The problems of use, protection and management of water-land resources of the Aral Sea Basin.

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The Aral Sea Basin
Land resources of the Aral Sea Basin

- Out of total 154.9 mln. ha some 59.1 mln. ha are considered as cultivable, of which only about 10 mln. ha are actually used.

- Good land availability in Kazakhstan and Turkmenistan and land scarcity for the three other countries.

- Cotton still remains one of the most important crops, even though between 1990 and 2005 its share of irrigated agriculture decreased from 45% to 25%.

- Wheat became the dominant crop in the region, which covers about 30% of total irrigated area.
## Land resources of the Aral Sea basin

<table>
<thead>
<tr>
<th>Country</th>
<th>Area of the country</th>
<th>Cultivable area</th>
<th>Cultivated area</th>
<th>Actually irrigated area</th>
<th>Share of irrigated area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ha</td>
<td>ha</td>
<td>ha</td>
<td>ha</td>
<td>%</td>
</tr>
<tr>
<td>Kazakhstan*</td>
<td>34 440 000</td>
<td>23 872 400</td>
<td>1 658 800</td>
<td>786 200</td>
<td>2.28</td>
</tr>
<tr>
<td>Kyrgyzstan*</td>
<td>12 490 000</td>
<td>1 257 400</td>
<td>595 000</td>
<td>422 000</td>
<td>3.38</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>14 310 000</td>
<td>1 571 000</td>
<td>769 900</td>
<td>719 000</td>
<td>5.02</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>48 810 000</td>
<td>7 013 000</td>
<td>1 805 300</td>
<td>1 735 000</td>
<td>3.55</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>44 884 000</td>
<td>25 447 700</td>
<td>5 207 800</td>
<td>4 233 400</td>
<td>9.48</td>
</tr>
<tr>
<td>The Aral Sea basin</td>
<td>154 934 000</td>
<td>59 161 500</td>
<td>10 036 800</td>
<td>7 895 600</td>
<td>5.09</td>
</tr>
</tbody>
</table>

* only provinces in the Aral Sea basin are included
Land resources per capita in the countries of the Aral Sea Basin
Desertification

The gradual transformation of habitable land into desert: *is usually caused by climate change or by unsustainable use of the land*
Risk of Human Induced Desertification
Desertification

- **Overgrazing** - the cattle, sheep, goats and other animals take away the vegetation cover and expose the bare soil
- **Overcultivation** – constantly growing numerous crops and others on the same land areas damages the soil structure and reduces the soil fertility
- **Poor irrigation** - can lead to salinisation
- **Deforestation** - leads to lower rainfall and higher temperatures
Land degradation in the Aral Sea Basin

• The five Aral Sea Basin countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) share common land degradation problems due to their geographic proximity and the Soviet legacy of environmental mismanagement.

• Soil degradation (loss of fertility, salinization, waterlogging); degradation of pastures (due to overgrazing and excessive agricultural and timber harvesting); degradation of forests (due to illegal logging, fires, grazing, erosion); erosion, landslides, and mudflows.
Degradation of the land

Natural - climatic factors and antropogenic activities led to desertification and degradation of the lands in the region and main concerns:

• Secondary salinisation, flooding and rehumidifying of the lands in the conditions of irrigated agriculture

• Water and irrigational erosion of soils in mountain and foothill areas

• Desertification, aforestiation and other phenomena

• A deflation and pasturable digression in areas of intensive cattle industries

• Technogenic desertification at agricultural and industrial land development

• Salinization of soils, caused by drying up of the Aral Sea and sedimentation salinedust erosols and etc.
Soil Salinization
Washing of the salinizated soil
Land Pollution by Pesticides in Uzbekistan, 2006

Source: Goskompriroda
Dust storm from the Aral Sea

Dust storm in the Aral Sea Basin

http://rapidfire.sci.gsfc.nasa.gov/gallery/

Number of days with dust storms (per year)

26

Number of days with higher content of particulate matters in city air (per year)

340
What can be done?

Combating following problems:

- Overgrazing - Fence off of young trees to prevent grazing
- Overcultivation - Using good farming practices such as proper crop rotation and the use of manure as a fertiliser
- Poor irrigation – Prevent excessive evaporation on the surface which wastes water and increases its salinity
- Deforestation - Afforestation, that is planting trees, especially in shelter belts. Planting grasses can help stabilise the soil and cut down on erosion by wind and rain.
- Drought - This can be triggered by deforestation, so afforestation should help reduce this. Also terracing the land to slow down the water running off will make better use of the rainfall
## Surface water resources in the Aral Sea Basin
(mean annual runoff, km³/year)

<table>
<thead>
<tr>
<th>Country</th>
<th>River Basin</th>
<th>Total Aral Sea Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Syrdarya</td>
<td>Amudarya</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>2.52</td>
<td>—</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>27.54</td>
<td>1.65</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>1.00</td>
<td>58.73</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>—</td>
<td>1.40</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>5.56</td>
<td>6.79</td>
</tr>
<tr>
<td>Afghanistan and Iran</td>
<td>—</td>
<td>10.81</td>
</tr>
<tr>
<td>Total Aral Sea basin</td>
<td>36.62</td>
<td>79.39</td>
</tr>
</tbody>
</table>
Water resources of Main rivers

- The total mean annual flow of all rivers in the Aral Sea Basin is estimated as about 116 km3. This amount comprises:
  1. the flow of the Amudarya at 79.4 km3/year.
  2. the Syrdarya at 36.6 km3/year.

- In accordance with flow probabilities of 5% (high wet years) and 95% (dry years),
  1. the annual flow ranges from 109.9 to 58.6 km3 for the Amudarya river,
  2. from 51.1 to 23.6 km3 for the Syrdarya river, respectively.
The Aral Sea Basin countries jointly use surface water resources.

- **Area of the Basin** – 1,550,000 km²
- **Total length of irrigation network:**
  - inter-farm – 47.75 th. km
  - on-farm – 268.6 th. km
- **Total amount of drainage wells** – 1,865
- **Total length of collector-drainage network** – 191.9 th. km,
- **including subsurface** – 47.9 th. km
Surface runoff of the rivers (Uzgidromet)

- *Surface runoff* of the rivers is formed mainly in the mountainous part of the region, in general, due to precipitation in the cold period of the year.
Annual Runoff of the Main Rivers

mln.m³/yr

Year

Syrdarya
Amydarya
Number of large and medium reservoirs - 60

- Total volume – 64.8 km³
- Useful volume – 46.8 km³

Number of system forming reservoirs – 7:
- Toktogul - 19.5 km³
- Kayrakkum – 3.4 km³
- Chardara – 5.2 km³
- Nurek – 10.5 km³
- Tuyamuyun – 7.27 km³
- Charvak – 2.01 km³
- Andijan – 1.9 km³
Share of water resources in agriculture among the Aral Sea Basin countries

- **Turkmenistan**: 21%
- **Kazakhstan**: 13%
- **Kyrgyzstan**: 8%
- **Tajikistan**: 10%
- **Uzbekistan**: 48%
Cotton watering
Average water consumption for irrigation (1997-2004)
Loss of water resources

• Agricultural sector is the main water resources consumer in the region, as its agricultural production almost entirely depends on irrigation for which about 90% of the water withdrawal from the surface sources is used.

• Due to poor conditions of the irrigation network and ineffective water resources management, a great amount of water is lost through evaporation and infiltration. The losses in the irrigation network are estimated at 40%.
The main sources of pollution in river water of the Aral Sea Basin are “Return Water”.

The annual mean values of return flows, consisting of drainage and wastewater from irrigation, industry, and municipal users have varied:

- 28.0 km$^3$ - 33.5 km$^3$
- 13.5 to 15.5 km$^3$ form in the Syrdarya river basin
- 16.0 to 19.0 km$^3$ in the Amudarya river basin

Drainage water is highly saline:

- from 2 to 3 g/l from April to September
- 5-12 g/l during autumn and winter periods
Return flows

- About 95% of the total volume of return flow is the irrigation drainage water and the rest part is the industry and municipal wastewater.

- The annual volume of dumped salts in composition of return water is more than 70-80 mln. ton.

- Only about 15% of total return flows are re-used and more than 55% returns to rivers. About 30% ends up in natural depressions.
Drainage and wastewater variations in the Syrdarya river basin
WASTE WATER DUMPS IN THE SYRDARYA RIVER ON BRANCHES OF NATIONAL ECONOMY

- Housing-municipal economy: 90%
- Animal industry: 2%
- Industry: 7%
- Irrigated agriculture: 1%

Legend:
- Red: Housing-municipal economy
- Light blue: Animal industry
- Yellow: Industry
- Green: Irrigated agriculture
Drainage and wastewater variations in the Amudarya river basin
Formation of the lakes caused by inefficient water use
Quality of surface water. Source: Uzgidromet

The distribution of the basin area according to water pollution indexes (%)

Water pollution indexes of some rivers

<table>
<thead>
<tr>
<th>River</th>
<th>Water quality</th>
<th>Pollutant</th>
<th>MAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zeravshan</td>
<td>Normal</td>
<td>NO₃</td>
<td>0.38</td>
</tr>
<tr>
<td>Aral</td>
<td>Normal</td>
<td>NH₃</td>
<td>0.5</td>
</tr>
<tr>
<td>Syrdarya</td>
<td>Normal</td>
<td>Cl</td>
<td>1.38</td>
</tr>
<tr>
<td>Amu-Darya</td>
<td>Normal</td>
<td>Zn</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Complex characteristics of the surface water quality according to the water pollution index (WPI)

- **Good**: 0.1-1.0 - the anthropogenic influence is noticeable, but water kept its natural qualities. It can be used for drinking
- **Satisfactory**: 1.1-3.0 - there is an admixture of sewage, and the natural quality of water has been changed. Water can be used in fishery and, using modern methods of purification, for drinking
- **Bad**: 3.1-5.0 - polluted as a result of admixture of industrial and municipal sewage and the runoff of sewer-drainage waters and regenerated flow from the irrigated area. It is unsuitable for water supply of the population and for use in the municipal services. It can be used for irrigation
- **Dangerous**: 5.1-10.0 - extremely polluted with industrial and the municipal sewage. In the lower limits it can be used for irrigation of some crops
- **Very dangerous**: over 10.0 - water has turned into constant or periodical runoff of very polluted industrial and municipal waters. It is unsuitable for use in municipal services
- **The area where there is no constant overland runoff**
<table>
<thead>
<tr>
<th>State</th>
<th>Evaluation of regional resources</th>
<th>Exploitation resources approved to use</th>
<th>Available to use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kazakhstan</td>
<td>1.84</td>
<td>1.22</td>
<td>0.17</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>0.862</td>
<td>0.67</td>
<td>0.291</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>6.65</td>
<td>2.20</td>
<td>0.97</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>3.36</td>
<td>1.22</td>
<td>0.42</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>18.45</td>
<td>7.79</td>
<td>6.95</td>
</tr>
<tr>
<td>Aral Sea Basin</td>
<td>31.17</td>
<td>13.11</td>
<td>8.07</td>
</tr>
<tr>
<td>SyrDaria basin</td>
<td>16.42</td>
<td>7.43</td>
<td>4.76</td>
</tr>
<tr>
<td>AmuDaria basin</td>
<td>14.75</td>
<td>5.68</td>
<td>3.31</td>
</tr>
</tbody>
</table>
Influence of climate change

- It is expected that the water flow will potentially decrease by 2-5% in the Syrdarya River Basin and by 10-15% in the Amudarya River Basin by 2050.

- During the years of acute water scarcity (assessment for extremely warm and dry years), irrigation water use in the Syrdarya and Amudarya Rivers basins might decrease by 25-50%.

- It is expected that irrigation norms will increase in average by 5% by 2030, 7-10% by 2050, and 12-16% by 2080 in Uzbekistan.

(Data source: from Uzgidromet.)
WATER RESOURCES MANAGEMENT OF THE ARAL SEA BASIN

• After disintegration of Soviet Union there were certain difficulties in water resources management of the Aral Sea basin.

• The main rivers of the Aral Basin originate in Tadjikistan, Kyrgyzstan and Afghanistan.

• Main consumers of water resources of the Basin are downstream Uzbekistan and Turkmenistan and Kazakhstan. Therefore, now there are some disagreements with upstream riparian's planning huge hydropower projects that might influence irrigation regime of the downstream neighbours.

• This creates the need for proper mechanisms of water and energy resource management, including mechanisms of prevention and resolution of conflicts in dry years.

• It is also necessary to take into account the future water withdrawal by Afghanistan.
THE INTERNATIONAL COOPERATION ON ENVIRONMENTAL PROTECTION

The above-stated scales and complexity of ecological problems require the complex and diversified approach and significant internal resources, which in conditions of transition economy, and the formations of the market relations, are rather limited.

For this reason the significant role is got by external financing, which should be concentrated on the decision of global and regional questions of environmental protection and rational use of water resources of the Aral Sea Basin.
SOME RECOMMENDATIONS

Development of scientific - practical, engineering - design works directed on the savings, rational use and protection of water resources of the Aral Sea basin.

Development of monitoring of water in the basin of the rivers Amu Darya and Syr Darya, equipment by modern means of the account of volume and quality of river waters.

Realization of research and engineering-design works on clearing, regeneration of collector-drainage waters for reuse, demineralization of salty waters.
Reconstruction of water-industry and irrigation systems.

Perfection and development of economic mechanisms in sphere of water distribution and use at national and regional levels.

Joining respective international laws and conventions and enforcement of their implementation for joint rational use and management of the transboundary waters in the region.

Strengthening interaction between NGOs, Mass media, governments, international funds, and organizations on decision level of the Water problem.
Village in Priaralie got drinking water
THANK YOU FOR YOUR ATTENTION!