Policy brief – May 2022

The scientific online tool "Water Use Efficiency Monitor for Central Asia - WUEMoCA" for monitoring and optimizing national water use efficiency measures

Main Findings

- Management interventions to increase water use efficiency in the irrigation sector of Central Asia were introduced but a scientific control instrument is still missing
- The online tool WUEMoCA provides relevant irrigation performance indicators in the Aral Sea Basin from satellite data in combination with additional sources
- WUEMoCA-based analysis of water security and water use efficiency showed:
    - 11 out of 33 provinces in the Aral Sea Basin were below the critical level to supply crop water demands for more than 5 years in 2000-2018.
    - Irrigation water use efficiency is very low in general (55%-60%) and scientific data hints at missing or failing water management interventions in the Amu Darya and Zarafshan basins.
- WUEMoCA can strategically supplement the ongoing digitization efforts of the countries in the water sector.
- By utilizing WUEMoCA-like tools, Central Asian governments and water management bodies will have new platforms for steering and assessing current and future strategic interventions in regional water management.

Introduction

Transboundary water distribution in the Aral Sea Basin is based on protocols agreed by the Interstate Coordination Water Commission (ICWC) on a seasonal basis. In all countries sharing the Aral Sea Basin, reorganization of water allocation in the river systems is a current policy task. It is challenging as water demand for agriculture is increasing, among others due to population growth in the rural Aral Sea Basin, climate change and increasing irrigation activities, e.g. in Afghanistan.

Climate models, e.g. applied to the Syr Darya or Isfara catchments, suggest that rising air temperatures most likely will increase water availability in spring, but reduce runoff in summer. At the same time, crop water demands will increase. Higher climatic variability will increase the frequency of severe droughts particularly for middle and lower reaches of the Aral Sea Basin. Overall, there is a high risk that climate change negatively affects crop yields, challenging food security in the Aral Sea Basin.

To meet the challenges of climate change, various measures to increase water use efficiency have been implemented. However, successful water-saving at a particular site could be neutralized with increased water use at another site in the same basin. Also timely water provision

downstream is essential. Optimization is only possible using spatial analysis at larger scales, but currently, there is a lack of instruments in place for area-wide control or monitoring the success or optimized planning of these measures.

Consequences

Various organizations worldwide showed scientific evidence that spatial data and techniques can be essential in optimizing water resources, enhancing crop water productivity and devising strategic policies for food security and sustainable development of ecosystems. To the contrary, policy decisions without updated spatial information about irrigated areas and cropping pattern result in incoherent strategies on water allocation, water management and infrastructure development and investment. Thus increases the risk that policy measures fail or mismatch and may lead to continued low irrigation water use efficiency, harvest shortfalls and reduced water and food security, and inefficient investments in the water sector.

Solution

We propose the usage of the scientific online tool WUEMoCA to increase irrigation water use efficiency in the Aral Sea Basin. WUEMoCA enables to monitor and assess the level and trends of water security and irrigation water use efficiency at various spatial scales. WUEMoCA is based on satellite technology and can integrate observations on water supply. This can help ministries and implementing water management bodies in Central Asia (i) to implement water use decisions at national and regional (oblast) levels and (ii) to monitor the success of measures in terms of large-scale irrigation performance. Two examples should illustrate the usefulness of WUEMoCA.

Example: Water security

WUEMoCA shows the dynamics of water security for oblasts in the Aral Sea Basin from 2000 to 2018. Figure 1 demonstrates unequal water security in the region. All basins show negative trends. After a

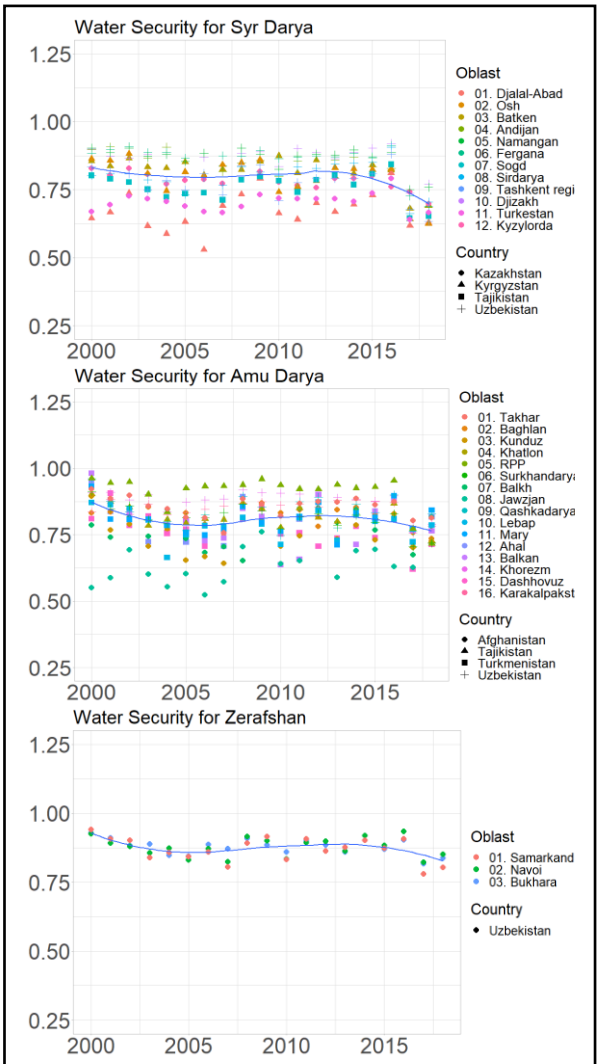

Figure 1: Agricultural water security for different river basins at oblast and country levels. The oblasts are grouped by countries and river basins. Water security means that crop water consumption achieves optimally 100% of crop water demand. Oblasts that underscore the critical level of 75% water security require special attention because the water demand is not matched by the supply. The blue line indicates the general trend.

plateau between 2010 and 2015 water security declined in 2016-2018.

In the Syr Darya Basin, the critical level of 75% water security was reached in 2017 and 2018 for almost all oblasts. Before this time period, reduced water security occurred especially in Djalal-Abad (Kyrgyz Republic) and Turkestan (Kazakhstan). Oblasts located in the Syr Darya regions of Uzbekistan and the Kyrgyz Republic (upstream, e.g. Fergana Valley) showed relatively better water security as compared to other countries.

Also the Amu Darya basin tended towards the critical threshold in 2018. The situation in parts of Turkmenistan was particularly bad compared to other countries in the region. Uzbekistan and Tajikistan showed overall good results throughout the study period. The risk of harvest shortfalls can be assessed very high in eleven out of the total 33 oblasts in the Aral Sea Basin. These oblasts were below the critical level to supply crop water demands for more than 5 years in 2000-2018. The Zerafshan basin indicates the highest water security for crop production.

Example: Irrigation water use efficiency

WUEMoCA provides information on crop water consumption. In combination with data on water supply it shows the dynamics of irrigation water use efficiency of oblasts in the Aral Sea Basin. Figure 2 indicates an enormous range of irrigation water use efficiency among the Oblasts, in particular in the Syr Darya Basin. The average is approximately 55% to 60%. At average irrigation water use efficiency increased in the Syr Darya catchment in 2000-2017. The indicator exhibits advancements in Fergana valley where measures to improve water use efficiency are working. In contrast, irrigation water use efficiency undulated in the Amu Darya catchment with a declining tendency after 2010. For the Zarafshan catchment, a negative trend can be observed. Overall irrigation water use efficiency is a big concern for the entire

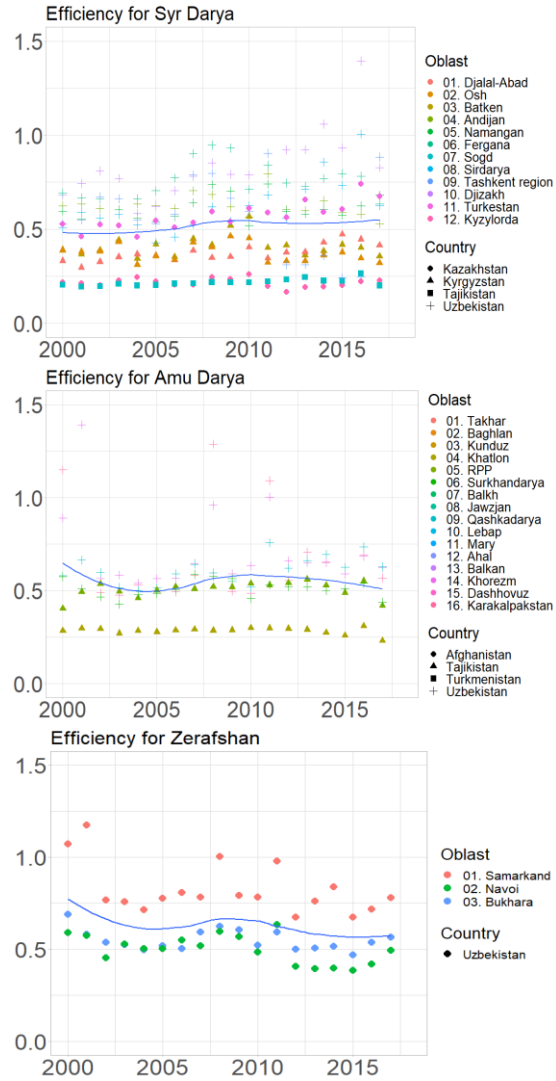

Figure 2: Irrigation water use efficiency for different river basins at oblast and country levels. The oblasts are grouped by countries and river basins. Irrigation water use efficiency indicates the amount of water consumed by crop production in relation to water supply through irrigation. The optimum is "1.0". The calculation relies on data from remote sensing, climate models, and statistics. Water intake data were available for Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan in 2000-2017. After the end of the CAWa project in which WUEMoCA was developed, no funds were available to maintain WUEMoCA with updated secondary data.

region as its values are rarely achieving optimum values

The two examples underline that satellite information provided through the digital online tool WUEMoCA shows current developments in irrigation systems.

Comparisons of the actual development of water use efficiency with existing management plans would allow decision-makers to assess the success and/or failure of water management measures taken in the past.

Expected positive effects

WUEMoCA can facilitate policy making by exploring critical levels of water security and water use efficiency at various oblasts and country levels in the Aral Sea Basin. The implementation of the scientific online tool WUEMoCA will better prepare them for the current and future water challenges as well as climate change.

Moreover, comparisons between countries, oblasts, and watersheds can be made easily for successful orientation of the irrigation systems in their spatial and temporal development. WUEMoCA enables better control of management measures for increasing water use efficiency in the irrigation sector and helps to control the success of

- the introduction of alternative, water-saving crops, e.g. the ongoing crop diversification
- expansion and maintenance of irrigation and drainage systems
- irrigation demand and supply gap analysis at various spatial levels and devise water allocation strategies accordingly
- optimization of water resources by achieving equity and reliability analysis.

Recommendations

The presented examples should encourage national water and land management bodies in the irrigation sector to utilize WUEMoCA for controlling extensive territories of agricultural land. Its usage for monitoring water resources in space and time will make specific measures to increase water security and irrigation water use efficiency in the Aral Sea Basin more efficient.

National and transboundary water management are recommended to utilize further new opportunities as provided by WUEMoCA-like digital online tools for data management and to close the gap of existing monitoring demand, e.g., for Integrated Water Resources Management.

Central Asian governments and water management bodies should increase the use of digital tools, digitalization, and satellite remote sensing for data management and monitoring.

Links: www.wuemoca.net
https://wuemoca.geo.uni-halle.de/

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