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Ecosystem Services and Community-Based Approaches to Wastewater and Saline Soils Reclamation in the Drylands of Uzbekistan

Kristina Toderich (1), Timur Khujanazarov (2), Dildora Aralova (3), Elena Shuyskaya (4), Liliya Gismatulina (5), and Hasan Boboev (6)

(1) International Center of Biosaline Agriculture, ICBA-Dubai, Tashkent office (Uzbekistan), Email: kristina@biosaline.org.ae; ktoderich@yahoo.com, (2) Water Resources Research Center, Disaster Prevention Research Institute, Kyoto University, Uji, Kyoto 6110011, Japan; E-mail: khujanazarov.timur@gmail.com, (3) Dresden Technology University, Institute of Photogrammetry and Remote Sensing, Dresden, (Germany) & Laboratory of Environmental Problems, Samarkand State University, , (Uzbekistan), E-mail: dildora.aralova@tu-dresden.de, (4) Plant Physiology Institute, Academy of Sciences of Russian Federation (Russia), Email: evshuya@gmail.com, (5) Laboratory of Environmental Problems, Samarkand State University Email: lfoton@gmail.com, (6) International Center of Biosaline Agriculture, ICBA-Dubai, Tashkent office (Uzbekistan)

Abstract.The working hypothesis of this article support an indication of declining water quality, increasing soils salinity and higher production costs in the Bukhara oasis- a borderline lands between the sandy Kyzylkum Desert and irrigated zone in the lower stream of Zarafshan River Basin. The pollution of waters and soils with toxic metals is the major environmental problem in these agro-ecological zones. Conventional remediation approaches usually do not ensure adequate results. The mobility of toxic pollutants can be highly facilitated by the chemical properties of soils and the aridity of the climate. The impact of these factors of land degradation induces reduction in biodiversity and yields losses of agricultural crops and wild desert plant communities. A recent survey showed that the chemical composition of the drainage effluents is sulfate-chloride-hydrocarbonate - magnesium-sodium-calcium with high level of mineralization 4200 – 18800 ppm. Concentration of chloride and sulfate, detected both in drainage effluents and ground water, is 10 times higher than maximum allowable concentration (MAC); and traces of heavy metals, such as strontium, selenium, arsenic, lead, zinc, uranium are 2 times higher than MAC. Distribution of boron showed a strong correlation with those of arsenic and antimony. Aluminum has a significant correlation with arsenic and lead distribution. Antimony correlates significantly with zinc and arsenic, while copper and iron (Fe^{57}) also well correlate with each other. Because these metals rarely exist in natural environment, it is presumed that they are caused both by the usage of some chemicals at the agricultural field in harvest season and by the discharge of some technogenic chemicals from industry.

The desalinated/treated wastewater were used to irrigate high value crops and the waste brine is transformed into a resource that was used to grow aquatic species (fish, algae) and irrigate halophytic species with benefits for livestock, farmers and environment. Halophytes are unique plants capable to accumulate high concentrations of mineral compounds (about 40e50% of DM) compared with conventional grasses (5e10% of DM). Biomass of halophytes grown of high saline unproductive soils is considered as a valuable source of renewable energy production. Some of halophytes contained a big amounts of crude protein (5e13 mg/g DM); cellulose (10.38e20.54 mg/g DM); and lipids (0.5e5.06 mg/g DM) and being cultivated in pure stands or mixed with non traditional salt tolerant crops, such as licorice, quinoa, amaranthus, sorghum, pearl millet, mung bean provides a means to reclaim salinized water and soils and return them to production for forages and grain which in turn provides livestock with consistent year-round feed.

A multiprofile agro-industrial enterpriser (MultiAgroEntr) established at village scale should be considered an innovative approach towards utilization of wastewater and returning of salinized lands to agro-aquaculture-pastoral production to increase availability of forages, improve livestock health, and availability of non-traditional cash crops both at the household and community levels by keeping ecosystem health in parallel.