Project Concept Template

Project Proposals for the RCA Programme 2024/2025

Part 1: Information Sheet

Project proposals for the RCA Programme 2024/2025 are to be prepared using the attached template and submitted BEFORE 31ST OF DECEMBER 2021. Completed templates will be reviewed by the RCA PAC in January 2022.

Resource documents required for developing Project Concepts can be found in the RCA web-site – (RCA Regional Office (rcaro.org)), under Projects/Resource Documents. (see below for the list of resource documents.

The Project Concept should be prepared in consultation with the stakeholders of the other participating GPs. Information on RCA stakeholders can be found in the RCA web-site (RCA Regional Office (rcaro.org)), under Projects/Project Information.

Please request access to the RCA Members Only web-site from RCARO (email: rcaro@rcaro.org) through your National RCA Representative if you do not already have access.

A proposal will be evaluated against the following criteria:

- Alignment of the objectives with priorities set out the RCA Regional Programme Framework (RPF) for 2024/25.
- Whether the project addresses a regional need.
- Whether nuclear technology is an essential component of the project.
- Whether outcomes and achievements of previous projects in this area of technology are considered.
- Does the proposal overlap or duplicate current or previous RCA projects?
- Is a convincing case made to justify further projects in this area?
- Is there a strong TCDC component?
- If the proposal is essentially an extension of previous projects in this area that have been implemented for more than 2 TC Cycles, does the proposal include arrangements for the transfer of project leadership to another GP?

List of Resource Documents on RCA web-site (www.rcaro.org)

1. Timeframe for preparation, review and approval of Project Concepts
2. Brochure on Logical Framework Matrix (Quick Reference Guide on Designing IAEA TC Projects)
3. RCA Regional Programme Framework for 2024-29
4. Details of RCA TC Projects implemented in 2007-2019
5. List of TC Projects being implemented in 2020/21 and projects approved for 2022/24
6. Recommendations on Technical Cooperation among Developing Countries (TCDC)

Please note that your National Representative will be reviewing the concept document to ensure that it has been prepared in compliance with the RCA and IAEA Criteria for TC Projects

Please contact the Chair of the RCA Programme Advisory Committee, Dr. Prinath Dias at prinathd@yahoo.com if you need assistance.

Part 2: Concept Template[1]

Title:

The title should be as concise as possible and should summarize the objective of the project.

Application of isotope techniques for evaluating the efficacy of artificial recharge to groundwater in water scarce RCA region.

Analysis of gaps / problems / needs as applied to the RCA region:

Outline the major gaps / problems/ specific needs to be addressed by the project (~ max 300 words):

Groundwater plays a crucial role in coping up with the growing water crisis across the globe. With the rise in population, the groundwater resources that supply freshwater to domestic and irrigation purposes, are severely stressed. Uneven rainfall distribution coupled with extreme temporal and spatial variations has negatively impacted the natural recharge to groundwater. In addition, failure of monsoons over extended periods has become a new-normal in several parts of the globe. The interplay of these factors has manifested into near-drying up of shallow groundwater sources and forced the communities to tap deep groundwater sources in most of the countries.

The global estimates suggest that the groundwater extraction rate (~ 1500 km^3/Year) is less compared to global recharge rate (~ 12,600 km^3/Year) still the groundwater status across the world indicates high groundwater depletion in several parts of the world due to large surface runoff, evaporation and non-uniform distribution of recharge. The affected regions include parts of India, Northeastern China, Western USA, Mexico, Iran, Saudi Arabia and Northern Africa. Highest groundwater depletion is reported in Indo-Gangetic plains encompassing India, Bangladesh, and parts of Pakistan and Nepal. The estimates from GRACE data show the mean groundwater depletion rate as 17.7 ± 4.5 km^3/year during Aug. 2002 to Oct. 2008. Evapotranspiration as well as excessive abstraction due to intensive cropping system are found to aggravate the problem of depletion in groundwater levels.

Several RCA countries are experiencing severe groundwater depletion in recent years and a few are categorized as water-scarce as per global index. Therefore, water conservation measures have been made as the primary goals for many RCA countries. In order to replenish the groundwater resources, rainwater harvesting can be carried out by de-silting naturally occurring ponds, reviving natural paleochannels, constructing percolation tanks, check dams and other structures. In addition to above mentioned measures, better and cost effective recharge measure would be to use defunct/abandoned dug wells for replenishing groundwater levels. In this method, the rainwater runoff is channelized and diverted to the defunct/abandoned dug-wells so that the groundwater recharge would be faster and more effective.

[1] If you have not been involved in drafting a concept before and if you are not fully acquainted with the RCA and its Programme you are encouraged to support advice and assistance from your RCA National Representative.

The major challenges often faced while implementing these recharge measures are; i) assessment of recharge efficacy, ii) vulnerability towards anthropogenic contamination and iii) economic burden. These challenges often hinder the successful implementation of these recharge measures. Isotope tools can provide precise information on the potential recharge areas, mechanism of groundwater recharge, contaminant sources, circulation time of groundwater and its sustainability. Most of the RCA member states in Asia pacific are still lacking skill and expertise in application of isotope techniques for evaluating the efficacy of artificial recharge structures. This RCA project intends to build awareness about the isotope techniques towards evaluating the interventions for augmenting groundwater recharge through artificial recharge measures. The outcome of this project would provide a substantial societal benefit to water scarce regions in RCA countries.

Review the resource documentation and list any past RCA projects that have addressed similar problems/needs in this area of technology. Consider outcomes and achievements of previous projects, and avoid any overlap or duplication.

Use of isotope technology for achieving sustainable water resources development and management has been the main focus of the RCA projects undertaken till date. The isotopic inputs are provided to the end-user departments involved in policy formulations and governance of water resources for better management of water resources.

Below list presents the major objectives covered under the RCA Programme;

1. RAS/8084 - To promote the routine use of isotopic techniques in addressing the problem of supply of fresh drinking water in Regional Co-operative Agreement (RCA) Member States; and to develop and verify groundwater flow and pollutant transport models for selected aquifer systems in these countries (1999-2002).
2. RAS/8087 - Isotope Techniques for Groundwater Contamination Studies in Urbanized and Industrial areas and to promote the use of isotope hydrology techniques in addition to conventional techniques (hydrogeological, chemical, and biological) for study of pollutant behaviour and contaminant transport in groundwater systems (2003-2006).
3. RAS8104 - Assessment of Trends in Freshwater Quality Using Environmental Isotopes and Chemical Techniques for Improved Resource Management (2007-2008).
4. RAS8108 - Assessing Trends in Freshwater Quality Using Environmental Isotopes and Chemical Techniques for Improved Resource Management (2009-2011).
5. RAS7/022 - Applying Isotope Techniques to Investigate Groundwater Dynamics and Recharge Rate for Sustainable Groundwater Resource Management (2012-2015).
6. RAS7/030 - Assessing Deep Groundwater Resources for Sustainable Management Through the Utilization of Isotopic Techniques (2016-2019).
7. RAS/7/035 “Enhancing Regional Capability for Effective Management of Ground Water Resources Using Isotopic Techniques” focussed on cause and effect of groundwater pollution for mitigation & management strategies (2020-2023).

The essential aspect of evaluating the challenges in augmenting groundwater recharge through rainater

harvesting has not been addressed in any of the previous RCA projects. There is a pressing need to understand this aspect, which can be achived through application of isotopes (both stable and radioactive) in conjunction with geochemical and hydrogeological information. This integrated approach can provide very pertinent insights such as, i) Potential groundwater recharge areas and replenishment rates, ii) Changes in groundwater quality and quantity due to artificial recharge measures, iii) Surface water and groundwater interactions as well as inter-aquifer hydraulic interactions, iv) Vulnerability towards anthropogenic contamination and iv) Groundwater renewability and sustainability.

The key objectives achieved through previous RCA (mailny RAS 8104 and RAS 8108) projects such as (i) establishing a regional database of water-quality parameters for ground waters and surface waters and (ii) providing a suitable scientific basis for improving the understanding of surface water-groundwater, can form a good basis to undertake the proposed RCA project and successfully accomplish the overall objective of the project.

What are the major additional capabilities/skills in this area of technology that will be provided through this project (~ max 200 words).

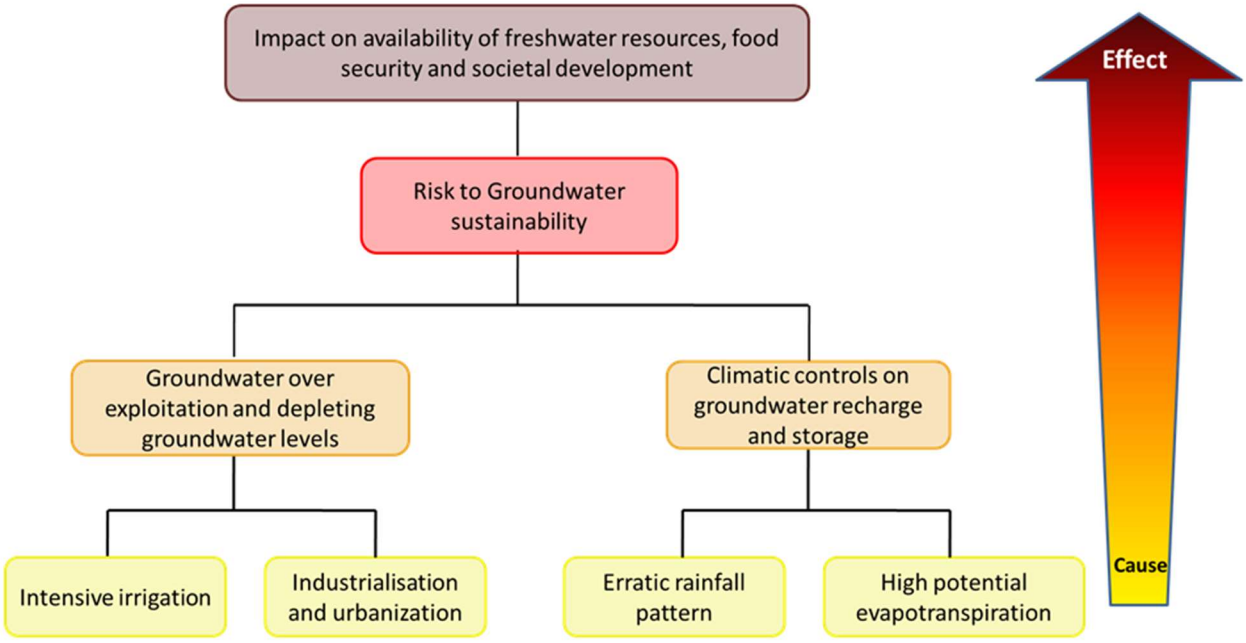
Stable isotopes (^{2}H and ^{18}O) of water molecule and radioisotopes (^{3}H and ^{14}C) are the most commonly employed isotopes in RCA projects. In this project other isotopes, such as ^{222}Rn, $^{13}C/^{12}C$, $^{15}N/^{14}N$, $^{34}S/^{32}S$ along with isotopes of dissolved organic matter will be used to gain better insights into the groundwater recharge, movement and the impact of the artificial recharge on groundwater quality. The outcome of this project will provide methods to estimate the relative contribution of the natural and artificial recharge to groundwater as well as apportion various sources of contaminants to groundwater through multi-tracer approach.

In earlier occasions the generated isotope data is sparse and not well integrated with the numerical modelling and satellite data. In this project large set of data will be generated by collecting samples at frequent intervals and measuring in situ parameters as well as dissolved ^{222}Rn in close time intervals. The large data thus generated will be integrated with the numerical and satellite data to assess the groundwater replenishment through artificial recharge with better accuracy and also predict the vulnerability of groundwater towards anthropogenic contamination.

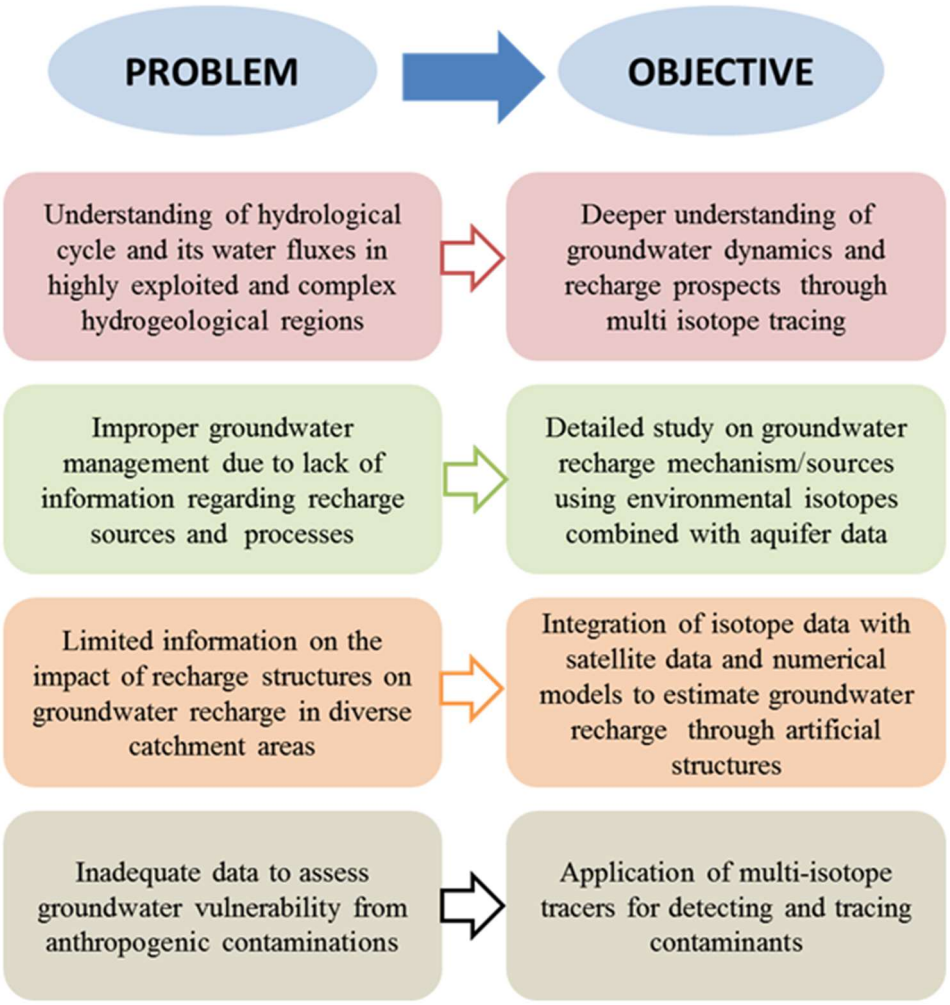
Overall Objective: (Required for the preparation of the IAEA Regional Programme Note)
State the overall long-term objective to which the project will contribute. This should reflect an impact related to the RCA Regional Programme Framework for 2024/29.

Effective adaptation of the nuclear related technologies to enhance groundwater recharge through artificial recharge measures and to develop capabilities of the participating RCA GPs towards sustainable development and management of water resources with special attention to water scarce regions.

Problem and objective analysis using objective and problem trees is recommended. (See pages 9 and 10 of the Quick Reference Guide on Designing IAEA TC Projects in resource documents)
Cause and Effect Analysis:



Problem and Objective Tree:



Project Outcome: (Required for the preparation of the IAEA Regional Programme Note)
The outcome is the planned result of a project, achieved through the collective effort of stakeholders and partners. It represents the change or improvement that occurs as a result of the project. Should be worded in past tense. (eg. The capability for ……developed)

- Impact of artificial recharge structures on the groundwater replenishment assessed
- Groundwater vulnerability to anthropogenic contaminants using multi-isotope tracers evaluated
- Artificial recharge as a tool for enhanced groundwater recharge scientifically demonstrated
- The awareness on usefulness of isotope technology to various end-user departments propagated

RCA Projects are to be designed to have a Socioeconomic Benefit:
What is the potential socioeconomic benefit that would be realised from the project concept over a 5 to 7-year horizon?

- Inferences based on isotope techniques in conjunction with hydrochemistry and geological information will be disseminated to the national water administrators as well as end users from the participating RCA GPs for effectively implementing artificial groundwater recharge.
- Utilization of the surface runoff as well as stored water in ponds/lakes in augmenting the groundwater recharge so that shallow water table is replenished in an efficient and economical manner.
- This RCA will generate large isotope data set that can be used for evaluating the impact of artificial interventions on groundwater recharge at local and regional scales.
- The outcome from this project will provide insights into the vulnerability of groundwater towards anthropogenic contamination so that suitable precautions can be taken during the implementation of the artificial recharge measures.
- In totality, the successful completion of this RCA project will build awareness on application of isotope techniques towards evaluating the interventions for augmenting groundwater recharge through artificial recharge measures. The outcome of this project would provide a substantial societal benefit to water scarce regions of RCA countries.

Proposed Participating Government Parties:
List the Government Parties expected to participate in the project. Indicate target and resource GPs:

India will be the LCC for this project.

The other GPs expected to be part of this RCA project are;
1. Australia, 2. Bangladesh, 3. China, 4. Indonesia, 5. South Korea, 6. Malaysia, 7. Mangolia, 8. Myanmar, 9. New Zealand, 10. Pakistan, 11. Philippines, 12. Sri Lanka, 13. Thailand and 14.Vietnam

Technical Cooperation among Developing Countries (TCDC) Project Component:

Please refer to the resource documents (RPF and Recommendations on TCDC)

Will the project design feature partnering arrangements between those advanced and those less advanced in the technology to be transferred through this project?

Yes

If so, list those expected partnerships.

Those member states with less advanced technology can get benefit from IAEA (Isotope Hydrology Laboratory) or from more advanced countries in the region. The project relies on mutual cooperation between the advanced and less advanced government parties. Those government parties with less advanced technology may get benefit from advanced government parties through utilizing isotopic analytical facilities and other technical support. The NPCs will work in close cooperation for solution of common problems and may seek guidance from each other. Transfer of scientific knowledge/experience to less advanced countries through technical meetings, organization of regional training courses on common issues, dissemination of information through executive meetings and expert missions for technical guidance/training is possible through this project. This regional approach will provide economical solution of common regional problems and will also promote TCDC among RCA regional member states.

Requirements for participation:

Indicate the minimum requirements that the counterpart institutions in Government Parties would need to meet in order to participate in this project.

The minimum requirements for the participation in this project are:

- Mass spectrometer to analyse the stable isotopes of water (hydrogen, oxygen, carbon, nitrogen and sulphur)
- Liquid scintillation counter for tritium and carbon-14 measurements
- Dissolved Radon Monitor
- Analytical capability to analyze major and minor ions in water samples
- Reasonable man power to carry out sampling, measurement and data interpretation

Stakeholder analysis and partnerships:

Briefly describe who are expected to be the end-users and principal beneficiaries of this project. Indicate whether the end-users contributed to development of the Concept.

All the national departments in member states dealing with the water resources development and management, Central and State Water Boards, Pollution Control Boards, Universities, Research institutes and NGOs are stakeholders in this project. The results will be disseminated /shared with all the stakeholders through reports, seminars/workshops at national level.

Yes, the project has been conceptualized in consultation with end user departments. These departments have been actively involved in the past RCA projects. The principal beneficiaries/end users will provide all the support related to field sampling, geological and hydrogeological information and conducting onsite measurements based on the needs of the project.

Have any extrabudgetary funding possibilities been identified?
Nil.

Role of nuclear technology:

Indicate the essential nuclear technique that would be used and outline why it is suitable for addressing the problems/needs in question.

Stable isotopes (^{2}H, ^{18}O, ^{13}C, ^{15}N and ^{34}S) and radio isotopes (^{3}H, ^{14}C and ^{222}Rn) will be mainly used in this project. The roles of various isotopes in addressing the objectives proposed in this RCA have been summarized below:

a. The $^{2}H/^{1}H$ and $^{18}O/^{16}O$ isotope ratios indicate recharge sources and mechanism. The mixing among various water sources can be also discerned from these isotopic ratios
b. ^{3}H and ^{14}C are used for estimating the groundwater residence times
c. $^{13}C/^{12}C$, $^{15}N/^{14}N$ and $^{34}S/^{32}S$ ratios can be used to fingerprint the contaminant sources of both geogenic and anthropogenic origin
d. The $^{13}C/^{12}C$ isotope ratio is also helpful in radiocarbon dating
e. ^{222}Rn is a good indicator of surface water – groundwater interactions. This isotope will not only provide additional confirmation on the impact of artificial structures on groundwater recharge but also help in mass balance calculations for water budgeting

Is this the only available technique that could be applied to address the problem/ need?

To get the information about the possible recharge area and dynamics of groundwater and also to estimate the replenishment of groundwater through artificial recharge structures, nuclear techniques are the only available option. However, integration of the isotope data with other allied techniques will allow deeper understanding and provide better insights and estimates.

Does it have a comparative advantage over non-nuclear techniques?
Yes.

Conventional geochemical studies, involving analysis of major cations and anions, hydrogeological studies provide first-hand information on the geochemical processes and factors involved in geochemical evolution of groundwater and overall groundwater level variations. But they fail to provide the information of the recharge area, interactions between surface water and groundwater, residence of groundwater, contaminant sources and effect of artificial recharge structures.

Stable isotopic studies (nuclear techniques), on the other hand, help to discern the type of water recharging the groundwater system, zones or levels from which recharge is derived and quantitative estimate of groundwater recharge as well as apportion the contaminant sources through isotope finger printing.

Duration of the project:

Indicate the number of years required to complete the project.

Four years with two cycles 2024-2025 and 2026-2027.

Part 3: National Representative Endorsement for Project Concept

As the RCA NR of India (*RCA GP),* I have reviewed the Project Concept thoroughly and confirm that it meets the following requirements:

1. The objective of the Project Concept is aligned with priorities set out the RCA Regional Programme Framework (RPF) for 2024/25.
2. The project addresses a regional need.
3. Nuclear technology is an essential component of the project.
4. Outcomes and achievements of previous projects in this area of technology have been taken into consideration
5. There is no overlap or duplication with current or previous RCA projects
6. Further projects in this area can be justified (if relevant)
7. The Project Concept has a strong TCDC component

Signature: 

Name: SUNIL GANJU

NATIONAL RCA REPRESENTATIVE, INDIA

Date: 07 January 2022