COOPERATION

Environment

GEO Capacity Building Initiative in Central Asia (SEOCA)

# CA's Regional Database of Surface Waters observations
# Version 1

## Contents page

# Introduction

Preserving regional surface water resources is one of the most urgent and difficult issues of regional EO activities. In fact, all countries of the region healily depend on water for sustainable agriculture and other priority areas of economies (like mining and cotton processing). During the Soviet times the structure of the regional economy was shaped in or5der to provide the entire USSR with grain (predominantly Kazakhstan), cotton (mainly Uzbekistan and Tajikistan) and other products manufacturing processes of which require large volumes of water. Until now, the unbalanced economy's structure leads to over-exploitation of surface water in all countries of the region.

Irresponsible exploitation of very limited water resources has already resulted in irreversible environmental changes (e.g. degradation of the Aral Lake, rapid desertification of large areas previously used for agriculture, salinization, etc.). Moreover, the growing population faces serious shortage of drinking water of acceptable quality.

The countries of the region are clearly divided on those who provide water originating from mountains of Tajikistan (partially Kyrgyzstan) and those who do not possess their own sources of surface waters – above all Uzbekistan and Kazakhstan. This situation required the high-level region-wide decisions and implementation mechanisms in order to ensure fair and sustainable exploitation of water resources. In this process the quality of waters is one of the most central questions, especially taking into account trans-boarder character of the water use agreements.

The presented work is the first region-wide effort to establish in-situ observation mechanism of surface waters quality and enable exchange of data between the national organizations in charge of water quality observations (normally – Hydromets).

# Methodology

One of the tasks of the SEOCA project is the development of the regional pilot database of surface waters quality.

Water quality is the characteristics of the chemical composition and properties of water defining its usability for certain types of economic activities. The water quality can be assessed by using various indicators. One of the main indicators is Maximum Allowable Concentrations (MAC) of polluting substances.

MAC is a value of concentration of polluting substance, which should not directly or indirectly influence a human organism during its lifetime, as well as the state of health of its offspring. This concentration should not also worsen the hygienic conditions of water use or provide suppressing influence on fish population depending on a particular type of water use. Therefore, there are different values of MAC (for fisheries, for drinking, for household use, etc.)

The water quality monitoring is being carried out in all Central Asian countries, as timely and accurate data about water quality is the basis for water use regulation, rational use of water, informing authorities and population about potential hazard situations linked to use of water.

As well known, chemical composition of water in the nature is complex and diverse. But, under the manmade influence, surface waters adsorb more and more additional pollutants. One-time measurements of concentrations of particular pollutants do not allow an accurate and full picture about overall pollution of water objects. Therefore, the special methods of complex assessment of surface waters pollution have been developed.

**Water Pollution Index (WPI)**

Environmental indicator allowing classifying water pollution is hydro-chemical water pollution index (WPI)

WPI is an index, which is being calculated on the basis of summary presence of 6 most present pollutants. WPI is used in the monitoring systems of all Central Asian countries. Therefore, the consortium made a decision to create the database on the basis of this indicator.

**Assessment method for WPI**

Index of water pollution can be calculated by using the following formula:

$$\text{WPI} = \sum_{i=1}^{6} \frac{Ci}{MACi}$$

Where

$C_i$ – concentration of the pollutant i

$MAC_i$ – MAC of the pollutant i, used for fishery water objects

6 – strictly limited number of measured indicators, typically these are the following parameters:

- Concentration of dissolved oxygen
- Biological need in oxygen (BNO)
- Concentration of four pollutants exceeding their MACs most of all others

**Major requirements for data monitoring and gathering used for WPI assessment**

- Accuracy of average values of pollutants concentrations

- All chemical tests shall be done by accredited laboratories with developed system of quality control
- The number of indicators is strictly limited, the simultaneous measurements of all of them are compulsory

The data about WPI observations is available starting from 80ths. Annually the data is being also published in Review of water quality.

**Classification of water objects quality in accordance with WPI**

According to the values of WPI all water objects are classified into classes (see Table 1)

**Table 1. Classes of water quality in accordance with the values of IWP**

| Waters | WPI value | Classes of water quality |
|---|---|---|
| Very clean | Up to 0,2 | 1 |
| Clean | 0,2-1,0 | 2 |
| Low polluted | 1,0-2,0 | 3 |
| Polluted | 2,0-4,0 | 4 |
| Significantly polluted | 4,0-6,0 | 5 |
| Very polluted | 6,0-10,0 | 6 |
| Unacceptably polluted | >10,0 | 7 |

## Regional pilot database description

As observation objects, two largest trans-border rivers of Central Asia have been selected – rivers Syrdarja and Amudarja.

The pilot DB is first developed in the MS Excel environment. It has the following attributes:
- Name of country
- Name of river (water object)
- Geodetic coordinates of observation range
- Name of the place (name of the water object, administrative unit, region, etc.)
- Name of the range
- Year
- WPI value
- WPI class

**Characteristics of the DB objects**

**Syrdarya river basin**
- Total area of Syrdarya river basin is about 345 thous. km2.
- The main river is formed with the merging of Naryn and Karadarya rivers, and its length up to the mouth is more than 2800 km, and on the distance of about 2000 km it flows outside the territory of Uzbekistan.
- Alimentation of Syrdarya and its tributaries is attributed to the snow-and-glacier type.
- Water capacity of Syrdarya is 41,6 km3, in average.

- The main flow volume (about 70%) is formed in the upper part of the basin up to the place of outflow from Fergana valley. The highest number of the river inflows is from the right side, in the eastern part of Fergana valley; from the left side the numerous temporal water courses inflow the river, and their flow is negligible.

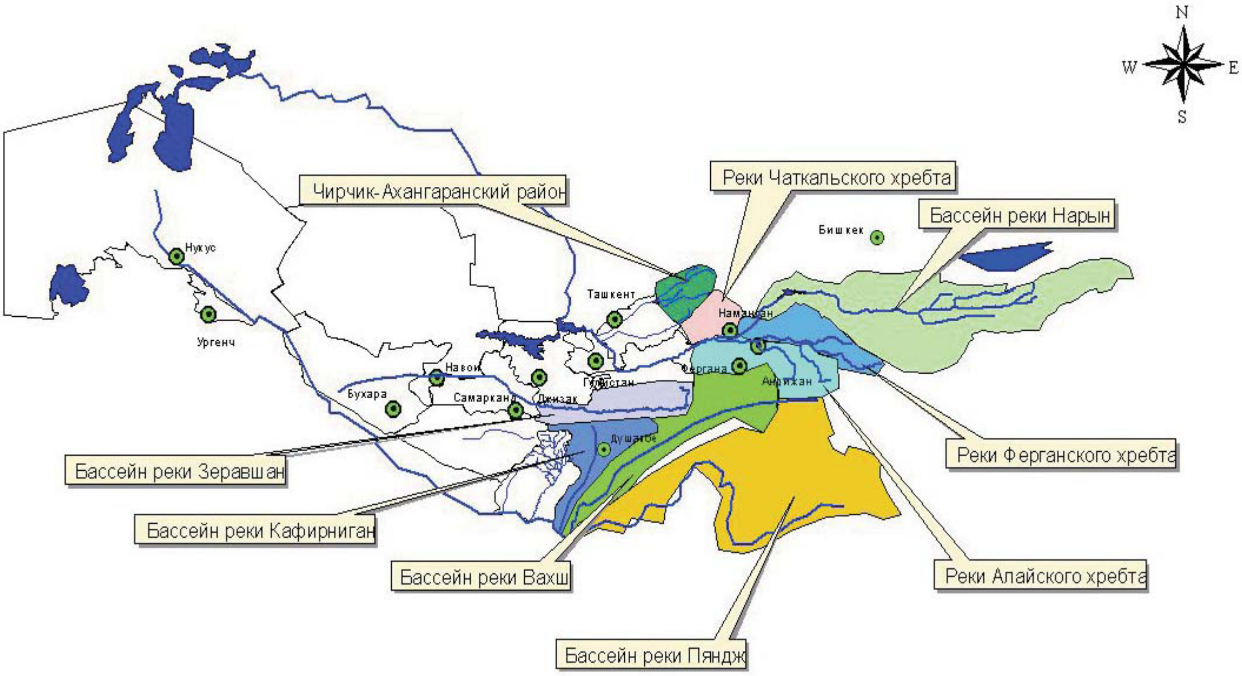
**Amudarya river basin**

- Amudarya is the river with the highest flow, which is 2/3 of the total water resources of the Aral basin.
- The length of Amudarya from the origin of Pyandj river up to the Aral Sea is 2540 km; on the distance of more than 1000 km the river flows along the territory of Uzbekistan.
- The basin occupies the vast territory (about 1,327 thous. km2).
- After merging with Vakhsh the river becomes to be named Amudarya.
- Then it flows along the border between Afghanistan and Uzbekistan, then flows along the territory of Turkmenistan, afterwards, it again flows back to Uzbekistan and inflows to the Aral Sea with forming the vast delta (with the width up to 300 km) approaching it. In the middle flow two big right-side tributaries (Kafirnigan, Surkhandarya) and one left-side one (Kunduz) inflow Amudarya. Then up to the Aral Sea it does not get any inflow. The river current crosses the deserts and semi-deserts being the separating line between Karakum and Kyzylkum deserts. On the plain from Kerki up to Nukus Amudarya river looses the major part of its flow in the result of evaporation, infiltration and water intake for irrigation.
- By its turbidity Amudarya takes the first place in Central Asia and one of the first places in the world.
- Amudarya is attributed to the rivers of the snow-and-glacier alimentation,
- Its water capacity is 68,63 km3.
- The main flow volume (85%) is formed by the inflows of Vakhsh and Pyandj while the inflows from Surkhandarya, Kafirnigan and Kunduz make only 15%.
- Total accounted surface inflow from the water catchments area is more than 80,5 km3.

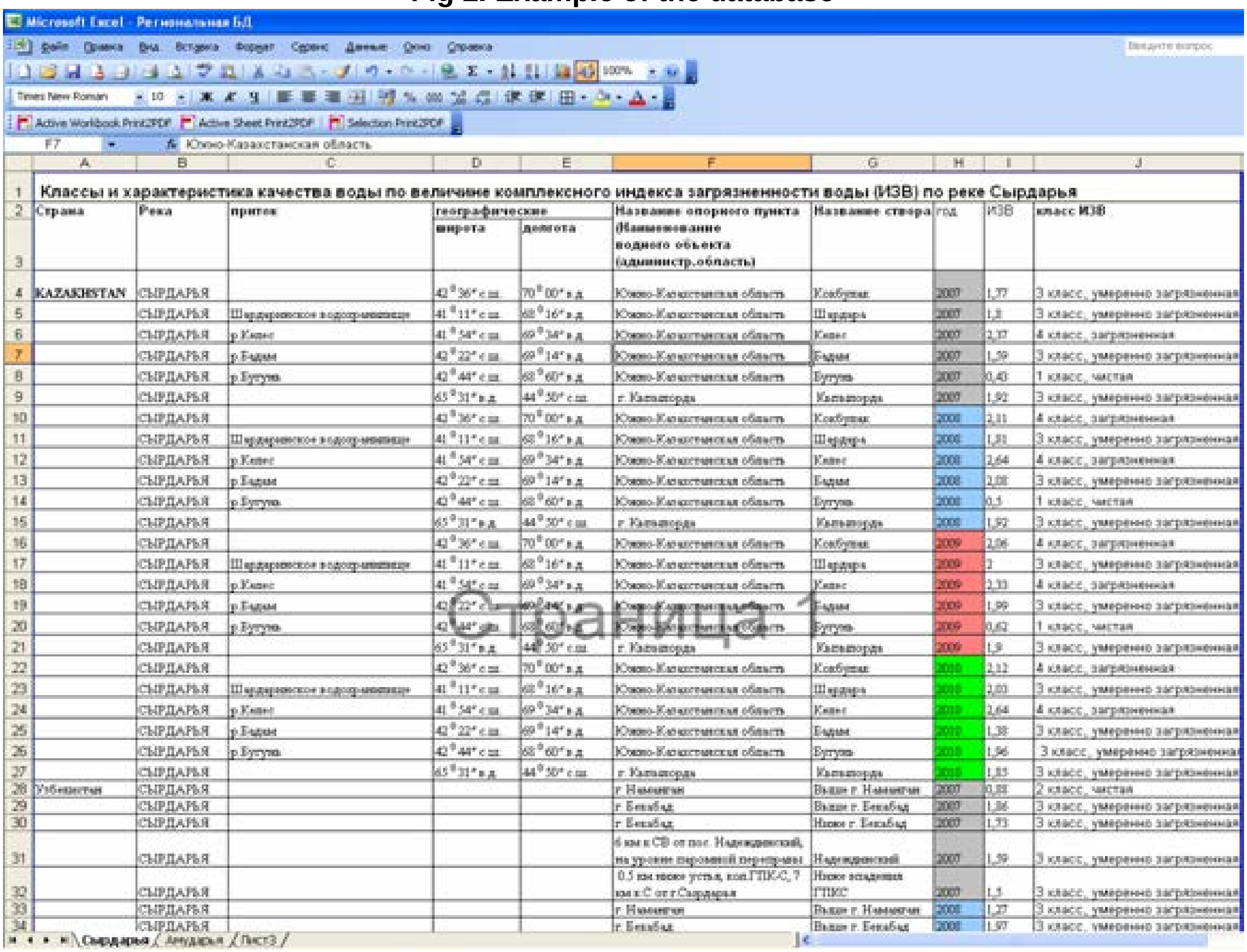
**Chu river basin**

- Chu river flows over territory of Kyrgyzstan and Kazakhstan.
- Its length is 1067 kmм, basin area is 62500 $km^2$. Chu is attributed to the rivers of the snow-and-glacier alimentation; the role of the ground flow is substantial.
- Its water capacity is 6,64 km3, 5,5 km3of them is formed on the territory of Kyrgyzstan.
- Chu river is formed with the merging of Joonaryk and Kochkor rivers which take their origin in the glaciers of Terskei-Ala-Too and Kyrgyz Ala-Too ranges. Down their merging in the mountain gorge Ortotokoi water storage is constructed on Chu river. Then the river is entering Issykkul trough but it flows to the west from Issyk-Kul lake; in the flood period the part of Chu flow along Kutemaldy horn inflows to the lake. Across Boomskoe gorge the river inflows to Chui valley where a lot of glaciers flow down from the surrounding mountains.
- But later from the river over the numerous canals (the biggest of which is Big Chui Canal) more than half of the flow is taken for the irrigation of fields. Chu current is mainly the border between Kyrgyzstan and Kazakhstan, and then it flows to the Kazakhstan steppes.
- In the low reaches the river crosses Muyunkum desert and disappears in the Aschikkol depression.

## Fig 1. Map of territories covered by observations




## Fig 2. Example of the database




Классы и характеристика качества воды по величине комплексного индекса загрязненности воды (ИЗВ) по реке Сырдарья

| | Страна | Река | приток | географические: широта | географические: долгота | Название опорного пункта (Наименование водного объекта (администр.область) | Название створа | год | ИЗВ | класс ИЗВ |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | KAZAKHSTAN | СЫРДАРЬЯ | | 42°36' с.ш. | 70°00' в.д | Южно-Казахстанская область | Кокбулак | 2007 | 1,77 | 3 класс, умеренно загрязненная |
| 5 | | СЫРДАРЬЯ | Шардаринское водохранилище | 41°11' с.ш. | 68°16' в.д | Южно-Казахстанская область | Шардара | 2007 | 1,8 | 3 класс, умеренно загрязненная |
| 6 | | СЫРДАРЬЯ | р.Келес | 41°54' с.ш. | 69°34' в.д | Южно-Казахстанская область | Келес | 2007 | 2,37 | 4 класс, загрязненная |
| 7 | | СЫРДАРЬЯ | р.Бадам | 42°22' с.ш. | 69°14' в.д | Южно-Казахстанская область | Бадам | 2007 | 1,59 | 3 класс, умеренно загрязненная |
| 8 | | СЫРДАРЬЯ | р.Бугунь | 42°44' с.ш. | 68°60' в.д | Южно-Казахстанская область | Бугунь | 2007 | 0,43 | 1 класс, чистая |
| 9 | | СЫРДАРЬЯ | | 65°31' в.д | 44°50' с.ш. | г. Кызылорда | Кызылорда | 2007 | 1,92 | 3 класс, умеренно загрязненная |
| 10 | | СЫРДАРЬЯ | | 42°36' с.ш. | 70°00' в.д | Южно-Казахстанская область | Кокбулак | 2008 | 2,11 | 4 класс, загрязненная |
| 11 | | СЫРДАРЬЯ | Шардаринское водохранилище | 41°11' с.ш. | 68°16' в.д | Южно-Казахстанская область | Шардара | 2008 | 1,81 | 3 класс, умеренно загрязненная |
| 12 | | СЫРДАРЬЯ | р.Келес | 41°54' с.ш. | 69°34' в.д | Южно-Казахстанская область | Келес | 2008 | 2,64 | 4 класс, загрязненная |
| 13 | | СЫРДАРЬЯ | р.Бадам | 42°22' с.ш. | 69°14' в.д | Южно-Казахстанская область | Бадам | 2008 | 2,08 | 3 класс, умеренно загрязненная |
| 14 | | СЫРДАРЬЯ | р.Бугунь | 42°44' с.ш. | 68°60' в.д | Южно-Казахстанская область | Бугунь | 2008 | 0,5 | 1 класс, чистая |
| 15 | | СЫРДАРЬЯ | | 65°31' в.д | 44°50' с.ш. | г. Кызылорда | Кызылорда | 2008 | 1,92 | 3 класс, умеренно загрязненная |
| 16 | | СЫРДАРЬЯ | | 42°36' с.ш. | 70°00' в.д | Южно-Казахстанская область | Кокбулак | 2009 | 2,06 | 4 класс, загрязненная |
| 17 | | СЫРДАРЬЯ | Шардаринское водохранилище | 41°11' с.ш. | 68°16' в.д | Южно-Казахстанская область | Шардара | 2009 | 2 | 3 класс, умеренно загрязненная |
| 18 | | СЫРДАРЬЯ | р.Келес | 41°54' с.ш. | 69°34' в.д | Южно-Казахстанская область | Келес | 2009 | 2,33 | 4 класс, загрязненная |
| 19 | | СЫРДАРЬЯ | р.Бадам | 42°22' с.ш. | 69°14' в.д | Южно-Казахстанская область | Бадам | 2009 | 1,99 | 3 класс, умеренно загрязненная |
| 20 | | СЫРДАРЬЯ | р.Бугунь | 42°44' с.ш. | 68°60' в.д | Южно-Казахстанская область | Бугунь | 2009 | 0,62 | 1 класс, чистая |
| 21 | | СЫРДАРЬЯ | | 65°31' в.д | 44°50' с.ш. | г. Кызылорда | Кызылорда | 2009 | 1,9 | 3 класс, умеренно загрязненная |
| 22 | | СЫРДАРЬЯ | | 42°36' с.ш. | 70°00' в.д | Южно-Казахстанская область | Кокбулак | 2010 | 2,12 | 4 класс, загрязненная |
| 23 | | СЫРДАРЬЯ | Шардаринское водохранилище | 41°11' с.ш. | 68°16' в.д | Южно-Казахстанская область | Шардара | 2010 | 2,03 | 3 класс, умеренно загрязненная |
| 24 | | СЫРДАРЬЯ | р.Келес | 41°54' с.ш. | 69°34' в.д | Южно-Казахстанская область | Келес | 2010 | 2,64 | 4 класс, загрязненная |
| 25 | | СЫРДАРЬЯ | р.Бадам | 42°22' с.ш. | 69°14' в.д | Южно-Казахстанская область | Бадам | 2010 | 1,38 | 3 класс, умеренно загрязненная |
| 26 | | СЫРДАРЬЯ | р.Бугунь | 42°44' с.ш. | 68°60' в.д | Южно-Казахстанская область | Бугунь | 2010 | 1,96 | 3 класс, умеренно загрязненная |
| 27 | | СЫРДАРЬЯ | | 65°31' в.д | 44°50' с.ш. | г. Кызылорда | Кызылорда | 2010 | 1,83 | 3 класс, умеренно загрязненная |
| 28 | Узбекистан | СЫРДАРЬЯ | | | | г. Наманган | Выше г. Наманган | 2007 | 0,88 | 2 класс, чистая |
| 29 | | СЫРДАРЬЯ | | | | г. Бекабад | Выше г. Бекабад | 2007 | 1,36 | 3 класс, умеренно загрязненная |
| 30 | | СЫРДАРЬЯ | | | | г. Бекабад | Ниже г. Бекабад | 2007 | 1,73 | 3 класс, умеренно загрязненная |
| 31 | | СЫРДАРЬЯ | | | | 6 км к СВ от пос. Надеждинский, на уровне паромной переправы | Надеждинский | 2007 | 1,59 | 3 класс, умеренно загрязненная |
| 32 | | СЫРДАРЬЯ | | | | 0.5 км ниже устья, кол.ГПК-С, 7 км к С от г.Сырдарья | Ниже впадения ГПКС | 2007 | 1,5 | 3 класс, умеренно загрязненная |
| 33 | | СЫРДАРЬЯ | | | | г. Наманган | Выше г. Наманган | 2008 | 1,27 | 3 класс, умеренно загрязненная |
| 34 | | СЫРДАРЬЯ | | | | г. Бекабад | Выше г. Бекабад | 2008 | 1,97 | 3 класс, умеренно загрязненная |

Fig 3. Visualization of the DB