Project Description for ARASIA TC Programme

TC Cycle 2018-2019

Project Number: RAS5080

Project Title: Developing Sustainable Agricultural Production and Upscaling of Salt-Degraded Lands through Integrated Soil, Water and Crop Management Approaches – Phase III.

Overall Objective: To apply best agricultural practices to enhance crop productivity in salt affected lands and combat land degradation in ARASIA States Parties.

Project Duration: (2018 – 2021)

Project Description: Agricultural production is rapidly declining in many of the RASIA countries due to the increasing problem of water scarcity and salinization of soil and water resources. The project will aim at the rehabilitation of salt-degraded lands for agricultural production by using sustainable and environment friendly bioremediation approaches, namely: (1) soil organic amendments, such as mulching and application of biofertilizers; and (2) planting salt-tolerant varieties of existing crops or introducing new/alternative halophytic crops, such as quinoa and forage grasses. Mutation breeding for enhanced salt-tolerance will also be a very important complementary approach to increase the yield per land area and the stress-tolerant mutant lines generated earlier of crops such as wheat and barley in IAEA's TC projects will be tested and adopted for improving productivity of the salt-affected lands. The outputs from the project can be scaled-up to support achieving the Sustainable Development Goals (SDGs) aimed at poverty and hunger reduction at the larger level.

Problem to be addressed: Agricultural food production needs to increase between 50 and 70% by 2050 to match the population growth. Due to the scarcity of new arable agricultural land, increasing food production will require increasing the productivity of existing agricultural lands. However, growing water scarcity and degradation of soil due to nutrient depletion and salinization are becoming serious constraints to farm productivity. The ARASIA (Arab States in Asia) region is one of the driest areas of the world and an increasing area of fertile soils is becoming saline due to a number of factors that include poor on-farm irrigation practices and lack of adequate drainage facilities, among others. Although recent estimates are not available, some 20-40% of the total irrigated area is affected and several countries in the region are experiencing serious reductions in crop yields. For instance, in the Jordan valley, where over 60% of Jordan's agricultural produce is grown, about 63% of soils are indeed saline, out of which almost 46% are moderately to strongly saline (Ammari et al.2013). In Yemen, about 60% of the irrigated area is slightly to moderately saline and the rest 40% have high levels of salinity that prevent economic farming. In Syria, it is estimated that 530 000 ha of irrigated land in the Euphrates basin (i.e. more than 40% of the total irrigated area in Syria) is affected by varying degrees of salinity (World Bank 2004). Iraq depends on the Euphrates river for agriculture and salinity has increased from approximately 500 ppm to 4500 ppm due to a combination of factors. The country is losing valuable farming land to rising levels of salinity in soil and groundwater due to a failing drainage infrastructure. Salinity problems are believed to have robbed the production potential of the 70% of the total irrigated area of Iraq with up to 30% gone completely out of production. Climate change predictions for the ARASIA States indicate less rainfall and higher temperatures in the near future which will exacerbate the problem of salinity and land degradation. In view of the need to enhance food production to feed the growing populations and the limited scope to expand agriculture to new areas, is imperative that the productivity of salt-affected lands is restored, especially in areas where significant investments have already been made in irrigation and drainage infrastructure of agriculture. Enhancing the productivity of salt-degraded lands requires a multi-pronged approach involving policy maker tothe farmers and the use of a combination of management and agronomic practices tailored to the characteristics of site and soil in different countries. These include integrated soil and water management practices that enhance soil productivity and its resilience against degradation and other impacts of climate change/variability, together with the introduction of salt-tolerant varieties of existing crops (e.g. wheat and barley) or new and alternative high value crops including halophytes (e.g. quinoa, forage grasses) to the agricultural areas suffering from salt accumulation. To be cost-effective in agriculture production, salt-degraded soils need careful consideration to improve resource capacity for better crop production. Thus, improving the water-use efficiency through innovative technologies such as the use of organic amendments (e.g. composting, mulching and biochar) and biofertilizers (e.g. rhizobia, phosphate-solubilizing bacteria, arbuscular mycorrhizal fungi and Azolla) will be a key project component that will help in improving both water- and nutrient-use efficiencies. Studies on value-chain and market development will be taken up for the newly introduced food crops such as quinoa if the results from field trials and economics of cultivation are found encouraging. The final outputs of the project would be integrated into scaling-up research to in larger areas with funds from governments and developing agencies to use the salt-degraded lands for increased food production and food security.

This project is proposed as a regional activity for the following reason(s): The participating countries share and face common problems of vital importance namely water scarcity and salinity that hamper agricultural production and decrease farmers' income, endangering the food security of the region. The upstream and downstream movement of both surface and groundwater impacts all the countries in one way or other and has to formulate common solutions that could reduce the problems. Furthermore, trade relations also exist in many of these countries where yield is also related to exporting products and bi-products to other neighbouring countries and hence regional cooperation is necessary.

Stakeholders: The main stakeholders of the project are the resource-poor small farm-holder communities in the harsh agro-climatic environments of the targeted countries, especially where natural resource degradation has reached an alarming degree, calling for prompt action. stakeholders of the relevant national programs in participating countries will also benefit in developing the human resources under the project, that would include researchers, extension and farmer's and would be responsible for all scaling-up activities during and after the project period. Example: research centers, ministries, universities, etc. The policy makers will be the high level stakeholders to make sure that the achievements and outputs of the project becomes part of country policy and guidelines.

Partnerships: The Cooperative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology, entered into force on 29 July 2002. IAEA and UAE (ICBA) entered into a practical arrangement agreement in February 2015.

Role of nuclear technology: The countries that have relatively advanced laboratories for using nuclear techniques will be part of team to provide analytical assistance to other countries. Soil moisture neutron probe and stable isotopes will be used to measure soil water and nutrient contents under saline conditions. Assistance will be requested from IAEA both in terms of use of radioisotope material for monitoring salinity in soil and water and in mutation breeding. In addition, the technical backstopping to the Member countries will also be provided by IAEA. Expertise form IAEA would also be needed to strengthen the gaps identified in each participating country. Nuclear and related isotopic techniques, including nitrogen-15 (15N), soil moisture neutron probe and oxygen-18 (18O) are central to this project. Analysis of stable isotopes 15N can be used to study dynamics of soil fertility, to assess fertiliser use efficiency, and biological nitrogen fixation in different agricultural systems. 18O signature may provide information on groundwater salinity. Similarly, the moisture neutron probe is useful for irrigation scheduling as well as for water losses via evaporation. The IAEA is the key player and organizer for the use of nuclear science and technology. Therefore, the IAEA's support, involvement and assistance are extremely important in the development, implementation and monitoring of this project. IAEA personnel have specialised expertise, knowledge and equipment for analysis of stable isotopes in soils and related samples that could complement the resources and expertise of the participating Member States. Assistance would be requested from the IAEA for guidance in the development of regional training curricula, the conduct of proficiency tests for this project and in the sourcing and provision of appropriate standards and reference materials.