UN environment

FORESIGHT Brief

October 2017

003

Early Warning, Emerging Issues and Futures

The changing Aral Sea

Background

The UN Environment Foresight Briefs are published by UN Environment to, among others, highlight a hotspot of environmental change, feature an emerging science topic, or discuss a contemporary environmental issue. The public is thus provided with the opportunity to find out what is happening to their changing environment and the consequences of everyday choices, and to think about future directions for policy.

Introduction

The Aral Sea was once the world's fourth largest inland lake. Its hydrological balance is strongly determined by inflows from the Amu Darya and Syr Darya rivers which are fed by glacial melt waters from the southwestern Pamir Mountains in Tajikistan and the Tien Shan Mountains that border Kyrgyzstan and China.

In January 2014, the UN Environment featured the Aral Sea stating that that *"the future of Aral Sea lies in transboundary co-operation"*. The report stated that before the 1960s, the mean surface area of the Sea was 66,000 km², the sea's level was about 50-53m above sea level and its volume was 1,060 km³ (FAO, 2013).

During the 1960s, the implementation of major irrigation projects on both the Amu Darya and Syr Darya caused a marked increase in net evaporation compared to inflows resulting in less water reaching the Aral Sea. By the end of the 1980s, the surface area had declined by 50 percent; the sea's level and volume were down by 17 m and 75 percent respectively (FAO, 2013).

The extent of the Aral Sea basin

The total area of this basin is 1.76 million km^2 covering varying proportions of a number of countries in the Central Asia region as follows:

- Tajikistan (99 per cent)
- Uzbekistan (95 per cent)
- Turkmenistan (94.6 per cent)
- Kyrgyzstan (59.2 per cent) covering the provinces of Osh, Djalal-Abad and Naryn
- Kazakhstan (12.7 per cent) covering Kyzylorda and South Kazakhstan provinces
- Northern Afghanistan (37.7 per cent)
- A tiny portion of the Islamic Republic of Iran in the Tedzhen/Murghab basin

Source: FAO, 2012

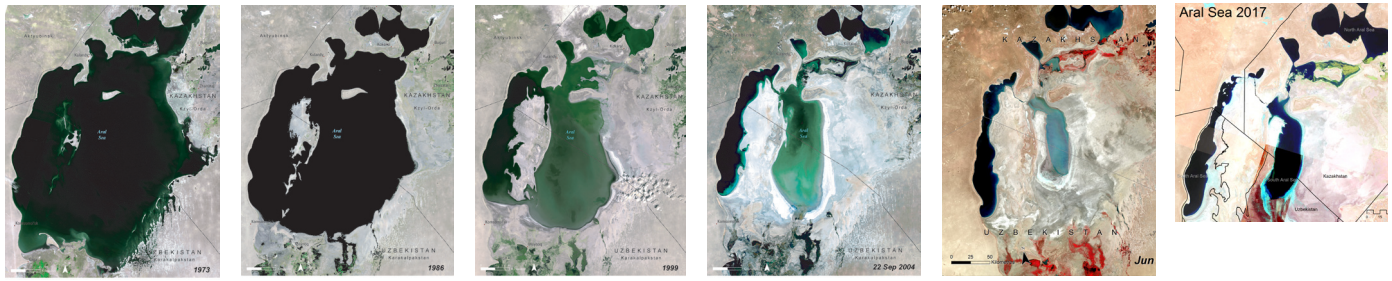
Why is this issue important?

The Aral Sea supports agriculture, industry, energy provision and the general wellbeing of the people in this region. However, the sea is under threat. The population in the region is growing and so are the demands for water, food and energy. Between 1960 and 2010, the population increased from 14 million to 50 million and is expected to reach 70 million by 2040 (EastWest Institute, 2014).

Research indicated the Aral Sea would eventually split into two by 2030. This has already happened and the situation is likely to deteriorate further if things do not change (Létolle, Aladin, Filipov, & Boroffka, 2005).

However, re-engineering along the Syr Darya River delta in the Small Aral Sea has shown the possibilities of deliberate intervention. The fact that it is possible to address some of the environmental degradation problems and improve the water management situation within the region makes this an important issue.

Satellite images illustrating the progressive shrinking of the large Aral Sea, but small Aral Sea expanding.



Key: Dark Blue color : Deep Water; Brown and whitish: Areas affected by salt concentration and others

Source: UNEP

What are the findings?

Exponential growth in irrigation agriculture

Between 1960 and 2010, irrigation agriculture grew from around 5 million to 8.5 million hectares (Bekchanov, Ringler, Bhaduri, & Jeuland, 2015). The demands for water were unsustainable and overwhelmed the regular water flow into the Aral Sea and led to its progressive desiccation and salinization (Micklin, 2016). About 22 million people depend on irrigated agriculture for their livelihoods in the Aral Sea basin, and 20 to 40 percent of the economic output of the countries is derived from agriculture, most of which is irrigated. The irrigation sector is further compounded by the fact that the infrastructure is aging and maintenance costs are growing (World Bank, 2014).

Growing energy demands

There is vast energy potential within the basin with estimates indicating that the region can meet more than 71 per cent of its energy requirements from hydroelectricity. There are more than 80 water reservoirs, each with a capacity of over 10 million m^3 and more than 45 hydropower plants with a total capacity of more than 34.5 Gigawatts. Hydropower makes up 27.3 per cent of the average energy consumption in the Aral Sea basin (FAO, 2013). There are complex inter-relationships between the upstream and downstream countries over water for energy and agriculture. The upstream countries (Kyrgyzstan and Tajikistan) use water for hydropower production while downstream, Uzbekistan, Turkmenistan and Kazakhstan use water primarily for irrigation (FAO, 2013).

Social, environmental and economic impacts of receding Aral Sea

Transportation routes across the Sea have been severely affected, and the ports at Muynak on the southern shore and Aralsk to the north are no longer operational as water levels have receded greatly. The receding waters left behind an arid area called the Aral-kum desert. Dust and salt from this area is carried during wind storms and causes harm to surrounding vegetation and fauna, affecting visibility and public health concerns for residents. For instance, there are have been increasing reports of cancer, respiratory, liver and kidney disease (Micklin, 2016). Although more study is required, it is thought that these are caused by dust polluted with chemicals used in the irrigated farms.The extensive deltas of the Syr and Amu rivers sustained a diversity of flora and fauna as well as irrigated agriculture, animal husbandry, hunting and trapping, fishing, and harvesting of reeds. The unique Tugay forests along the river banks and the number of species of mammals and birds have declined sharply (Micklin, 2016). At its height, fish catch averaged 40,000 tonnes per annum and was an important source of local employment (FAO, 2012). The changing river flow to the Aral Sea decimated this industry.

Climate change has been thought to influence the volumes of water reaching the Aral Sea. For instance, higher temperatures are thought to be shrinking the glaciers that feed the rivers and is leading to increased evapotranspiration. Already evaporation in the basin is higher than the total rainfall, snowmelt and ground water supply and the higher temperatures are accelerating the decline in the volumes of water and increasing salinity levels (Sorg, Boch, Stoffel, Solomina, & Beniston, 2012).

Irrigated areas in the Aral Sea basin

Source: http://www.fao.org/nr/water/aquastat/basins/aral-sea/aral.sea-map_detailed.pdf

What has/is being done?

Syr Darya Control and North Aral Sea Project

The countries of Central Asia appealed for international help to save the Aral Sea during the 48th and 50th session of the United Nations General Assembly in 1993 and 1995 respectively (UNGA, 2013).

In response, the World Bank and the Government of Kazakhstan funded the Syr Darya Control and Northern Aral Sea (SYNAS) Phase I project. It involved the construction of the Kok-Aral Dam in 2005 that raised and stabilized the level of the Small Aral Sea leading to a partial restoration and to greatly improved ecological conditions and replenishment of surrounding lakes. The restoration of the northern Aral Sea has seen resurgence in commercial fishery (Plotnikov, Aladin, Ermakhanov, & Zhakova, 2013) and biodiversity (World Bank, 2013). Fishermen have turned again to their age-old occupation, interacting with their restored environment in a seemingly sustainable way. A second phase started in 2012 and aims to bring the sea back to the former port town of Aralsk by raising the level of the small Aral Sea to 48 meters possibly.

Looking off over what used to be the Aral Sea, the raised land to the left used to be the shore *Credit: UNEP/Flickr.com*

Changes in the key indicators in the small North Aral Sea

Indicator	2001	2009
Water surface area (km^2)	2,414	3,288
Water losses to desert (m^3)	5 billion (in 2003)	<1 billion
Water volume (km^3)	15.6	27.1
Water level (m)	38.0	42.0
Rice plantations (ha)	58,500	73,300
Cattle (head)	185,000	260,000
Fish catch ('000 tons)	0.4	2.0
Water salinity level (g/l)	20	<10
Distance to Aralsk harbour (km)	75	18

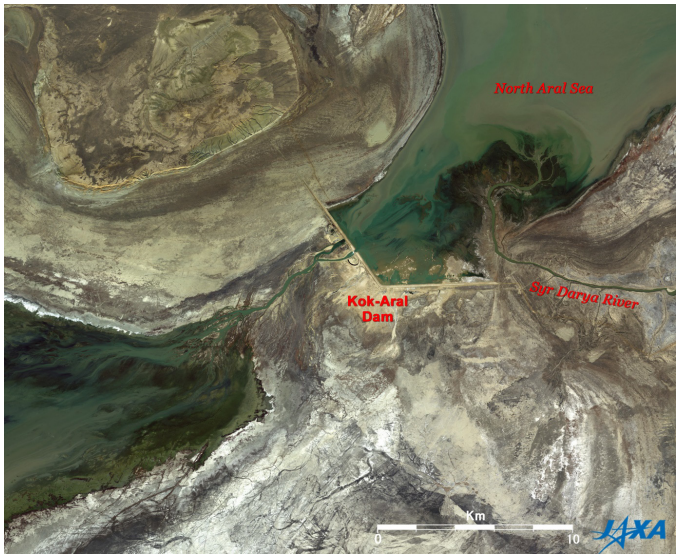
Source: (World Bank, 2010) (World Bank, 2011)

The International Fund for saving the Aral Sea (IFAS)

The International Fund for saving the Aral Sea (IFAS) with its programme of work on "the Aral Sea Basin Action Programme" was established in 1993. It brought together the governments of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, development partners and civil society. IFAS focused on integrated water resources management, socio-economic development and developing institutions and legal frameworks. Currently work is underway to develop the fourth Aral Sea Basin Action Programme.

IFAS is implementing a project to increase forest cover by 10 to 14 per cent across parts of Uzbekistan, Turkmenistan and Kazakhstan (EC-IFAS, 2012). So far, 740,000 ha of forest have been planted, including 310,000 ha on the desiccated seabed, with a further 200,000 ha of desiccated seabed over the next few years (UNGA, 2013).

The International Decade for Action: "Water for Sustainable Development", 2018-2028 to be launched by the United Nations on 22 March 2018, will further buttress IFAS to strengthen cooperation and partnerships on integrated management of water resources in order to reach the social, economic and environmental goals in line with Sustainable Development Goal 6 (UNGA, 2016).



The 13km Kok-Aral Dam in Kazakhstan as seen on Google Earth in 2007. *Source: http://www.eorc.jaxa.jp/en/earthview/2007/img/tp071226_03e.jpg*

Other initiatives

During the UN Sustainable Development Summit in September 2015, the Government of Uzbekistan initiated the establishment of a special Trust Fund for the Aral Sea and the Aral Sea Basin.

The aim was to coordinate efforts towards the preservation of the environment of the region, to combat desertification and implement a rational use of water. Further to this, the UN Joint Programme on *'Building the resilience of communities affected by the Aral Sea disaster through the Multi-Partner Human Security Fund for the Aral Sea'* was launched in February 2017 (UN, 2017).

This is in line with the Uzbekistan approved State programme for development of the Aral Sea Region for 2017-2021 to increase the investment attractiveness of the region, improve the infrastructure and water resources management, as well as combat desertification.

What are the implications for policy?

Benefits of environmental restoration

The restoration of the small Aral Sea demonstrates that sizable parts of the Aral Sea can be preserved and restored. Over the long-term, it may even be possible to reduce the use of water sufficiently to provide a certain level of discharge to rehabilitate the sea to some extent. Policy interventions need to focus on reducing the current degradation of the environment and on improving the quality of life of the population in the Aral Sea basin (Xu, 2017). Restoration of the Sea may also moderate the climate within the local area of the waterbody. This restoration shows that sustainable development policies can help to deal with even the most difficult water issues.

Improve policy framework for water resources

Development of new transboundary policies would gradually resolve disputes of water resources allocation, hydro-electricity development between upstream countries and downstream countries along Aral Sea to increase downstream water flows, and maintain water regimes. Additionally, better policy initiatives for public private partnership would stimulate private investment in water-saving technologies, and in research and development (Xu, 2017). Other policy reforms such as those to speed up the adoption of agroforestry should continue to be considered (Djanibekov, Villamor, Dzhakypbekova, Chamberlain, & Xu , 2016). These could be accompanied by awareness programmes to help people understand the benefits of planting trees and national legislation to support its adoption. The governments should also ensure policies to allow for more secure land tenure that would allow farmers security and flexibility to manage their land in a more long-term manner (Djanibekov, et al., 2013). Success stories such as the subsidies employed by Kazakhstan's government for no-till practices that have accelerated its adoption, and similar approaches could be used to encourage agroforestry adoption.

Improve the efficiency of irrigation technologies

The key to water resources utilization in Central Asia lies in rational and more efficient utilization of the water resources for agriculture. Long term sustainable solutions require not only major investments and technical innovations to improve irrigation water use efficiency, but also fundamental political, social and economic changes that take time (Micklin, 2016). Given the projections of water by climate experts at the regional level, there is an urgent need to introduce the latest water-saving and water management technologies such as promotion of precision irrigation in Central Asia for more effective water usage in industrial, agricultural and private retail sectors (FAO, 2013).

Encourage inter-state cooperation

Cooperation between the basin countries in the rational use of the water resources is of paramount importance. Planned water and energy projects all have the potential to impact the quantity and quality of water reaching the downstream countries. For instance, the dams planned by Afghanistan for flood control, irrigation expansion and electricity generation will impact the amount of water and timing of peak runoff to the Islamic Republic of Iran, Pakistan, Uzbekistan and Turkmenistan (Khurshedi, 2011 in (FAO, 2013). Such impacts are likely to lead to tensions between countries. The development of regional agricultural commodity and energy markets might create incentives for greater cooperation between the countries. The resulting benefits such as improved food and energy security, enhanced livelihoods and reduced environmental degradation could just provide the impetus needed (Bekchanov, Ringler, Bhaduri, & Jeuland, 2015).

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Acknowledgements: We acknowledge review by UN Environment colleagues in the Geneva office and the GRID Sioux Falls team.

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Upcoming Brief: Lake Urmia