Assessment of human activities impact in Zeravshan river basin

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1. Abstract

Zeravshan River basin is the origin place of the ancient agricultural and urban civilization of Central Asia. It is transboundary river originating in Tajikistan mountains and flowing to the Uzbekistan. The climate is sharply continental, mostly arid and semi-arid in downstream, main water source is glacier-snow melt. Zeravshan river basin has no significant tributaries and water is mostly used for irrigation. Previously it was a part of the Aral Sea basin, however due to intensive irrigation use, nowadays it disappears in the Kyzyl kum desert sands. The Soviet development plan for the basin was focused on increasing yield production through extensive irrigation (Saiko and Zonn 2000). This plan caused irreversible damage in terms of water quality and ecosystem degradation and biodiversity. The water diversion for irrigation is almost equal to the total water flow of the river. Nowadays downstream oases are irrigated from the Amu Darya River supplied by Amu-Bukhara canal. This phenomenon is result of poor watershed management, water consumption increase for irrigation and misuse for leaching of the salt affected lands. Among Central Asian rivers Zeravshan River basin is one of the most profoundly affected by mismanagement of the water resources. Considering Central Asian is landlocked it is greatly vulnerable to the climate variability with scarcity of water, drought and temperature extremes above global average, study on remediation strategies and adaptation measures are important factor for the agriculture and economic growth in the region. This study is focused on the results of the water monitoring analyses and adaptation measures.

2. Climate and human activity impact

According to different global and regional climatic scenarios, in the next 20-35 years the annual average air temperature will increase by 1.5-2.5°C in Central Asia (Agaltseva, 2002). Hagg *et* al, 2007 suggests that temperature in the region will be increasing leading to the progressive recession of the glaciers and reduction of the snow-melt, which in the short-term might increase the run-off from melting water, but in the long term, due to the higher temperatures will result in decreased run-off. Increasing water availability mainly in winter and early spring, while in summer the most important agricultural term in irrigation it may decrease. The short-time beneficial impacts of the increased annual runoff will be tempered by negative effects of increased precipitation variability and changes in seasonal runoff (Bates *et* al, 2008). Climate change in increased temperature, leading to droughts and therefore increase the potential for conflict between two countries (Toderich, 2005).

Traditional furrow irrigation practices on abundant of water is effective to leach soil from salts leads to the further decrease soil conditions and deterioration in water in downstream areas, which will have negative effects on the livelihoods of farmers and pastoralists, especially living in the remote rural areas. Water resources regulation started still doesn't cover potential of marginal water usage and regulations of the water pollutions, however it has brought some of future promises. The impacts of land cover change and water resources availability as well as water quality results should be investigated.

3. Water resources assessment

The authors have performed water quality monitoring and assessment from 2005 to 2010 along Zeravshan river in Uzbekistan (Toderich et al 2005; Khujanazarov et al, 2012). The monitoring points are located over the basin allowing spatial and statistical analysis of water distribution figure 1. The monitoring was accompanied by hydrological and meteorological observations and irrigation system studies as well as soil and plant chemistry analysis.

3.1.Iirrigation and drainage network: The existing irrigation and drainage network were mostly constructed in the 1960s and is mainly open horizontal. The drainage water is conveyed from the irrigated fields via the collector drainage canals into numerous artificial small lakes and salt prone depressions (Toderich et al., 2010). The drainage canals built during Soviet Union era are poorly maintained at present. As a result, most of the drainage canals are silted up, leading to water table levels and salt accumulation rise. Additionally, they are choked with reeds and there is an imbalance between the inflow and outflow of water in these channels. Drainage water with the mineralization of 4000-5000 ppm, 6-7 dS/m is the unique available source of water for irrigation of crops. Increase in groundwater depth due to high water use and non-functional drainage system. In these areas many farmers have been using drainage water for irrigating crops, in absence of good quality water. The drainage water are blocked in the channel and pumped to irrigate the fields through small pumps. This has also resulted in more seepage of drained water in neighboring areas, raising the water table and subsequently, inducing soil salinity.

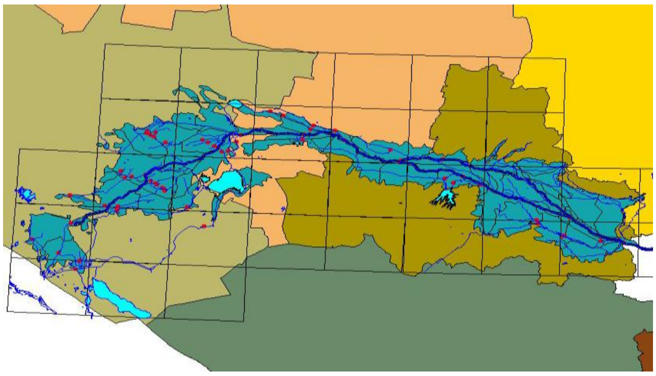

Figure. 1. Zeravshan river basin study area.

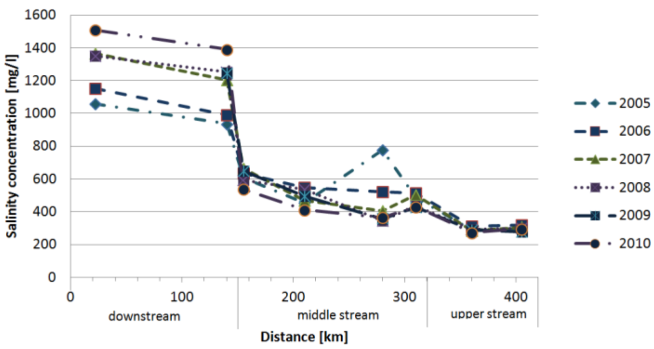

Figure 2. Water salinity level along Zeravshan river (2005-2010) (Khujanazarov et al, 2012)

3.2. Water quality and land use: The monitored datasets show that water quality of the upper part is significantly different than that in the lower reaches of Zeravshan river valley. Results showed that the river water consists of a variety of salts such as chlorides, of calcium, magnesium, biogenic elements and radionuclide with high concentration especially in the downstream area. Down the stream from mountains to Navoi city average mineralization increases from 0.3 to 1.5 g/l and then in Bukhara oasis it reaches 2.8 g/l. Mineralization level of water in the collector and drainage, broadly used in Bukhara oasis, is higher and ranges from 2.5 to 4.9 g/l.

The definitive correlation on salt level heading towards downstream can be extinguished on figure 2. It is mainly due to of the salt load in the return flows from irrigated areas discharged via the collector drains, which are usually poorly maintained. In the lower reaches of Zeravshan river basin there have been significant increases in mineralization of water and soil over the time because of the expansion of irrigated agriculture. The increased salinity level is mostly caused by leaching practice of irrigation and accompanied by decrease of river water discharge to the downstream in the last decade. Surface water from different sources in Bukhara oasis and part of Karakul plateau (lower reach of Zeravshan River) is contaminated by discharges from sewage treatment facilities.

4. Conclusion

The major problems of water management in all riparian countries of Aral Sea basins are pollution and overuse of water due to the supply-driven water management concept, luck of the crop rotation, weak water user's organizations, lack of investment in irrigation sector and rehabilitation of the irrigation infrastructure and finally, poor cooperation between upper and downstream riparian countries. Risk management strategies for the water resources management in the region needs to focus on the future water availability under climate change conditions and efficient irrigation strategies by including usage of the marginal waters. Current water conditions and policies for water resources pollution should be revised. Various water saving mechanisms and improved crop growth patterns at the downstream areas as wells as adaptation measures to the possible dam construction in upstream should be studied in order to reverse the water and land degradation of groundwater and surface water resources in future.

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Key words: risk assessment; water quality; land cover; climate change; Zeravshan river basin