized body (Kyrgyzstandart) is carried out. Every year «Kyrgyzhydromet» and the SAEPF laboratory participate in comparative testing, organized by the Finnish Environment Institute SYKE, UNEP program GEMS/Water Canada, and also inside the country – by the NGO «ILIM». The quality control in «Kyrgyzhydromet» is carried out by the Chief of the laboratory, in SAEPF – by the Quality Engineer. The «Kyrgyzhydromet” laboratory on monitoring of the of land surface waters quality is not accredited as the major repairs of its building or construction of a new building for the laboratory is required. The SAEPF laboratory is accredited in accordance with ISO/IEC 17025.

In Turkmenistan once in 3 years certification

of laboratories is done. All blanks are filled out and submitted by the form, specified by Turkmengosstandard (Turkmen State Standard). These blanks include all the data on the personnel, specialists, instruments, reagents. The Turkmengosstandard's national accreditation is available. The internal quality control is carried out using resources of the laboratory itself.

Every year in «Tajikhydromet» the state verification of analytical instruments and equipment is carried out by the specially authorized organ "Tajikstandard". By its results the certification about verification of tools and equipment is given.

In «Uzhydromet», in accordance with the established practice the external control with other departmental laboratories, as well as the internal control in laboratories is carried out. Verification of the equipment is carried out every year by the agency "Uzstandard". Both laboratories of "Uzhydromet" are not accredited but are authorized by the State Environmental Committee (Goscomecology).

As this study demonstrates, currently "Tajikhydromet" laboratories and laboratories in Turkmenistan do not participate in comparative testing and intercalibration between-laboratory tests.

ANALYSIS AND DETERMINATION OF ESSENTIAL NEEDS FOR IMPROVEMENT:

THE SPHERE WHERE IMPROVEMENT IS REQUIRED	EXPLICATION
Increasing reliability authenticity of the monitoring data, improvement of the quality control management	Improvement of the quality control management is the objective for all services of the region, engaged in the monitoring. Procedures on the quality assurance and the quality control should become a good practice for any laboratory, engaged in observations over the quality of water resources. It would be practicable to assign a separate job position (post) for these activities. It will allow to carry out the objective inter-laboratory control, to develop programs on the equipment verification, to conduct training of the personnel and to carry out tests of sampling procedures and of analytical works.
The need in laboratories accreditation	Of course all laboratories engaged in the monitoring of the quality of water resources and especially of transboundary waters should be accredited in the long view for the compliance with international standards, In Kazakhstan this issue has been addressed, but for other countries of the region it is becoming quite important, especially in the view of starting the data exchange and cooperation on the quality of shared water resources.
The need in regular comparative testing and intercalibration	Participation of laboratories in comparative testings, between-laboratory tests and in other programs on checking the qualification of laboratories should become a good practice. These programs were duly financed and they should be included into monitoring programs or at least into the plans of these services.

ON THE REGIONAL LEVEL, FOR SYNCHRONIZATION OF EFFORTS OF COUNTRIES ON THIS ISSUE IT IS RECOMMENDED:

- To develop regional methodical guidance on the quality management and to conduct the regional training for the personnel of laboratories, responsible for the control and quality assurance procedures.
- To realize the project on providing technical assistance to Services in accreditation of laboratories engaged in monitoring transboundary water resources quality in accordance with national and international standards.
- To develop the regional program on comparative testing and to introduce it on the regular basis.

2.3.8. SUBMISSION OF THE INFORMATION ABOUT THE QUALITY OF SURFACE WATERS AND USING IT IN MAKING DECISIONS ON WATER RESOURCES MANAGEMENT

THE CURRENT SITUATION:

Information about the quality of surface waters is prepared as a rule on the monthly or the quarterly basis in the form of tables (Kazakhstan) or information sheets (Kyrgyzstan) or in TG-52 format (Turkmenistan).

In Kazakhstan, «Kazhydromet» branch offices pass the yearly datato the Department of environmental monitoring, which is then coordinated by the Director of the Department. «Kazhydromet» database is checked by results of the year and then is passed to the archive. The analytical report is not prepared, but information is published as a section of the "Information bulletin on the environment state" on official sites of the Ministry of Energy and «Kazhydromet». In the structure of «Kazhydromet» there is an Administration of ecological monitoring under the Department of ecological monitoring. Specialists of the Administration carry out statistical checking, process the data with different time resolutions and release information bulletins. Moreover, the information on surface waters quality is regularly requested by Ecology Departments of Jambyl and South-Kazakhstan oblasts, by the Department of Natural resources management under the Akimat of Jambyl oblast. In case of detecting the high-level pollution, the operative information for Ecology Departments and Emergency Committees shall be prepared.

In Kyrgyzstan, the information about the quality of surface waters is sent on the quarterly basis in the form of the information sheet to the Ministry of Emergencies, the Ministry of Health, SAEPF, National Statistical Committee and also is provided by the consumers' request. In the end of the year by results of the monitoring the summary "Annual data about the quality of land surface waters of the Kyrgyz Republic" is prepared. In addition, the yearly report about the quality of waters is submitted to SAEPF for preparing the National report about the state of the environment. Yearly reports are checked by the Chief of the Department and approved by the Director. Information about surface waters pollution is placed at free access on the site. By request, «Kyrgyzhydromet» provides the information about surface waters quality to the Government, state institutions and ministries, non-governmental organizations, international projects, private companies. In case if results of observations show deterioration of the water quality, the information is immediately passed to the operative Department of the Ministry of Emergencies. In the Department of monitoring of natural environment pollution the Chief Specialist is engaged in data processing and preparing of the relevant information.

In Tajikistan, the information received in result of the yearly monitoring is approved by the Director of Hydrometeorology agency and is stored in the Agency fund. Analytical report is not prepared. The information is provided upon request, for example from the Government, the Committee of Emergencies, scientific-research institutions and international projects. For the last 5 years, several dozens of requested information sheets have been prepared. The specialist of the Information Department processes the data and prepares the information by the established form for the Committee on the Environmental Protection.

In Turkmenistan the Agency engaged in monitoring does not share the data, it is stored in archives of the organization. Analytical reports are not prepared. More often the information is requested by international projects.

In Uzbekistan every year 75 types of information about surface waters pollution are released. The information is sent to the State Environmental Committee, to the Ministry of Health and by request - to other state organizations. In addition, "Uzhydromet" prepares the annual review about the surface waters quality. There is an Information Department that is engaged in the analysis and summarization of the data on water resources quality monitoring. The information about the quality of surface waters is not published in public sources.

Results of activities of Services on natural waters quality monitoring are used by authorities, engaged in making managerial decisions in different ways.

Thus in Kazakhstan the Committee of Environmental Regulation and Control under the Ministry of Energy uses the information developed by "Kazhydromet" on surface waters quality for taking measures on reducing (or elimination) of pollution in environmental objects. Occasionally, as and when necessary, the information about the quality of surface waters is used by the Environmental Prosecutor's Office, Akimats, the Committee on Emergencies, District Departments on Natural resources and Environment. The Committee of Environmental Regulation and Control every month provides the data about measures taken on contamination of water objects to «Kazhydromet»..

In Kyrgyzstan, the information developed by «Kyrgyzhydromet» is used on the national level on the regular basis. For example the information about the level of surface waters pollution is submitted to the Ministry of Emergencies, Ministry of Health, National Statistical Committee, SAEPF (the mandatory quarterly circular). To other organizations and agencies the information is provided by request. Based on the submitted information, the pollution objects are examined and measures for improvement of the situation are taken. The national report on the environment protection is issued, the statistical data on the nature protection is gathered. The feedback information about measures taken on pollution sources usually does not come.

In Tajikistan and Turkmenistan the information developed by laboratories for making the managerial decisions is used occasionally, as and when necessary. The feedback about taken measures does not come.

There is no data about that how the information, developed by "Uzhydromet" is used. The feedback about taken measures, as a rule, does not come.

ANALYSIS AND DETERMINATION OF ESSENTIAL NEEDS FOR IMPROVEMENT:

THE SPHERE WHERE IMPROVEMENT IS REQUIRED	EXPLICATION
Improvement of the submitted information about the quality of surface waters	The information flows (especially in Tajikistan and Turkmenistan) about the quality of water resources can be essentially improved. For this purpose, it is required to determine on the national level, to which agencies and in what kind should the information be submitted on the regular basis. In addition, for all countries of the region it is recommended to consider the issue about preparing the informational-analytical reports about activities of hydrometeorological services on issues of the water quality monitoring. In these reports the received data should be summarized, the problems of the quality of water resources should be revealed, the analysis and localization of "hot" spots should be done, conclusions should be made about that whether the monitoring program has reached its purposes, etc. This will provide transparency of activities of services engaged in the monitoring of water objects quality and will add them greater authority on the national level, as the main supplier of the monitoring information. In addition, it is recommended to improve the character of informing the civil society about the qualitative state of water resources through adaptation of the information provided in a free access (on websites). The submitted information should be easily understandable and accessible to non-specialists, expressed mainly in graphic forms and in the color spectrum. Using of GIS and interactive maps can improve the visualization of monitoring data as a whole.

ON THE REGIONAL LEVEL FOR SYNCHRONIZATION OF EFFORTS OF COUNTRIES ON THIS ISSUE, IT IS RECOMMENDED:

- To implement a pilot project on development of analytical-information report about results of of the of water resources quality monitoring and to conduct a training for information groups.
- To implement a demonstration projects on the subject "Adaptation of monitoring information for consumers" (water users, civil society).

2.3.9. HYDROBIOLOGICAL MONITORING, THE CONTROL OVER THE CONTAMINATION OF BEDLOAD SEDIMENTS

THE CURRENT SITUATION:

The hydrobiological monitoring in Kazakhstan has been established in West Kazakhstan and Karaganda oblasts since the end of 1980-s. The hydrobiological monitoring is carried out on benthos, biotest, zoobenthos, zooplankton, periphyton, and phytoplankton. The program of hydrobiological monitoring has been developed on the basis of GOST 17.1.3.07-82 «Rules of monitoring of the water quality in water reservoirs and watercourses». In addition, since 2003 the work was started on determining the concentration of mercury in fish tissues and studying of morphometric characteristics of fish. However, there is limited data available about hydrobiological monitoring of transboundary watercourses between Kyrgyzstan and Uzbekistan.

Hydrobiological monitoring in Kyrgyzstan is not carried out, but it is one of actual trends that should be developed. Currently in Kyrgyzstan, there are no specialists in the sphere of hydrobiological monitoring and there is no experience in carrying out researches.

In Tajikistane and Turkmenistan, the hydrobiological monitoring is not carried out because of the lack of equipment, methodology and specialists.

In Uzbekistan, currently hydrobiological observations by «Uzhydromet» monitoring network of are carried out on the monthly basis, since March till November, only within the limits of Tashkent oasis on 10 water objects, in 27 section lines, including 1 section line on river Boshkizilsay on the territory of Chatkal biosphere reserve. The quality of water and the ecological state of watercourses is assessed by indicative biocenosis, being of riority for conditions of the region – by periphyton and zoobenthos in accordance with the methodical recommendations "Methods of hydrobiological monitoring of water objects in Central Asia" (RU 52.25.32-97, Tashkent, 1997). At development of these recommendations the experience gained in realization of hydrobiological monitoring on observation networks was used, as well as original developments of specialists of the hydrobiological laboratory "Uzhydromet" on adaptation of available methods of bioindication to hydrobiological specific aspects of the region. For assessment of the water quality class the saprobity indexes are applied. By results of hydrobiological monitoring the information is issued in the form of yearly periodicals, information sheets and monthly bulletins about the quality and ecological state of the water quality, the level of trophicity and ecological conditions of watercourses.

Samples of bedload sediments in Kazakhstan are collected with the purpose to determine the character, level and rooting depth (penetration depth) of specific, contaminating substances for monitoring duration of self-purification processes, calculation of the balance elements, determining sources of secondary contamination and consideration of the anthropogenic factor impact. Collection and analysis of bedload sediments is done on 38 water objects twice a year (in spring and autumn). Monitoring is carried out on the basis of GOST 17.1.5.01-80 "General requirements to sampling of bedload sediments in water objects for the contamination analysis"; NPRD F (Nature protection regulatory documents) 16.1:2:2.2.63-09 "The methodology of measuring mass content of vanadium, cadmium, cobalt, manganese, cuprum, arsenic powder, nickel, hydrogenium (mercurium), chrome, zink, in the samples of soil, ground and bedload sediments by the method of atomic absorption spectrometry with the use of atomic absorption spectrophotometer with electrothermal atomization", NPRD F

16.1:2.21-98 «The methodology of measuring mass content of oil products in soil and ground samples by fluorimethric method with the use of fluid analyzer". Analysis of bedload sediments within the frames of the arrangement "Carrying out monitoring of transboundary transfer of toxic components" is carried out by X-ray fluorescence and neuro-activation method.

Up to 90-s of the last century "Tajikhydromet" carried out regular expeditionary works on the Sarez lake and Nurek water reservoir, but only on determination of the siltation cone, without determining the contamination level of bedload sediments. Thus no issues or sources of the public health hazard for local population were observed.

ANALYSIS AND DETERMINATION OF ESSENTIAL NEEDS FOR IMPROVEMENT:

THE SPHERE WHERE IMPROVEMENT IS REQUIRED	EXPLICATION
Lack of hydrobiological monitoring on transboundary rivers	Arranging regular works on hydrobiological monitoring on transboundary rivers in the long term should become an important aspect of activities of services on monitoring of water resources quality. The classification of the water object status by biological indicators is important as it allows to orient monitoring programs on the ecological state of water reservoirs. This issue should be first of all duly developed in Kazakhstan as it is supposed that this country in due course will pass to the ecological classification of the water object status. The current experience of EU countries shows that reaching of so-called "good ecological status", which is first of all determined by safety of water systems, is becoming a target of water resources management. For this purpose all rivers and lakes should be classified by ecological regions and types. One water object (for example, a river) may consist of sections of different types, depending on the water collection area, the height of the watercourse bedding, geological formations and other criteria. For every type, the typical set of biological and chemical quality and hydromorphology elements (ecological quality elements, chemical quality elements) is determined. The hydromorphological, hydrochemical and hydrobiological monitoring allows to assess the ecological status of the water body and also to follow up whether the target status will be reached in the result of taken measuresor not.
Lack of monitoring of the quality of bottom sediments on transboundary rivers	The control of the quality of bottom sediments currently is not the priority task for services engaged in monitoring of water resources quality. Nevertheless, taking into consideration the content of suspended materials (air-born dust) in the medium and lower watercourses of rivers in the region, as well as modern landscape processes, taking place in upper reaches of rivers (mudflows, landslides, avalanches, ice lakes, melting of glaciers (deglaciation), monitoring of the content of contaminating substances of the natural or anthropogenic origin can become the important aspect for assessment of the general state of water resources. Taking into consideration that suspended particulate matters are physical carriers of some metals, synthetic organic substances, radionuclides, and zones of regulating river courses by dams are accumulating "traps" – then this aspect may seem important also for determining transboundary transportation of contaminating substances.

ON THE REGIONAL LEVEL, FOR SYNCHRONIZATION OF EFFORTS OF COUNTRIES ON THIS ISSUE IT IS RECOMMENDED:

- To study the need and requirements in organization of hydrobiological monitoring on transboundary rivers and to develop the support program for countries.
- To study the need and requirements in organization of monitoring of bedload sediments quality on transboundary rivers and to develop the support program for countries.

CHAPTER 2.4.
TRANSBOUNDARY/REGIONAL COOPERATION OF HYDROMETEOROLOGICAL SERVICES ON WATERS QUALITY MONITORING

The Diagnostic Report[9] has paid special attention to regional cooperation between CA countries on water resources quality, at that stating that the level of such cooperation is not effective enough. Section 1 of this document related to actualization of the Diagnostic Report, in the context of regional cooperation (Chapter 1.3) contains thesis development of the regional/ inter-state cooperation on transboundary water resources quality in Central Asia still requires significant efforts and targeted policies both from the countries themselves and also from international structures. Therefore, within the frames of this study, the issue of cooperation between hydrometeorological services, as the most effective national structures on studying water resources quality, was elaborated in more details by national experts.

At present, the hydrometeorological services of Central Asian countries are important «providers» of the monitoring information at the national level, both in terms of the quantity of water resources and also by their quality, forecasting the hydrological situation on water objects, responding to critical state of water resources, including sudden changing of water resources quality, general assessment of the state of surface water resources. Thus, more precise definition of the degree of hydrometeorological services participation in the regional cooperation is extremely important for planning measures on strengthening the cooperation of countries on issues of transboundary waters quality.

Annex 5 shows the extent of hydrometeorological services' involvement in international conventions in which countries of the region participate. Not all considered conventions are directly related to water resources, but deal with them in this way or another, to a fuller extent or indirectly.

Thus, for example, hydrometeorological services of Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan are very closely involved in addressing issues of the United Nations Framework Convention on Climate Change (Rio de Janeiro, Brazil, 1992). They participate mainly in the context of the climate information. Within the framework of obligations under the "UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus, Denmark, 2000), the hydrometeorological services of Kazakhstan and Kyrgyzstan ensure transparency of the information on the environment quality, including also on issues of water resources quality. In Tajikistan, the Hydrometeorological Service also participates in activities of the Aarhus Center under the Committee for Environmental Protection, providing the monitoring information upon request.

At the same time, the formal participation of hydrometeorological services in other international conventions is not seen. Their participation is limited by attraction of individual specialists to projects or workshops.

The most important convention on the quality of transboundary water bodies is the "UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, Finland, 1992) and the "Protocol on Water and Health". Only three countries in the region (Kazakhstan, Turkmenistan and Uzbekistan) are parties to this convention. However, the role of hydrometeorological services in implementing provisions of this Convention is currently limited. In the long view, this Convention could become an important element in strengthening cooperation of

[9] *For development of the regional cooperation on provision of waters quality of in Central Asia and of the plan on the cooperation development, 2012*

countries of the region on many issues of transboundary watercourses management and protection.

In addition to international Conventions there are also regional Agreements in the Central Asian region that directly concern environmental and water resources issues (Annex 6). It should be noted that for today none of these Agreements explicitly includes into agenda the issues of cooperation between countries on the quality of water transboundary resources. Consequently, the hydrometeorological services are not involved in activities under these Agreements regarding water resources quality, though they are involved in other issues of Agreements implementation by providing the necessary monitoring information.

At the same time, there always existed a mechanism of cooperation and information exchange between hydrometeorological services, which was laid down still at establishment of these services (Annex 7). At the agency level, all hydrometeorological services of CA countries to the full extent cooperate on the hydrological and meteorological data exchange, as well as on the exchange of normative and methodological documents in the field of hydrometeorology and environmental protection. However, there is no information exchange on the quality of water resources, on methodological issues of assessment and analysis of the monitoring data on the water quality, on notification about the dangerous divergence of the water quality.

Bilateral agreements also can become an important mechanism for cooperation between countries on issues of water resources protection. Today, there are two such agreements in the region (Appendix 8). Thus, within the framework of the basin agreement between Kazakhstan and Kyrgyzstan on using of interstate water facilities on Chu (Shu) and Talas rivers there are examples of successful cooperation in joint environmental monitoring of transboundary watercourses and exchange of the monitoring information on the water resources quality. The key moment of such cooperation was establishment in 2016 of an expert working group on the environment under the Chu-alas Water Commission Secretariat.

SUMMING UP, IT CAN BE STATED THAT PERFORMED ANALYSIS OF COOPERATION MECHANISMS ON ISSUES OF THE QUALITY OF TRANSBOUNDARY WATER RESOURCES IN CA REGION (ON THE EXAMPLE OF HYDROMETEOROLOGICAL SERVICES) DEMONSTRATES THAT WITH FEW EXCEPTIONS THERE IS NO INTERACTION BETWEEN COUNTRIES ON THIS ISSUE. THE REASONS FOR SUCH SITUATION HAVE BEEN ANALYSED IN NATIONAL REPORTS, WHICH CAN BE SUMMARIZED AS FOLLOWS:

- Difficulties with the interstate division of shared water resources, in some cases – uncertainty of issues with operation and maintenance of the hydraulic infrastructure, problems with regulation of river discharge, taking into account water use priorities for hydroenergetics and irrigation. In such a situation, issues of regional cooperation on water resources quality are often considered less important or are ignored.
- Inconsistency of measures on reforming the water sector in the region in the context of IWRM principles, inadequate application of the basin approach to water resources management at the national and regional levels, and as a result, insufficiently active inclusion of issues of transboundary watercourses quality into the agenda of Governments and agencies making managerial decisions of regional significance.
- Not full coverage of countries of the region for participation in international conventions related to transboundary watercourses, in particular in the “UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, Finland, 1992)”.
- Lack of the legal basis of the regional or basin nature (except for Chu and Talas rivers) for cooperation of countries and departments on issues of shared watercourses quality. In this regard, there are no mechanisms for realization of such cooperation.

CONCLUSION

The carried out survey of needs of surface waters quality monitoring systems in the CA region showed the urgent need to reform and modernize this important water management sector, both at the country level and also in the regional context. National reports have recommendations and proposals specific to each country on improvement of water quality monitoring systems. This conclusion presents recommendations and proposals summarized in the regional context on responding to present-day regional challenges with which hydrometeorological services engaged in monitoring of the quality of surface waters currently face.

RECOMMENDATIONS OF THIS STUDY ON IDENTIFYING NEEDS IN THE SPHERE OF ENSURING QUALITY OF SURFACE WATERS IN THE REGION CAN BE BROKEN DOWN INTO SEVERAL INTERRELATED AREAS. THE CONDUCTED RESEARCHES ALLOW TO FORMULATE THE BASIC STRATEGIC LINES OF SUCH REFORM THAT CONSIST IN THE FOLLOWING:

A. reforming of the water policy for water quality monitoring in the IWRM context;

B. increasing the material and technical, methodological and human capacity of hydrometeorological services engaged in monitoring of water bodies quality;

C. promoting regional cooperation on issues of ensuring quality of transboundary water resources;

D. coordination and integration of efforts of countries on improvement of the system of transboundary waters quality monitoring and management.

A. REFORMS IN THE SPHERE OF WATER POLICY

Though a detailed analysis of national legislative and institutional frameworks for the water quality monitoring was not the main objective of this survey, but based on actualization of the Diagnostic Report and studying needs of water quality monitoring systems at the national level in CA countries, it can be stated that, despite of that the IWRM principles are reflected in the legislation of a number of CA countries, but their practical application for monitoring of surface water resources quality has not been yet duly developed.

It is reflected in the insufficient application of the basin principle in organization of monitoring networks, choosing quality parameters for determining the status of water bodies, standards and systems applied for classification of natural waters quality, sometimes - in duplicating efforts of various agencies on monitoring water resources quality, lack of the information exchange between these agencies, and the most important - in the lack of clear understanding of the role of the data on water resources quality for making managerial decisions on ensuring water bodies quality.

Therefore, revision or adaptation of national water policies in general and in the context of ensuring water resources quality, shifting natural waters management to the planned principle, establishment of perspective target indicators of water bodies quality for ensuring the reliable water use and protection of water/near-water ecosystems, overall coordination of agency-level water quality monitoring systems can become an important step at the national level.

As the first steps, it is recommended to carry out a relevant analysis of the legal and institutional framework in CA countries concerning monitoring of surface water resources quality in order to add integral functions to monitoring of water bodies quality as an integral element of IWRM and defining an appropriate institutional platform for this. It is important to assign authorities and responsibilities to the national body/agency for formulation and implementation of national policies in this direction. Such a body/agency may be responsible for development of norms/standards on the quality of natural, waste and return waters, systems of water resources classification by their quality,

division of water resources into aquicultural or ecological sections in the context of existing and prospective water resources management and protection of relevant ecosystems, development of methodologies on assessment of the impact of pollution sources and defining national environmental priorities related to the quality of natural waters, setting target indicators on the quality of water bodies, depending on their economic or environmental purpose, development of plans on ensuring the quality of water bodies, coordination of departmental monitoring programs, preparing national reviews on the water quality, implementation of methodological and technical policy in the sphere of monitoring of natural waters quality and standards for discharges etc.

In order to assist countries in this direction, it is recommended to develop a regional project to study the existing national legislative and institutional specifics and to develop a set of recommendations for governments on adding advanced functions and institutional frameworks to water quality monitoring systems in the IWRM context.

B. INCREASING CAPACITY OF MONITORING SYSTEMS

For obtaining regular and reliable data on the quality of water bodies at the national and regional levels, certainly it is needed to increase the capacity of national services engaged in the monitoring of water resources quality. For today it can be considered a priority task in the CA region in the context of surface waters quality management. This survey (section 2) has identified the main areas where it is needed to improve monitoring systems by countries and by the region as a whole:

THE SPHERE, WHERE IMPROVEMENT IS REQUIRED	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
Panning of monitoring programs					
Spectrum of the water quality parameters for the monitoring					
Systems of assessment and classification of the quality of water resources					
Ensuring samples selection and transportation of samples					
Logistic and maintenance support of laboratories					
Provision of reagents to laboratories					
Methodological support of laboratories					
Staffing support of laboratories					
Information storage systems					
Data processing, interpretation and visualization of data					
Quality control at selection of samples					
Quality control at analytical works					
Information flows about the quality of water resources					
Using of the monitoring information					

Explication:

Significant changes and reforms are needed, current approaches have to be revised

Changing, modernization and specification of applied approaches is required

No significant changes are needed, but efforts are needed for improvement of the situation

THUS, THE IDENTIFIED WIDE RANGE OF NEEDS FOR CARRYING OUT THE PROPER MONITORING OF WATER RESOURCES QUALITY (ON THE EXAMPLE OF HYDROMETEOROLOGICAL SERVICES) CAN BE TENTATIVELY DIVIDED INTO THREE MAIN GROUPS, AND NAMELY:

- Material and technical capacity
- Methodological capacity
- Human capacity

Strengthening the material and technical capacity. As of today, the adequate material and technical support of laboratories and expeditionary groups on samples selection is a critical factor in implementation of monitoring programs. Limitation of funds allocated for modernization and development of the technical capacity of laboratories engaged in monitoring of surface waters led to the physical and moral exhaustion of the equipment stock and, as a consequence, to reduction of a number of observation posts and of the number of studied indicators. Some laboratories do not have the basic equipment for doing analysis of heavy metals, oil products, SSAS, phenols and other industrial pollutants. Not all countries do analysis of priority industrial substances, Persistent Organic Pollutants, herbicides and pesticides.

One of important problems identified at the national level in all five countries is the inadequate equipping of expeditionary groups engaged in samples collection, doing primary analysis in-situ, conservation of samples and their delivery to analytical laboratories. There is no or not enough instruments for doing express analysis, there are no modern means for samples selection, cooling chambers, specialized transport for the delivery of samples, sometimes –specialized dishes, containers and even reagents.

Of course, the situation with the material and technical capacity currently varies from country to country, from the laboratory to laboratory. In any case, equipping of laboratories with modern analytical equipment for performing the required set of analysis at the expense of national budgets can be implemented only very limitedly. Therefore, for addressing this issue the donor support is needed. In this regard, this survey strongly recommends to develop a regional project. Within the frames of this project it is necessary to carry out a detailed audit of the material and technical equipage of services engaged in the monitoring of water resources quality, to identify priorities for modernization of laboratories and equipage of expeditionary groups, to develop a regional investment plan for technical re-equipage and to prepare specification of the necessary equipment. Based on such a plan, at the next stage it is necessary to purchase and install the new equipment and to conduct a training on work with new equipment.

It is also important to mention the need to provide necessary premises for laboratories . In most cases, in the region, there is not enough laboratory space, or buildings and premises do not meet essential standards, for some of them the major repairs or even construction of new premises is needed. Without addressing this issue, it is impossible to set going implementation of the quality monitoring, to accomplish accreditation of laboratories in accordance with national and international standards. The issue with premises should be mainly addressed through national funding.

In addition, it is necessary to address the issue with laboratories that supplement activities of central laboratories. Previously, in all countries, along with the central laboratories of hydrometeorological services, there was organized a network of regional (district) laboratories. Such a structure has been preserved and is functioning effectively in Kazakhstan, but in other countries the majority of regional (district) laboratories are either liquidated (Kyrgyzstan) or, because of the lack of equipment, reagents and qualified personnel, they are not able to carry out the set of required analysis (Tajikistan, Uzbekistan). In this regard, it is recommended to carry out a feasibility study on maintaining such laboratories and to decide whether their reanimation and further development is justified, or it would be more effective to re-profile them for selection and transportation of samples to central laboratories, while expanding the area of sampling coverage and increasing the number of posts and frequency of water samples selection.

Strengthening the methodological capacity. As this survey has shown, the services engaged in the monitoring of water bodies quality have difficulties with the methodological support of their activities. This includes using of outdated approaches for planning of monitoring networks, selection of water quality parameters for analysis, quality standards (MPC) and classifiers of water bodies. These approaches have not been revised for several decades already. Today, practically the entire regulatory and methodological basis for monitoring of surface waters quality in the region, with rare exceptions (Kazakhstan), has remained unchanged in its essence still since the times of the Soviet Union.

THEREFORE, IT IS RECOMMENDED TO STRENGTHEN THE METHODOLOGICAL CAPACITY OF WATER QUALITY MONITORING IN THE REGION THROUGH A NUMBER OF REGIONAL PILOT/DEMONSTRATION PROJECTS. BY IMPLEMENTING SUCH PROJECTS IT IS POSSIBLE:

- To develop and test a series of regional methodological tools on planning and optimization of monitoring programs in the context of IWRM; on procedures of sampling and field measurements; on the analysis, processing, verification and visualization of data on water resources quality; on the quality management and control and quality assurance procedures etc.
- To develop and implement a pilot project on testing different approaches to water quality assessment (MPC, WPI, CWPI, the water body status, quality classes, water use classes, etc.) and their application in the regulatory system.
- To develop and implement a demonstration project on development of an analytical and information report on results of water resources quality monitoring and adaptation of the monitoring information for consumers and for making decisions.

Strengthening human resources capacity. In the course of this survey it was revealed that certain efforts are needed in the region for maintaining and strengthening human resources capacity for water quality monitoring. Currently, the lack of qualified personnel has become one of key problems for some countries. Therefore, it is recommended to organize the process of professional development of the staff at the regional level. In future, it can be accomplished through establishment of a regional training center. On the basis of this centre regular thematic trainings for managers, engineering and laboratory personnel from all countries of the region can be conducted.

In the nearest future, for supporting countries in this direction, it is recommended to develop a regional project that will be aimed at preparing and conducting basic trainings, for example for expeditionary groups, for the personnel of laboratories, for managers, for information groups and other specialists engaged in processing and analysis of the monitoring information, for specialists engaged in monitoring and ensuring data quality etc.

C. SUPPORTING OF THE REGIONAL COOPERATION ON WATER RESOURCES QUALITY

As actualization of the Diagnostic Report (Chapter 1.2) showed, the cooperation of countries of the CA region on issues of shared water resources quality is still not effective enough. Fundamental principles of the Diagnostic Report still remain important.

Today, at the regional level, only this UNECE/CAREC project supports the cooperation of countries of the region on water quality issues. One of its crucial tasks is formation of a permanent Regional Working Group and ensuring its legal status, possibly under the aegis of one of international structures in the region (IFAS, ICSD, ICWC). For this purpose, first of all, it is necessary to develop the mandate of RWG, to define its tasks, responsibilities, legal status and activities regulations.

At the level of certain river basins in the CA region, currently only the Chu-Talas Water Management Commission (Kazakhstan, Kyrgyzstan) has an expert group on environmental issues in its structure that deals with issues on water

quality monitoring. Currently, by efforts of these two countries and with the support of the GEF project, the transboundary monitoring system is being developed in this river basin. Therefore, it is necessary to support this working group, among others on issues of coordination of a unified system of water resources quality assessment , organization of a transboundary monitoring network on the basin principle, setting target parameters on the water quality in rivers etc. The experience of the Chu-Talas Water Management Commission on water quality issues can become a model for other transboundary basins in the Central Asian region.

THUS, AS IT WAS MENTIONED IN THE DIAGNOSTIC REPORT, THE MAIN PRIORITIES ON COOPERATION BETWEEN COUNTRIES IN THE CONTEXT OF SHARED WATER RESOURCES QUALITY, AT THE FIRST STAGE, SUGGEST THE UNIFICATION (HARMONIZATION) OF THE REGULATORY AND LEGAL FRAMEWORK FOR THE WATER QUALITY REGULATION, AND NAMELY:

- Agreed classifiers of water resources quality for transboundary river basins;
- Agreed list of water quality indicators for monitoring of transboundary watercourses and especially hazardous priority sources of pollution;
- Agreed values of maximum permissible concentrations (quality standards) for the region or basins of transboundary rivers;
- Unified methods and instrumentation for measuring the quality indicators of natural transboundary waters;
- Agreed methodology for processing of the monitoring information;
- Coordinated procedures on theregular data exchange of on water resources quality, including criteria and procedures of prompt notification at sudden contamination of transboundary waters.

But for sustainability of regional cooperation on transboundary water resources quality management in the CA region, certainly a definite political platform is needed that can be implemented through the RWG mechanism or basin agreements on the quality of water resources.

D. COORDINATION AND INTEGRATION OF EFFORTS OF COUNTRIES ON RESPONDING TO NEW CHALLENGES

The following areas of the regional cooperation between CA countries can become important in the future. And though today such issues are not clearly and urgently included into the agenda of Services engaged in monitoring of surface natural waters quality, but they represent new challenges with which countries of the Central Asian region are already coming across. National water policies and Water Resources Management should take these challenges into account in the strategic plan and offer their responses. In these issues, the regional coordination and integration of countries' efforts will be a critical factor.

Step-by-step restoration/extension of the network for monitoring of the transboundary watercourses quality. As it is seen from this survey chapter 2.2), currently, the density (consistency) of observation posts for monitoring of the quality of main transboundary watercourses in the region in the most cases is low. This does not allow to obtain the adequate information. As a rule (on 9 from 13 transboundary watercourses), only one country carries out monitoring of the watercourse quality, while other countries do not have the necessary information about the water quality, because monitoring is not carried out on their territories. Therefore, while planning monitoring programs at the national level, it is highly advisable to coordinate location of observation posts taking into account the monitoring network of the neighbouring country. In the long view it will allow to gather the information and judge about the quality of transboundary rivers. This is the first step towards establishing a regional network for monitoring the quality of transboundary watercourses in the CA region.

The basin approach to organization of the transboundary monitoring. As carried out

studies show, currently, the IWRM principles are not applied in monitoring of the water quality in transboundary watercourses in CA countries. Analysis of location and functioning of observation posts on major transboundary watercourses in the region (Section 2) showed that apparently the number of observation posts is not enough (for the majority of rivers, one observation post comes to 200-800 km of riverbed) for obtaining information on the quality of river on its various environmental and water-resources sections, for different water ecosystems, in zones of basic water consumption and in areas affected by anthropogenic pollution sources.

Therefore, the basin approach in organization of a monitoring network for monitoring of water resources quality, primarily of transboundary water resources is a challenge for all countries of the CA region. It is important from the point of view of IWRM principles application, as the quality of water in river systems is formed on the basis of particular qualities of this or that concrete basin (geology, water-collecting area, hydromorphology of riverbeds, substrates, biological cenosis, sources of point and diffuse pollution). Therefore, on a regional, transboundary scale, it is necessary to orient at organization of a monitoring network by the basin principle, covering the upper, middle and lower reaches of rivers, different climatic zones, topographic and landscape features (rivers typology), water management conditions and requirements for protection of water use and various ecosystems along the entire river. Such formulation of the task on designing monitoring networks is quite new for the region and it is associated with targeted planning of water bodies quality, identification of different conditions for provision of the water quality formation in the catchment area, assessment of the watercourse quality as a single hydrographic unit and so on.

Therefore, it is recommended to start addressing the issue of basin level organization of the monitoring network with development of a pilot and demonstration project for some rivers. It will demonstrate the basin approach application to planning of water quality monitoring programs and show the ways and special aspects of building monitoring networks on the new principle in the light of IWRM.

Exchange of the information on water resources quality in the basin/regional context. As of today, there is no exchange of information between countries on the quality of joint watercourses and transboundary water bodies, with few exceptions (in the Chu-Talas river basin the information exchange on the quality of transboundary watercourses is more or less arranged). It is caused, first of all, by the lack of bilateral, regional or basin agreements on such information exchange. Today, none of international structures in the region sets addressing of water quality issues as its primary task, accordingly, there is no any interstate mechanism for sharing the information on water resources quality with the neighbouring country. It is possible to overcome this gap only by including the issues of awareness raising and exchange of the monitoring information into the agenda of one of international structures.

Therefore, for actualization of this issue it is recommended to develop a project on formation of a unified information system (GIS database and analytical unit) on transboundary waters quality in the CA region. In the long term it can become the basis for exchange of agreed information on the quality of shared water resources.

Moreover, at the first stage, it would be advisable to study the possibility of the information exchange on the quality of transboundary rivers in the region through a departmental system of hydrometeorological services. Today, hydrometeorological services exchange the climate and hydrological data, but not the data on water resources quality. As it is mentioned in the Diagnostic Report, it is recommended to start the data exchange by a limited list of indicators (temperature, oxygen, BOD/COD, nitrates/ammonium, mineralization). First of all, it will demonstrate the willingness of countries to cooperate on this very important issue.

Climate changes and the quality of natural waters. Currently, the issue of global climate changes and searching ways for adapting to them is becoming an important issue in the agenda of many regions, including the CA region. Here water resources are particularly vulnerable, both from the quantitative and also from the qualitative point of view. But, unfortunately, for today in the region there is practically no information on the change of quality characteristics of water bodies in response to the climate change. as Also there

are no long-term forecasts on the of natural waters quality in the light of climate changes. Current monitoring networks on the water quality in the CA region are not able to fix such changes and long-term trends, as they were designed for other purposes. Therefore, at the regional level it is recommended to design a specialized regional monitoring network that could fix climatic trends and changes, including changes of water resources quality. Location of observation posts for such a network and selection of limited water quality parameters should be correlated with the meteorological and hydrological information. Presumably, such unified regional network could be built on the use of automated climatic, hydrological and hydrochemical complexes located in remote locations, that exclude the human impact and transmit the information to central servers in the automatic mode. The related issue is the question of identifying such sections of watercourses and establishing monitoring of so-called reference conditions.

Improving quality and reliability of the monitoring data. As a whole, for the Central Asian region the issue of reliability of the received monitoring information on the quality of natural waters is important. It is connected both with the incompleteness of monitoring networks, insufficient frequency of samples selection, using of morally and technically obsolete laboratory equipment, different methods and instruments, and also directly with samples selection and analytical procedures. Often the data of laboratories vary even at doing analysis of the same water sample, that arouses mistrust to the received information. And although in the most cases laboratories have established procedures for monitoring and ensuring the data quality, nevertheless, only laboratories in Kazakhstan have international accreditation. Therefore, it is recommended to implement a project on providing technical assistance to Services in accreditation of laboratories engaged in monitoring of transboundary water resources quality in accordance with national and international standards. It is also recommended to develop a regional program of comparative tests and intercalibration of laboratories and to introduce it on the regular basis.

Adding ecological elements to the water quality monitoring. Currently, water resources quality monitoring in the CA region is mainly limited to monitoring of physical and hydrochemical parameters of the water quality. Only in Kazakhstan and Uzbekistan monitoring of the water quality by hydrobiological parameters is established and that is only for certain water reservoirs. Also, in the region, analyses of the chemical quality of bedload sediments, the content of hazardous compounds in fish tissues and other hydrobionts, analyses of the water quality on the basis of biological tests (biotesting) are carried out very rarely. Moreover, any specialized studies on the typology of watercourses and lakes for organization of water resources management by the basin principle, as well as assessment of hydromorphological changes caused by the human influence have not been carried out so far in the region.

However, in the future, these issues can become important for the region, especially in the light of prospects for the ecological rationing of the water quality, transition to the assessment of ecological status of reservoirs, consideration of iological and hydromorphological constituents in the water quality. Such an integrated approach was determined by the European Water Framework Directive for countries of the European Union, when so-called «biological elements of water quality» began to be used as the main criterion for assessing the status of water bodies. This required a radical revision of principles on organization of the water quality monitoring systems, planning of monitoring programs and interpretation of the received data. All this led to that the system of surface waters quality monitoring in the European Union, from a passive tool for data accumulation, became a part of active management of water resources quality for bringing them to a planned, targeted ecological status. In this case, monitoring of water resources quality (Chapter 1.1) becomes an instrument not only for assessment of water objects quality, but also provides an adequate information for bodies making decision on taking necessary measures for improvement of natural waters quality and serves as a tool for assessment of the effectiveness of taken measures.

ANNEXES

ANNEX 1. BASIC NATIONAL LEGISLATION IN CA REGION IN THE CONTEXT OF THE MONITORING OF WATER RESOURCES QUALITY

THE LEGISLATIVE BASIS OF THE MONITORING OF WATER RESOURCES QUALITY	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
Laws, codes	• Environmental Code (2007) • Water Code (2003 с уточнениями 2009) • Code "On People's Health and Healthcare System" (2009) • The Law on Technical Regulations (2004)	• Water Code (2005) • The Water Act (1994) • The Law “On Environmental Protection” (1999) • The Law on basics of technical regulations», (2004) • General technical regulations on provision of the environmental safety in KR (2009).	• Water Code (2000 with additions and amendments 2011 и 2012) • The Law “On Environmental Protection” (1993 и 2011) • The Law “On Drinking Water and Drinking Water Supply” (2010) • The Law “On Environmental Monitoring” (2011) • The Law “On Environmental Information” (2011) • The Law “On Environmental Expertise” (2010)	• Water Code (2016) • The Law “On Environmental Expertise” (2014) • Drinking Water Law (2010) • Sanitary Code (2009)	• The Water and Water Use Law(2013) • The Law “On safety of hydraulic structures” (1999)
Resolutions, orders, normative-legal acts		• Regulations on the Water Fund monitoring (1995) • Regulations on the state registration and monitoring of the water use	• Regulations on delineation of powers of specially organs on regulation, use and protection of water resources, (2002)	• Regulations of the Ministry of Agriculture and Water Management of Turkmenistan (2016) • Regulations of the State	• Regulations on the state monitoring of the natural environment in the Republic of Uzbekistan (2002)

THE LEGISLATIVE BASIS OF THE MONITORING OF WATER RESOURCES QUALITY	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
		(1995) • Rule of surface waters protection (2016) • Regulations on the order of maintaining ·the State Water Cadastre (1995) • Regulations of the Hydrometeorology Agency (2012) • Regulations of the State Agency on the environmental protection and forestry (2012) • Regulations of the Department of diseases prevention of the Sanitary and Epidemiological Surveillance of the Ministry of Health (2013) • Regulations of the Department of Water Management and Land Reclamation (2012) • Regulations protection of underground waters (2015) • About fisheries, management of natural and artificial water reservoirs (2009)	• About the order of maintaining the State Water Cadastre (2002) • Regulations of the Committee on the environment protection under the Government of the Republic of Tajikistan (2008 и 2015) • Regulations of the Hydrometeorology Agency of the Committee on the environmental protection (2015) • Regulations of the Ministry of energy and water resources (2014) • Regulations of the State Surveillance Service in the sphere of waterworks safety (2014) • Regulations of the Service on Sanitary and Epidemiological Surveillance of the Ministry of Health and Social Protection of the Population (2007) • Regulations of the Head Department of Geology under the Government of the RT (2006)	Corporation “Turkmegeology” (2012) • Regulations of the National Hydrometeorology Committee (2011) • Regulations of the State Committee on the Environment Protection and Land Resources (2016)	

THE LEGISLATIVE BASIS OF THE MONITORING OF WATER RESOURCES QUALITY	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
Other basic normative-legal acts	• Sanitary and epidemiological requirements to water sources, points of water withdrawal for purposes, drinking and household water supply and places of cultural and general water use, as well as to water objects safety и безопасности водных объектов» (2015)	• Maximum permissible concentrations of chemical substances in the water objects for drinking and household and cultural and general water use; Approximate permissible levels of chemical substances in the water objects for drinking and household and cultural and general water use (2016)	• Sanitary and epidemiological requirements on protection of surface waters from contamination (SanPiN 3.02.003.04); • Sanitary Rules and Regulations on protection of surface waters from contamination (SanPiN 4630-88; • Requirements to the quality of water in non-centralized water supply system. Sanitary protection of water sources (SanPiN 2.1.4. 005-07)		

ANNEX 2. TYPES OF MONITORING IN THE CA REGION AND ENGAGED INSTITUTIONS

TYPE OF THE MONITORING	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
Monitoring of surface natural water bodies quality (rivers, lakes)	RSC (Republican State Company) «Kazhydromet» under the Ministry of Energy Republic of Kazakhstan	Agency for hydrometeorology under the Ministry of Emergencies (Kyrgyzhydromet)	Committee on the environmental protection under the Government of the Republic of Tajikistan Agency for hydrometeorology (Tajikhydromet) of the Committee on environmental protection under the Government of the Republic of Tajikistan	State Committee on the environmental protection and land resources	Center of the Hydrometeorogical Service under the Ministry of Emergencies (Uzhydromet)
Monitoring of the impact of pollution sources on the quality of water resources	Committee of the ecological regulation and controlunder the Ministry of Energy	State agency on the environmental protection and forestry under the Government of Kyrgyzstan	Committee on the environmental protection under the Government of the Republic of Tajikistan Agency for hydrometeorology (Tajikhydromet) of the Committee on the environmental protection under the Government of the Republic of Tajikistan	State Committee on the environmental protection and land resources	—
Monitoring of the water quality on entry section lines of water objects assigned for household and drinking water supply	Committee on the public health protection of the Ministry of Health	Department of diseases prevention and sanitary and epidemiological surveillance of the Ministry of Health	The state service on the sanitary and epidemiological surveillance of the Ministry of Health and social protection of the population	Sanitary and epidemiological service	The Ministry of Health

TYPE OF THE MONITORING	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
Monitoring of the quality of water for irrigation		Meliorative hydrogeological expedition of the Department of water management and land reclamation of the Ministry of agriculture, food industry and land reclamation		Operating units of the Ministry of agriculture and water management	Ministry of Health
Monitoring of underground waters quality	Committee of Geology and subsurface resources management of the Ministry of investments and development	Complex hydrogeological expedition of the State Committee of industry, energy and subsurface resources management	Head Department of Geology (Tajikglavgeology) under the President of the Republic of Tajikistan	Secure parties of hydrogeological expeditions of the State corporation «Turkmengeology»	State Committee of geology and mineral resources

ANNEX 3. WATER QUALITY PARAMETERS FOR MONITORING IN CA COUNTRIES

WATER QUALITY INDICATOR	UNITS OF MEASURE-MENTS	TEST METHOD	IS MONITORING CARRIED OUT ON MAIN TRANSBOUNDARY WATERCOURSES (YES/NO)				
			KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
PHYSICAL PROPERTIES							
Smell at 200C	points	Organoleptic	Yes	No	Yes	Yes	Yes
Color (coloration) of water	the column height, sm	Comparison with standard sample	Yes	Yes	Yes	Yes	No
Floating matters	Presence	Visually	No	No	No	Yes	No
Suspended substances	mg/l	Gravimetric	Yes	Yes	Yes	Yes	Yes
Transparency	см	Visually, Secchi disk	Yes	Yes	Yes	Yes	Yes
Hardness of water	mg-экв/l	Complexometric	Yes	Yes	Yes	Yes	Yes
TEMPERATURE CONDITIONS							
Temperature of water	t^0C	Temperature measurement	Yes	Yes	Yes	Yes	Yes
OXYGEN CONDITIONS, GENERAL ORGANIC CONTAMINATION							
Dissolved oxygen , O_2	мгO_2/л	Titrimetric	Yes	Yes	No	Yes	Yes
Chemical oxygen demand, $COD_{bichrom}$	мгO_2/л	Titrimetric	Yes	No	No	Yes	Yes
Chemical oxygen demand, $COD_{permang}$	мгO_2/л	Titrimetric	No	No	No	No	Yes
Biochemical oxygen demand, BOD_5	мгO_2/л	Titrimetric	Yes	Yes	No	Yes	Yes
Biochemical oxygen demand, BOD_{full}	мгO_2/л	Titrimetric	No	No	No	No	No

WATER QUALITY INDICATOR	UNITS OF MEASURE-MENTS	TEST METHOD	IS MONITORING CARRIED OUT ON MAIN TRANSBOUNDARY WATERCOURSES (YES/NO)				
			KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
OVERACIDIFICATION CONDITIONS							
Hydrogen index, pH	points	Indicative	Yes	Yes	Yes	Yes	Yes
Alkalinity of waters	mg-экв/l	Titrimetric	No	No	Yes	Yes	No
SALINITY CONDITIONS, SALT CONTENT							
General mineralization of water, Min $_{gen.}$	mg/l	Gravimetric	Yes	Yes	Yes	Yes	calculated
Sulphates , SO_4	mg/l	Titrimetric	Yes	Yes	Yes	Yes	No
Chlorides , Cl	mg/l	Argentometric	Yes	Yes	Yes	Yes	Yes
Calcium, Ca	mg/l	Titrimetric	Yes	Yes	Yes	Yes	Yes
Magnesium, Mg	mg/l	Titrimetric	Yes	Yes	Yes	Yes	calculated
Ammonia saline, NH_4	mg/l	Spectrophotometric	Yes	Yes	Yes	No	No
EUTROPHICATION CONDITIONS, BIOGENIC ELEMENTS							
Total nitrogen content, N_{gen}	mg N/l	Titrimetric	Yes	Yes	No	Yes	No
Nitrates, NO_3	mg NO_3 /l	Spectrophotometric	Yes	Yes	Yes	Yes	Yes
Nitrites, NO_2	mg NO_2/l	Spectrophotometric	Yes	Yes	Yes	Yes	Yes
Ammonia, NH_4	mg NH_4/l	Photometric	Yes	Yes	Yes	Yes	Yes
General phosphorus content, $P_{gen.}$	mg P/l	Spectrophotometric	Yes	No	No	Yes	Yes
Phosphates / orthophosphates, PO_4	mg PO_4/l	Spectrophotometric	Yes	Yes	Yes	No	Yes
Phosphorus elementary, $P_{эл.}$	mg P/l	Photometric	No	No	No	No	No
NON-ORGANIC MICRO-ELEMENTS, METALS							
Borium, B	mg/l	Spectrophotometric	No	No	No	No	No
Total ferrum, Fe_{gen}	mg/l	Photometric with ortho-phenanthrolin	Yes	Yes	Yes	Yes	Yes

WATER QUALITY INDICATOR	UNITS OF MEASURE-MENTS	TEST METHOD	IS MONITORING CARRIED OUT ON MAIN TRANSBOUNDARY WATERCOURSES (YES/NO)				
			KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
Ferrum, Fe^{2+}	mg/l	Photometric	No (Shu, Talas, Assa) Yes (Syrdaya)	No	No	No	No
Ferrum, Fe^{3+}	mg/l	Photometric	Yes	No	No	No	No
Cadmium, Cd	mg/l	Atomic-adsorption	Yes	SAEPF	No	No	Yes
Nickel, general content , Ni	mg/l	Photometric	Yes	No	No	No	No
Nickel dissolved, Ni dis. (Ni^{2+})	mg/l	Atomic-adsorption	Yes	No	No	No	No
Mercury, Hg	mg/l	Photometric	No (Shu, Talas, Assa) Yes (Syrdaya)	No	No	No	No
Plumbum, Pb	mg/l	Photometric	Yes	SAEPF	No	No	Yes
Chrome, Cr^{3+}	mg/l	Atomic-adsorption	Yes	Yes	No	No	Yes
Chrome, Cr^{6+}	mg/l	Photometric	Yes	Yes	No	No	Yes
Zink, Zn	mg/l	Photometric, Atomic-adsorption	Yes	SAEPF	No	No	Yes
Manganese, Mn	mg/l	Photometric, Atomic-adsorption	Yes	SAEPF	No	No	No
Cuprum, general content, Cu	mg/l	Photometric. Atomic-adsorption	Yes	SAEPF	No	No	Yes
Arsenium	mg/l	Photometric	No (Shu, Talas, Assa) Yes (Syrdaya)	No	No	No	Yes
Barium	mg/l	Photometric	No	No	No	No	No

WATER QUALITY INDICATOR	UNITS OF MEASURE-MENTS	TEST METHOD	IS MONITORING CARRIED OUT ON MAIN TRANSBOUNDARY WATERCOURSES (YES/NO)				
			KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
Selenium	mg/l	Photometric	No	No	No	No	No
Silver	mg/l	Photometric	No	No	No	No	No
Strontium	mg/l	Photometric	No	No	No	No	No
Aluminum	mg/l	Photometric	No	No	Yes	No	No
OTHER CONTAMINANTS							
Oil products	mg/l	Thin-layer chromatography	Yes	SAEPF	No	Yes	Yes
Benzol	mg/l	Gaz chromatography	No	No	No	No	No
Phenols	mg/l	Photometric	Yes	No	No	Yes	Yes
Fluorides, F	mg/l	Photometric with latan-alizarin complex	Yes	Yes	No	No	Yes
SSAS	mg/l	Photometric	Yes	SAEPF	No	Yes	Yes
Rhodanides	mg/l	Spectrophotometric	No	No	No	No	No
Cyanides, CN	mg/l	Spectrophotometric	No	No	No	No	Yes
ORGANIC MICRO-CONTAMINANTS (PESTICIDES)							
Dichlorodiphenyltrichlo-roethane and its isomers	mkg/l	Gas chromatography	Yes (chemical analysis of pesticides in the laboratory of the branch office by North-Kazakhstan province)	No	No	No	Yes

ANNEX 4. MPC VALUES APPLIED IN CA REGION

WATER QUALITY INDICATOR	MEASURE-MENT UNITS	MPC VALUE, APPLIED FOR ASSESSMENT OF THE QUALITY OF SURFACE WATERS				
		 KAZAKHSTAN	 KYRGYZSTAN	 TAJIKISTAN	 TURKMENISTAN	 UZBEKISTAN
Smell at 20°C	points	The water should not transmit foreign smells or tastes to the fish flesh	The water should not acquire foreign smells, tastes and coloration and transmit it to the fish flesh	The water should not have foreign smells or tastes		
Color (coloration) of water	Column height, cm	The water should not acquire extraneous foreign	The water should not acquire extraneous coloration	The water should not acquire extraneous coloration		
Floating matters	presence	On the surface of water there should not be found slicks of oil products (petroleum), oil, fat and aggregation of foreign matters	On the surface of water there should not be found slicks of oil products (petroleum), oil, fat and aggregation of foreign matters	On the surface of water there should not be ound slicks of oil products (petroleum), oil, fat and aggregation of foreign matters		
Suspended substances	mg/l	At the discharge of return (waste) waters by a concrete water user and implementation of works on the water object and in the coastal area, the content of suspended matters on the controlled section line (post) should not	Should not increase in comparison with natural conditions for more than 0,75 mg/l	Should not increase in comparison with natural conditions for more than 0,75 mg/l	In comparison with natural conditions, it should not increase for more than 0,75 mg/l	Less than 0,75

WATER QUALITY INDICATOR	MEASURE-MENT UNITS	MPC VALUE, APPLIED FOR ASSESSMENT OF THE QUALITY OF SURFACE WATERS				
		KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
		increase in comparison with the natural volume for more than 0,25 mg/dm^3.				
Transparency	cm			≥23		
Hardness of water	mg-eq/l			7		7
Temperature of water	t^0 C	The temperature of water should not increase in comparison with the natural temperature of the water object for more than 5 degrees, with the general temperature increase for not more than 20 degrees in summer and up to 5 degrees in winter for those water objects where cold-water fish (salmonids, ciscos) indwell; and not more than up to 28^0 C and 8^0 C in summer and winter accordingly in other cases. In places of burbot breeding site it is prohibited to increase the water temperature in winter for more than up 2^0 C.	The temperature of water should not increase in comparison with the natural temperature of the water object for more than 5 degrees, with the general temperature increase for not more than 20^0 C in summer and up to 5^0 C in winter for those water objects where cold-water fish (salmonids, ciscos) indwell; and not more than up to 28^0 C and 8^0 C in summer and winter accordingly in other cases	The temperature of water should not increase in comparison with the natural temperature of the water object for more than 5 degrees, with the general temperature increase for not more than 20^0 C in summer and up to 5^0 C in winter		

WATER QUALITY INDICATOR	MEASURE-MENT UNITS	MPC VALUE, APPLIED FOR ASSESSMENT OF THE QUALITY OF SURFACE WATERS				
		KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
Dissolved oxygen , O_2	mgO_2/l	In winter (under ice) period should be not less than 4 mg/l , in summer period - 6mg/l	In winter (under ice) period should be not less than 4 mg/dm^3 In summer (open) period on all water objects it should be not less than 6 mg/dm^3	In winter period not less than 4mg/l , in summer period -not less than 6mg/l	In winter period not less than 4,0; and in summer period - not less than 6,0	4-6
Chemical oxygen demand, $COD_{bichrom}$	mgO_2/l			30		
Chemical oxygen demand, $COD_{permang}$	mgO_2/l					15
Biochemical oxygen demand, BOD_5	mgO_2/l	3 mg/l	At the temperature of 20^0C it should not exceed 3,0 mg/dm^3	3		3
Biochemical oxygen demand, BOD_{full}	mgO_2/l				3	7-8
Hydrogen (pH) index, pH	points	It should not go beyond 6,5 - 8,5	6,5-8,5	6,5		—
Alkalinity of waters	mg-экв/l		—			
General mineralization of water, $Мин_{gen}$	mg/l		1000	1000	1000	1000
Sulphates , SO_4	mg/l	100	100	100	100	100
Chlorides , Cl	mg/l	300	300	300	300	300
Calcium, Ca	mg/l	180	180	180	180	180
Magnesium, Mg	mg/l	40	40	40	40	40
Ammonia saline, NH_4	mg/l			0,5 (0,4 by nitrogen)		0,5

WATER QUALITY INDICATOR	MEASURE-MENT UNITS	MPC VALUE, APPLIED FOR ASSESSMENT OF THE QUALITY OF SURFACE WATERS				
		 KAZAKHSTAN	 KYRGYZSTAN	 TAJIKISTAN	 TURKMENISTAN	 UZBEKISTAN
Total nitrogen content, $N_{gen.}$	mg N/l		—			
Nitrates, NO_3	mg NO_3 /l	9,1 (40,0 mg/l by NO_3)	40 (in conversion to nitrates nitrogen- 9,0)	40 (9 by nitrogen)	9	40
Nitrites, NO_2	mg NO_2 /l	0,02 (0,08 mg/l by NO_2)	0,08 (in conversion to nitrites nitrogen 0,02)	0.08 (0.02 by nitrogen)	0,02	0,08
Ammonium, NH_4	mg NH_4/l	0,5	0,5 (in conversion to nitrogen 0,4)	0,4	0,39	0,39
General content phosphorusa, $P_{gen.}$	mg P/l				3,5	
Phosphates/ orthophosphates, PO_4	mg PO_4/l		0,05 - oligotrophic waters			
Phosphorus elementary, $P_{эл.}$	mg P/l					
Borum, B	mg/l	0,017				
Total ferrum, $Fe_{общ}$	mg/l	0,1	0,1	0,1		0,5
Ferrum, Fe^{2+}	mg/l	0,005		0,5		
Ferrum, Fe^{3+}	mg/l				0,5	
Cadmium, Cd	mg/l	0,005	0,005	0,005		5,0
Nickel general content , Ni	mg/l		0,01	0,01		10,0
Nickel dissolved, $Ni_{diss.}(Ni^{2+})$	mg/l	0,01				
Mercury, Hg	mg/l		absence			5,0
Lead, Pb	mg/l	0,1	0,006			30,0
Chrome, Cr^{3+}	mg/l	0,005	0,07	0,07		
Chrome, Cr^{6+}	mg/l	0,02	0,02	0,02		1,0
Zink, Zn	mg/l	0,01	0,01	0,01		10,0

WATER QUALITY INDICATOR	MEASURE-MENT UNITS	MPC VALUE, APPLIED FOR ASSESSMENT OF THE QUALITY OF SURFACE WATERS				
		KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN
Manganese, Mn	mg/l	0,01	0,01	0,01		
Cuprum, general content , Cu	mg/l	0,001	0,001	0,001		1,0
Arsenium	mg/l	0,05	0,05	0,05		50,0
Barium	mg/l					
Selenium	mg/l			0,002		
Silver	mg/l					
Strontium	mg/l					
Aluminum	mg/l			0,04		
Oil products	mg/l	0,05	0,05	0,05	0,05	0,05
Benzol	mg/l					0,5
Phenols	mg/l	0,001	0,001	0,001	0,001	0,001
Fluorides, F	mg/l	0,75	0,75	0,75		0,75
SSAS	mg/l		0,1	0,1	0,1	0,1
Rhodanides	mg/l					0,1
Cyanide, CN	mg/l		0,05			0,05
Dichlorodiphenyltrichloro-ethane and its isomers	mg/l	absence	absence		Provisionally 0,01 mkg/l	0,01

ANNEX 5. PARTICIPATION OF HYDROMETEOROGICAL SERVICES OF CA COUNTRIES IN INTERNATIONAL CONVENTIONS

INTERNATIONAL CONVENTIONS	PARTICIPATION OF THE COUNTRY					PARTICIPATION OF HYDROMETEOROGICAL SERVICES				
	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN	KAZHYDROMET	KYRGYZHYDROMET	TAJIKHYDROMET	TURKMENHYDROMET	UZHYDROMET
United Nations Framework Convention on Climate Change (Rio de Janeiro, Brazil, 1992)	X	X	X	X	X	• Participation in preparing national reports; • Issue of the annual Climatic bulletin (newsletter)	• Permanent member of the National Committee on the climate change • Delivery of necessary information on the climate • Issue of the annual Climatic bulletin (newsletter)	• Center for the climate change established under the Agency on Hydrometeorology	• Participation in preparing national reports • Delivery of data for taking inventory	• Preparing the national report on the climate changes (in 2017 the Third national report was prepared)
UN Convention to Combat Desertification and Land Degradation (Rio de Janeiro, Brazil. 1994)	X	X	X	X	X	No	No	No	Participation in workshops	Yes
The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, Finland, 1992)	X	–	–	X	X	No	–	–	Participation in workshops	No

INTERNATIONAL CONVENTIONS	PARTICIPATION OF THE COUNTRY					PARTICIPATION OF HYDROMETEOROGICAL SERVICES				
	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN	KAZHYDROMET	KYRGYZHYDROMET	TAJIKHYDROMET	TURKMENHYDROMET	UZHYDROMET
UN Convention on the Law of the Non-Navigation Uses of International Watercourses (New York, the USA. 1991)	–	–	–	–	X	–			–	No
The UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, Finland. 1991)	X	X	X	X	–	No	No	No	Participation in workshops	–
The UNECE Convention on the Transboundary Effects of Industrial Accidents (Helsinki, Finland. 1992)	X	–	–	X	–	No	–	–	Participation in workshops	–
Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Arhus, Denmark, 2000)	X	X	X	X	–	• Posting of the information about the environment conditions on official sites of the Ministry of Energy	• Posting of the information about the quality of the atmosphere air, of surface waters and of the radiation background on the site. • Delivery of the archive information as and when	• Participation activities of the Aarhus center under the Committee on Environment protection • Delivery of the monitoring information	Participation in workshops	–

INTERNATIONAL CONVENTIONS	PARTICIPATION OF THE COUNTRY					PARTICIPATION OF HYDROMETEOROGICAL SERVICES				
	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN	KAZHYDROMET	KYRGYZHYDROMET	TAJIKHYDROMET	TURKMENHYDROMET	UZHYDROMET
							necessary			
UN Convention on Wetlands of International Importance (Ramsar, Iran, 2002)	X	X	X	X	X	Participation in GEF/UNDP project (2017) «Complex preservation of priority lobally significant wetlands, as habitats of migratory birds: demonstration on three territories»	No	No	Participation in workshops	Yes
Helsinki Convention's Protocol on Water and Health	In the process of joining	–	–	–	–	No	No, but specialist participate in the Working group on target indicators	–	–	–

ANNEX 6. PARTICIPATION OF HYDROMETEOROGICAL SERVICES OF CA COUNTRIES IN REGIONAL AGREEMENTS

REGIONAL AGREEMENTS	PARTICIPATION OF THE COUNTRY					PARTICIPATION OF HYDROMETEOROGICAL SERVICES				
	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN	KAZHYDROMET	KYRGYZHYDROMET	TAJIKHYDROMET	TURKMENHYDROMET	UZHYDROMET
Agreement of Heads of CA states on joint actions on addressing problems of the Aral sea and of the Aral Sea region, on environmental sanitation and ensuring the social and economic development of the Aral sea region (Kyzyl-Orda 1993)	X	Participation is temporarily stopped	X	X	X	No	Participated until the moment, when participation of the country was stopped	No	Participation in workshops	No
Agreement on cooperation in the sphere of joint management, use and protection of interstate water resources (Almaty, 1992)	X	X	X	X	X	No	No	No	Participation in workshops	No
Agreement on the water and energy use in the Syrdaria river basin. (1998)	X	X	X	–	X	No	No	No	–	No

REGIONAL AGREEMENTS	PARTICIPATION OF THE COUNTRY					PARTICIPATION OF HYDROMETEOROGICAL SERVICES				
	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN	KAZHYDROMET	KYRGYZHYDROMET	TAJIKHYDROMET	TURKMENHYDROMET	UZHYDROMET
Agreement on cooperation in the field of environmental protection and rational use of natural resources. (Bishkek, 1998)	X	X	X	X	X	No	No	No	Participation in workshops	No
Agreement about the IFAS and its organizations' status (Tashkent,1997)	X	Participation is temporarily stoppedX	X	X	X	n/a	Participated until the moment, when participation of the country was s topped	Delivery of the necessary monito-ring information, organizational support in arrangements, implementation of adopted decisions	Participation in workshops	n/a

ANNEX 7. PARTICIPATION OF HYDROMETEOROGICAL SERVICES IN DEPARTMENTAL AGREEMENTS

AGREEMENT	PARTICIPATION OF THE COUNTRY					PARTICIPATION OF HYDROMETEOROGICAL SERVICES				
	KAZAKHSTAN	KYRGYZSTAN	TAJIKISTAN	TURKMENISTAN	UZBEKISTAN	KAZHYDROMET	KYRGYZHYDROMET	TAJIKHYDROMET	TURKMENHYDROMET	UZHYDROMET
Agreement on cooperation in the sphere of hydrometeorology (1999)	X	X	X	X	X	• Exchange of hydrological and meteorological data	• Exchange of hydrological and meteorological data	• Data exchange	• Only hydrological data is delivered	• Participates in sessions of the Interstate Council on Hydrometeorology
Agreement between CIS countries in the field of hydrometeorology (2003)	X	X	X	X	–	• Exchange of hydrological and meteorological data; • Exchange of regulatory and guidance documentation in the sphere of hydrometeorology and environmental protection	• Exchange of hydrological and meteorological data	• Participation in the work of session of the CIS Interstate Council • Realization of set tasks	• Only hydrological data is delivered	–
Agreement between Government of the Republic of Kazakhstan, Republic of Kyrgyzstan, Republic of Uzbekistan, Republic of Tajikistan on cooperation in the sphere of hydrometeorology (Bushkek, 1999)	X	X	X	–	X	• Exchange of hydrological and meteorological data	• Exchange of hydrological and meteorological data	• Participation in accordance with the adopted Cooperation Programme	–	• Exchange of hydrometeorological data

ANNEX 8. ҮPARTICIPATION OF CA HYDROMETEOROGICAL SERVICES IN BILATERAL/BASIN AGREEMENTS

AGREEMENT	COUNTRIES-PARTICIPANTS	COMMENTS, THE NATURE OF PARTICIPATION
Agreement between the Government of the Republic of Kazakhstan and Government of the Republic of Uzbekistan on cooperation in the field of environmental protection and rational management of natural resources	 KAZAKHSTAN, UZBEKISTAN	Within its competence, in 2016 «Kazhydromet» offered to establish a Working group for further study of issues in the field of protection and rational use of water resources and prevention of their contamination, for joint realization of samples selection, analysis and exchange of data on the water quality and exchange of normative and regulatory documents. Currently «Kazhydromet» monitors the water quality in boundary areas on a unilateral basis.
Agreement between the Government of the Republic of Kazakhstan and the Government of the Republic of Kyrgyzstan on the use of water management facilities of intergovernmental status	 KAZAKHSTAN, KYRGYZSTAN	Up to 2013 specialists of «Kazhydromet» branch office on Zhambyl oblast (on the part of Kazakhstan), «Kyrgyzhydromet» and SAEPF (on the part of Kyrgyzstan) 2 times a year carried out a joint transboundary monitoring of rivers Shu (Chu) and Kara-Balta. Because of emerged disagreements on carrying out the transboundary monitoring, on the 4-th meeting of Kyrgyzstan-Kazakhstan Intergovernmental Council in November 2013, the monitoring of transboundary rivers was stopped in 2014 In 2015, within the frames of the UNDP/GEF regional programme «Promotion to Transboundary Cooperation and Integrated Water Resources Management in basins of rivers Shu and Talas», the Parties decided to found an Expert Working Group on the Environment under the Secretariat of Water Management Commission, where Parties will discuss the issue of carrying out monitoring of the quality of transboundary riversa. On the 20-th session of the Chu-Talas Water Management Commission, in 2016 the Working Group on the Environment was established. Currently, the project "Promotion to Transboundary Cooperation and Integrated Water Resources Management in basins of rivers Chu and Talas" is realized with the support of the UNDP/GEF project. By now, the Transboundary diagnostic analysis has been developed and works are in progress on development of the Strategic plan of actions that will allow to make decisions on distribution and management of water resources, taking into consideration the impact of each type of water use to other types of water use. At that, general social and economical targets, including targets on achieving sustainable development are taken into account.