Project Description for ARASIA TC Programme

TC Cycle 2020-2021

Project Number: RAS7034

Project Title: Managing and Protecting Urban Coastal Aquifers in States Parties (ARASIA).

Overall Objective: To assess the long term sustainability of coastal aquifer systems in ARASIA States Parties concerning the quantity and quality of the groundwater produced.

Project Duration: (2020 – 2021)

Project Description: Urban development takes place more along the coast (industries, oil refineries, desalination plants), and it is essential to identify factors affecting the groundwater of this region for proper management. This can be done by knowing the availability of the resources and understanding region-specific groundwater recharge sources. The project will address common problems related to groundwater assessment and management in Cooperative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA) States Parties (SPs) and aims at developing a better understanding of the recharge; issues governing salinization; agricultural contamination; impact of untreated domestic sewage in coastal aquifer systems; and focus on regions affected by specific processes. Activities will also focus on deriving the local meteoric water line (LMWL) for SPs and that of the entire peninsula. Aquifers are affected by both natural and anthropogenic processes, which may be due to the outcome of major developmental activities in the ARASIA countries during recent decades. Hence, the project will compare the changes in land use patterns and the variation in quality. The management of groundwater will be based on the identification of vulnerable and sensitive areas for recommending protection strategies. The project will support the implementation of national and regional studies on selected aquifers. The cooperative modalities among the participating SPs will include sharing data, experience, and dissemination of scientific and technical information through topical meetings by organizing regional training events on common issues and exchange of staff. The project will help in managing regional aquifers in ARASIA SPs and in the sustainable development of the resource by understanding regional processes. It will also help to (1) understand the sources of ions; (2) demarcate regions vulnerable to contamination; and (3) identify regional and local groundwater processes operating in ARASIA countries.

Problem to be addressed: The ARASIA region's shared aquifers include the Disi Aquifer (Jordan and Saudi Arabia) and the Rum-Saq Aquifer (Jordan and Saudi Arabia). There exists a contrasting and complex lithology on the western (hard rock) and eastern part (sedimentary formation) of the peninsula. Due to complex layered aquifer systems,

fossil water has been identified in various parts of the ARASIA SPs. Groundwater recharge is scarce in many locations due to lesser rainfall. The flow of groundwater is favoured by the gradient and topography of the region. The increase in population has resulted in the demand of fresh water resources subsequently leading to the increase in the number of desalination plants along the coast. Several studies have been conducted on the high dense saline sea waters of the Gulf. These studies identified that desalination rejects higher temperatures along with low rates of current flows, which has resulted in higher density and more salinity than in other parts of the world. This higher density has helped sea water intrusion into coastal aquifers. The variation of rainfall patterns and the decrease in the amounts of rainfall have also aggravated the demand for fresh water. Interpretation from long term rainfall and trends of atmospheric carbon dioxide (CO2) show relations to the variations in rainfall patterns. Few studies on climate variables in the Gulf region have highlighted the variation in rainfall patterns and attributed these to the recent climate change scenario. This situation has led to scarce rainfall and the depletion of water levels, thus increasing the salinity of the coastal aquifers along the eastern regions of the peninsula. Other general issues like submarine groundwater discharge (SGD) and growing coastal pollution are also of major concern. LMWL have been derived for Kuwait, Syria, Lebanon and Oman, but a regional line of comparison for identifying the recharge in shared aquifers is still lacking. So initially available long term isotope data for precipitation will record the collected and the spatial distribution of rainwater samples and will be considered for future rainwater sampling. Further, a complete set of spatial-temporal variations of groundwater isotopes and that of sea water is lacking. Precipitation predominantly recharges the western and the north-western part and in specific regions by surface water runoff, but the eastern regions along the Gulf are more affected by saline sludge from desalination plants and wastewater treatment plants. Further, the impact of urbanization in the recent decade has resulted in changes in land use patterns and aggravated the saline intrusion into the aquifer. The Gulf countries of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates are expected to suffer severe consequences of climate change as they represent the coastal region of the Arabian Peninsula. The present project proposal will try to address the sources of recharge, the interconnection between water bodies in the aquifers, and the factors governing their water chemistry. Especially, the project will focus on (1) addressing issues related to the recharge of transboundary aquifers shared by ARASIA States Parties; (2) investigating regional issues related to the pollution caused by nitrates, salt-water intrusion and that of spatial-temporal variations of other geochemical factors in the aquifers of interest; (3) contributing to a better understanding of the mechanisms of climate change and urbanization in the water resources of ARASIA States Parties; and (4) attempting to derive a regional LMWL with a robust data set and specific for ARASIA States Parties.

This project is proposed as a regional activity for the following reason(s): ARASIA's Medium Term Strategy (MTS) emphasizes the importance of strengthening isotope hydrology capabilities in ARASIA SPs and calls upon them to pursue collective efforts to

address common practical problems related to water resources assessment and management by using isotope hydrology techniques, and to consider the implementation of joint studies on transboundary aquifers. This study focuses on water resources management issues with the aid of isotope techniques. Falling in line with the focused objectives are the northern part of Kuwait, the Azraq region of Jordan, the Faw-Zuber region of Iraq, Wadi bani Kharus of Albatinah (Oman), the eastern region of UAE, and the coastal basin of Syria, which will be considered for the study. Since most of the aquifers of the region are shared and have common problems of salinity and pollution, the outcome of the project will help in solving regional issues and delineating local problems. Further, the recharge potential and identification of fresh water lenses in the shared aquifers will help in the management of the water resources of SPs from a regional perspective. The regional approach under the proposed project would provide the possibility for pooling resources, networking and direct exchange of experiences and good practices amongst the participating counterpart institutions. Laboratories in Jordan, Lebanon, Iraq, Syria, Kuwait and Oman have established adequate isotope hydrology laboratory facilities with well trained staff and carry out research that is supporting water resources management projects. Cases of pollution and salinity have been identified in the specific regions of the ARASIA SPs, but still the factors responsible for this hydrogeochemical status should be viewed from a regional perspective. Hence, sampling should be carried out in a definite pattern spatially and at specific time periods simultaneously to evolve the regional processes responsible for the geochemical nature of the coastal aquifers in SPs. The samples thus collected will be sent to the regional labs to enable cooperation in isotope analysis from water. The project will also enhance the exchange of specific expertise available within the region. Every effort will be made to ensure that the concerned parties are actively engaged in the project through providing them with an insight of its importance and overall benefits.

Stakeholders: In each ARASIA State Party, there are stakeholders and role players who will support and/or benefit from such a project. Ministries/authorities concerned with securing the water needs of the countries in the region will have an essential role in bringing this endeavour to a successful conclusion. In Kuwait, the main stakeholders are the Kuwait Institute for Scientific Research (KISR) and the Ministry of Electricity and Water (MEW) which are responsible for water management research and for developing respective policy decisions. The Ministry of Regional Municipalities and Water Resources along with the Central Laboratory for Food and Water are the main end users of the research in Oman. They are responsible for distribution, management and policy decision making. The outcome of the study will be useful for the Ministry of Water Resources of Syria as it governs the management of the resources in the country, and for the Ministry of Environment and Local Administration for developing policy decisions. There other end users in the Syrian administration, such as the Lattakia Water and Sanitation Authority (LAWSSA), as the results will help in the exploration and distribution of water resources in the country. The results of the study will form the basis of aquifer management in Jordan. The necessary steps will be carried out by the Water

Authority and the Ministry of Health of Jordan. The outcome on the impact of groundwater extraction and urbanization in the coastal regions will be adopted by the Water Authority and the Atomic Energy Commission of Lebanon and UAE for governing their resources. In all ARASIA participating SPs, competent national authorities, relevant government agencies, technical institutions and research organizations involved in the water sector and the public at large in the region will benefit from the project.

Partnerships: In each participating ARASIA SP, it is expected that the main counterpart institution will develop scientific and technical partnerships with other relevant national institutions. Effective partnership ties and collaborative arrangements will be worked out as appropriate between relevant national authorities, relevant government agencies and research organizations within the region.

Role of nuclear technology: Samples will be collected from rainwater and both from sea and groundwater to have an integrated approach, enabling measurements of an extensive suite of isotopic tools in the selected research site. The samples are planned to be taken at regular intervals to build up. The IAEA has been solving problems related to water and climate change, water resource management and application of isotopes in groundwater resources. In this regard, laboratories were supported for strengthening analytical facilities by the IAEA in a few ARASIA countries to carry out research in the field of isotope hydrology, groundwater management, surface water groundwater interaction, water resource management, pollution and submarine discharge. The studies were done by measuring stable and radioactive isotopes along with other basic geochemical and flow parameters. The measurements for the present study will include major and minor dissolved constituents and will be carried out in their respective labs; the isotopic compositions of oxygen (oxygen-18/oxygen-16), hydrogen (hydrogen-2/hydrogen-1), and tritium (hydrogen-3) analysis will be sought through regional laboratories. The different case studies carried out with the support of the IAEA in Kuwait, Lebanon, Jordan, Iraq and Syria have indicated that aquifers can be impacted by both geogenic (natural) and anthropogenic sources. The studies have also identified that often, many basins are salinized by multiple sources. Coastal aquifers are significant as they suffer tremendous stress due to urban development. In this regard, to identify sources of ions and manage coastal aquifers, isotopic signatures of rainwater and groundwater are essential. Hence, to fingerprint the source and the environment of recharge, this technique has its advantage over other techniques. The IAEA has a great role in helping ARASIA SPs regarding the analysis of samples for isotopes and the interpretation of the results of isotopic measurements. Previous ARASIA projects supported by the IAEA have helped in the measurement of stable isotopes to identify the sources of pollution in specific aquifers of participating countries. They also helped in the cooperative modalities among participating ARASIA SPs through sharing of experience and dissemination of scientific and technical information through topical meetings, and organization of regional training events on common issues and exchange of staff.