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Characteristics of Climate and Water Resources Derived from Field in Uzbekistan

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Water availability and soil salinization are major sources threatening the environment in downstream of the Amu Darya River. Control and distribution of it are critical for supporting people's food security and livelihood in arid and semi-arid regions. Water scarcity in the vegetation periods coupled with severe vegetation degradation due to salinization threatens all agricultural production in all downstream areas of the Amu Darya, including West Uzbekistan and the north of Turkmenistan. Continuous drying of the Aral Sea due to overuse of water for irrigation in agriculture, increased climatic extremes recorded recently (Kholmatdjanov, 2020), and consequential sandstorms that distribute dried sea salt over large areas have a significant impact on the economy, environment, health and vegetation.

Salt-affected irrigated lands in Amu Darya Delta make up more than 80% of the area (fig.1), mainly in cause of secondary salinization, which brings drainage water back to the river through low groundwater tables and unlined streams loss. Access to irrigation water has drastically decreased in the last decades, which stipulates the low productivity of croplands. Agricultural yields of traditional crops have reportedly declined by 20-35% due to soil salinization impact (Khaitov et al., 2020). If we consider changes in climatic conditions, mainly connected to increased temperatures and increased probabilities of the heatwave conditions (Kholmatjanov, 2020), it is very important to address practical solutions for future water shortages. Current river discharge can still cover limited needs, and although more resources are required, they may not be readily available in the future. In the case of Central Asia and the present state of glaciers, there is still some time available before glacier water availability will decline dramatically. The government should address present “peak waters” (Barandun et al., 2020) periods and prepare for future reduced water flow.

Although, some factors are not controllable on a state scale; soil salinity should and could be addressed with adequate drainage, irrigation control, and crop rotations. Measurement of water amount applied to crops and an irrigation scheduling for reclamation of salt-prone marginal lands are still based on conventional approaches. Touge, 2016 showed that using adequate water-saving techniques could have had a decreased impact on the Aral Sea shrinking while reducing waterlogging and salinization due to different irrigation techniques. This is further aggravated by the fact that there is little available data on basic water management requirements for crops, soil moisture extraction patterns, water requirements of different crops, impacts of water deficits at various crop growth periods, and others. It is why water quality and soil salinity should be monitored and studied thoroughly. In this study, we analyzed several locations in the Aral Sea Basin to characterize the state and current water distribution conditions, salinity impact to crop productivity, and define salinity distribution through river channels.

Several sites for soil moisture content, soil salinity, and water quality were established to analyze actual water application during irrigation season and salinization extent. Additionally, express water quality analysis along the river channel and drainage channels

were collected.

For the last 10 years, a stable cotton and wheat yields decreasing trend is observed, rice yield loss due to insufficient water supply ranges depending on district-level from 40 up to 50t/ha per year. As a result, many low-productive lands are abandoned by farmers. These factors have shown negative consequences on crop and livestock productivity and agricultural and rural livelihoods incomes. The ability to overcome the winter feed bottleneck is perhaps the greatest challenge for agriculture development in the entire Central Asian region (Robinson, 2020). These conditions extend to water and soil management and require significant control from the government side. The study area is in the lower stream of the Amu Darya River Delta (Fig. 1). Several filed expedition missions and ground surveys were performed at the crops planting (April-June) and harvesting (September-November) seasons (2015-2019).

According to the analysis, soil leaching (washing of the soils from accumulated salts) is usually conducted during late autumn, thus avoiding high temperatures and evaporation. Further, additional irrigation is applied in the late winter or early spring months to provide enough soil moisture for the coming season. Some of the accumulated salts are then washed to the drainage waters, which are characterized downstream by a significant amount of various minerals. In the field survey, more than 63% of the soil of the irrigated lands in the north part of target area are affected by salinity through water irrigation. Soil salt removal by leaching is used as a traditional method to combat salinization. Although effective in some parts, but gives only a temporary effect and in conditions of water availability, at the same time gradually accumulated in the soils and finally reaching a state of extremely unprofitable and unstable.

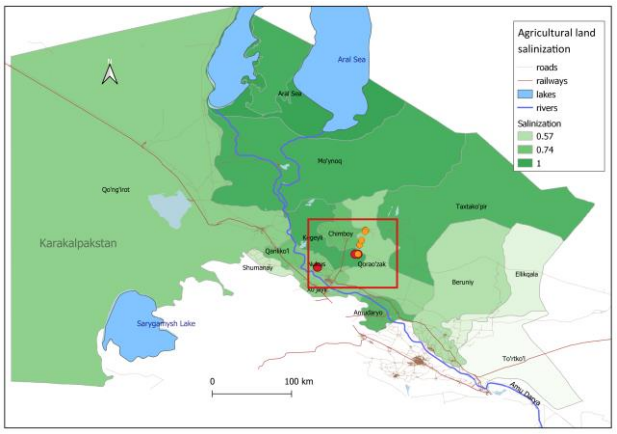

Fig. 1. Agricultural land salinization in downstream of the Amu Darya River with observation sites.

Soil electro-conductivity measurements have confirmed that water application for irrigation instantly increases salinization, which gradually reduces over time. These salts later accumulate on the surface of the soils and therefore required to be removed at the end of the irrigation season. Both sites have shown higher salt concentration in the water; however, results in Karakalpakstan are much worth it. It is due to a bigger accumulation basin and high groundwater levels that induce salinization in the upper layers of the soil.

The next urgent need is to identify alternative food and fodder crops/varieties that can withstand all limited resources available in the region to improve agricultural productivity, especially in livestock production and nutritional forage preparation. There are certain limiting factors for it, such as intense heat, harsh winter, water shortage for forage production, saline soil, and low carrying capacity of grazing lands, which cause the insufficient supply of feeds in quality and quantity.

Starting in 2022 SATREPS project in Uzbekistan, with the support of JICA and JST will try to find practical solutions on solving integration of agriculture and reducing environmental pressure in the downstream regions.