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.

Enhancing understanding of impact of climate change on the quantity of major water fluxes in the hydrologic cycle using isotopic techniques for better water resources management.

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):

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.

Primary cause of climate change is the burning of fossil fuels which emits greenhouse gases into the atmosphere. Climate change can have profound effects on the hydrologic cycle through precipitation & evapotranspiration. The hydrologic cycle will be intensified with more precipitation. However, the extra precipitation will be unequally distributed around the globe. Long-term effects of climate change will include shifts in precipitation patterns and snow cover, rain storms, rising sea levels, melting of glaciers thawing permafrost, and likely increase in the frequency of flooding and droughts. At global scale, rising temperatures are resulting in enhanced heat and water-stressed conditions, particularly in arid and semi-arid regions. Melting of glaciers at faster rate will increase the river flow. However long-term effect would result in decrease of river flow.

Most of the projects that have been implemented so far under the umbrella of RAS have general objective to promote the utilization of isotope techniques for improving water resources management in the region and for better understanding of surface water-groundwater interaction, inter-aquifer hydraulic interactions, pathways of contaminant migration in surface waters and ground waters. Their focus was to identify the government departments responsible for water resources management policy, preventive measures, mitigation, and to provide them with information and recommendations gleaned from using the environmental isotope tools and chemical techniques.

These projects have major emphasis on water resource management but pathways of water i.e. understanding the hydrlogical cycle and parameters associated with climate change, and its impact on the quantity of major water fluxes was missing. This is a major gap and there is urgent need to address it regarding the sources, movement and fate of water fluxes under prevailing changing climatic conditions. Rain and snow events responsible for meteoric waters are largely driven by global climate conditions. Climate dynamics affect the sources and distribution of rain and snow worldwide ultimately affecting the quantity of water flux going to the rivers, lakes, streams and groundwater recharge. The hydrogen and oxygen isotopes of water are highly sensitive indicators of their sources in the water cycle and are fundamental to our understanding of many environmental processes. Therefore nuclear science and technology can help monitor, mitigate and adapt to the impact of climate change on the quantity of major

[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.

water fluxes in the hydrologic cycle for better water resources management.

Review the resource documentation and list any past RCA projects that have addressed similar problems/needs in this area of technology.

Five projects concerned with the general area of Water Resources were implemented as part of the RCA Programme.

1. RAS/8/104 "Assessing Trends in Freshwater Quality Using Environmental Isotopes and Chemical Techniques for Improved Resource Management" filled the gap in information availability regarding ground water resource management, expanded the efforts into the development of a full-fledged regional database on water quality.
2. The same project continued with a new number RAS/8/108 to establish long term database. In these projects 12 to 16 MSs participated with active involvement of end users therefore adoption of the technology by the water agency managers and policy makers has been successful at significant level.
3. Under RAS/7/022" Application of isotopic techniques to investigate groundwater dynamics and recharge rates for sustainable management of an aquifer" efforts were made to improve the capability of member states for efficient and effective development and management of groundwater resources.
4. RAS/7/033 "Isotopic Techniques in the Assessment of Groundwater Resources for Sustainable Management" focused on recharge rates in connection with safe exploitation of groundwater resources.
5. 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.

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

In all previous RAS projects worked so far isotopes viz ^{2}H and ^{18}O give informations of source, recharge mechanism, recharge areas and surface water ground water interlationship. The isotopes namely ^{3}H, ^{14}C, ^{3}He, nobal gas isotopes and dissolved gases like SF_6 and CFCs provide information about age/ residence time distribution, different flow paths and recharge rate of ground water.
In this project additional capabilities will be provided through the characterization and quantification of hydrological fluxes within components of water cycle and across interfaces. Characterization will be done through the application of nuclear techniques using isotopes of hydrogen and oxygen . Quantification of water flux will be obtained from the amount of precipitation. Dissolved species of nitrates & sulphates will give information about sources of green house gases in the atmosphere. Previously isotopes were used to find the surface water-groundwater and inter-aquifer hydraulic interactions, residence time and for delineating pathways of contaminant migration in surface waters and ground waters. Now tools are same i.e. nuclear techniques but the approach to address the climate change impacts on water cycle will give additional capability. This project will help understand the hydrological cycle and its response against changing climatic conditions specifically on water fluxes and how mitigation efforts can be designed to minimize its negative effects.

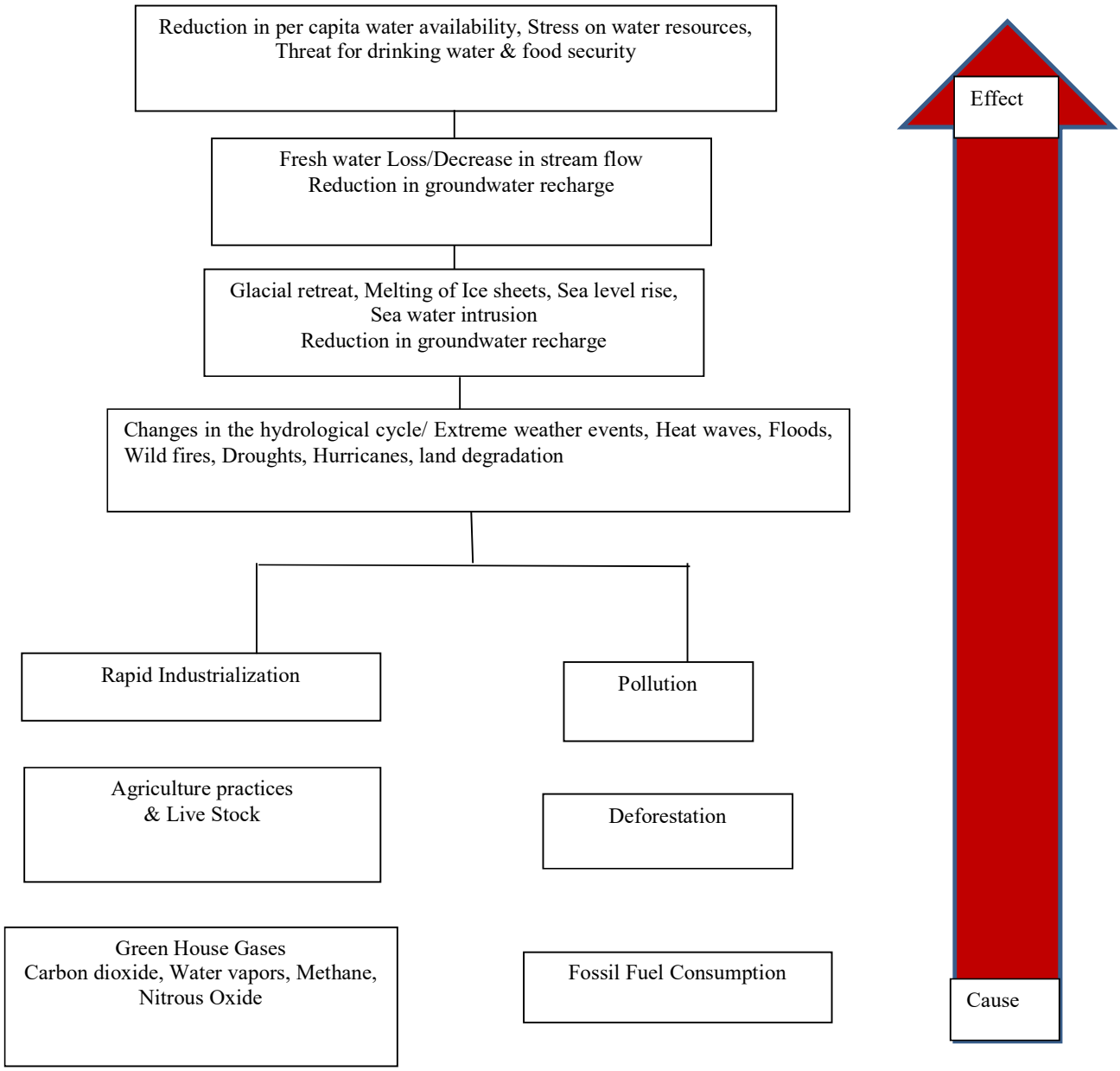
Overall Objective: (Required for the preparation of the IAEA Regional Programme Note)

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.

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)

The objective of this project is to enhance the understanding of impact of climate change on the quantity of major water fluxes in the hydrologic cycle and use of nuclear techniques for characterization and quantification of hydrological fluxes within components of water cycle and across interfaces. Climate change mitigation strategies and adaptation measures will be identified to minimize its negative effects. This project will enhance the capability of Member States to combat climate change for optimal water resources management.

Cause and Effect Analysis



Problem and

PROBLEM	OBJECTIVE
Fragile understanding of hydrological cycle and its water flux under climate change scenario	Robust understanding of hydrological cycle and its water flux under climate change scenario
Poor groundwater management due to lack of information regarding climate change	Excellent groundwater management with better understanding of climate change using nuclear techniques
Poor knowledge of water balance in groundwater bodies and catchments regarding climate change	Better understanding of water balance in groundwater bodies and catchments regarding climate change
Little understanding about effect of climate change on agriculture, public health, water quality and water borne diseases	Better understanding about effect of climate change on agriculture, public health, water quality and water borne diseases

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)

Enhanced understanding of impact of climate change on the quantity of major water fluxes in the hydrologic cycle. After the completion of the project each GP will have trained manpower and enhanced capability in the application of isotopic technique for climate change and its impact on hydrological cycle, so there will be sustained and continuous contribution to address the problem by all the GPs at their level.

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?

- Lower greenhouse gases concentrations associated with a mitigation policy will result in a smaller rise in temperature and thus less extensive damage to water resources.
- Better food security
- Better hydropower potential
- Less risk of sea water intrusion in the delta region
- Better availability of water through better management of water resources under changing climatic

condition

Proposed Participating Government Parties:

List the Government Parties expected to participate in the project. Indicate target and resource GPs:
1: **Pakistan (Lead Country)**: 2 :Australia: 3: Bangladesh: 4: China: 5: India: 6: Indonesia: 7: Korea: 8. Malaysia: 9: Mangolia: 10: Myanmar: 11: New Zealand: 12: Philippines: 13: Sri Lanka: 14: Thailand: 15.Vietnam:

Technical Cooperation among Developing Countries (TCDC) Project Component:

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

- The TCDC is designed to make use of existing capabilities among the Member States in the region by promoting synergies, networking and sharing of experience and facilities.
- Assistance to Member States to develop and implement Human Resource Strategies, particularly for the least developed countries.
- Assistance for strengthening national and regional nuclear training centres. Long-term training, along the line of the train-the-trainers concept, should be promoted.
- Provision of current modalities such as individual fellowships and scientific visits, which are still needed especially for the least developed countries and new Member States.
- Strengthening regional partnerships with development and financial institutions and UN organizations for the support of regional projects.
- Promoting networking among national, regional and international institutions relevant to nuclear science and technology and to regional cooperation.
- Human capital development is one of the high priority areas for all Member States in the region. The availability of skilled human resources in current and potential nuclear fields is an essential element for successful introduction and application of nuclear technology.
- Assisting in developing and implementing sustainable human resources development strategies, succession plans and nuclear knowledge management strategies at a regional level.
- Harmonizing and promoting, education and training programmes at a regional level through cooperation among academic institutions in the field of nuclear science, technology and engineering.
- Promoting the use of Information and Communication Technology (ICT) based training/learning tools and methodologies, including E-learning, as part of the regional cooperation projects.

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.

The IAEA has established most of the facilities regarding application of nuclear techniques at Isotope Hydrology Lab (IHL) Vienna. Those member states with less advanced technology can get benefit from IAEA IHL or from other advanced countries in the region through RRU/Collaborating Centres. 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, expert missions for technical guidance/on-the job training and national executive management seminars for information dissemination/technology promotion, is planned regional approach to address the common issues effectively. 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.

Well established Laboratories with capabilities of application of nuclear techniques in water resources, suitable buildings and staff. Most of RCA member states have these facilities; new members can use facilities of RRUs/Collaborating Centres in the region and IAEA labs.

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 stackholders including nuclear institutions, decision and policy makers, Pakistan Council of Research in Water Resources (PCRWR), Water and power Development Authority (WAPDA), Pakistan Metrology Department(PMD), Public Health Engineering, Water and Sanitation Agencies (WASAs), Water development and management authorities, layman, farmers, the economy and national water security will benefit from the project.
Yes concept has been developed in consultation with end users such as PCRWR, WAPDA, WASA and IRI. Among them PCRWR is mandated to conduct, organize, coordinate and promote research on all aspects of water. We have signed a memorandum of understanding and provide isotopic analytical services for their studies. We regularly conduct seminars and workshops on the promotions of nuclear techniques in hydrology & environment

Have any extra-budgetary 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.

For effective addressing of issues related to impact of climate change on the quantity of major water fluxes in the hydrological cycle one needs tools to study the cause and effect relationship of climate change and hydrologic cycle.

Environmental isotopes can be used to understand the changes associated with hydrological cycle due to climate change and their impact on water resources. The conservative nature of water isotopes δ^2H & $\delta^{18}O$ makes them effective tracers of atmospheric moisture origins and circulation. Distribution patterns and variability of atmospheric circulation have a considerable effect on the isotopic features of precipitation, as well as meteorological parameters such as rainfall amount, temperature and atmospheric moisture. Stable isotopes of oxygen, hydrogen, noble gases and radioactive isotopes such as tritium and carbon-14, provide unique insights into hydrological and climatic processes at local, regional, and global scales, including the role of rivers, lakes, groundwater recharge rates, and sources and recycling rates of atmospheric moisture. Environmental isotopes (N-15, C-13 and S-34) of dissolved species have potential applications in climate

studies with reference to greenhouse gases.

Integration of isotope techniques with conventional techniques gives excellent results. Commonly used isotopes (^{2}H, ^{13}C, ^{18}O, ^{15}N, ^{34}S, ^{3}H, ^{14}C) along with chemical techniques can provide information on atmospheric moisture origin, its evolution through fractionation, transportation process and associated acontaminants in the hydrlogical cycle.

Is this the only available technique that could be applied to address the problem/ need?
***Yes,* however Integration of nuclear techniques with conventional methods (chemical and hydrogeological techniques) gives excellent results.**

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

Yes
Isotopes are used as **tracers or fingerprints** of source and movement of water, climatic conditions (climate change studies), hydrological processes, etc. Comparative advantage of these techniques over non-nuclear techniques are the following.

- Allow a rapid understanding of the hydrological system that may otherwise require years or decades of monitoring,
- In some cases, nearly unique tool, e.g. source of water/moisture, age dating, recharge rates in arid areas,
- Cost-effective if the isotope analytical labs are available.

Duration of the project:

Indicate the number of years required to complete the project.
Two cycles each of two years (2024-2025, 2026-2027) as long term data of precipitation and metrological parameters is needed.
Starting from January 2024

Part 3: National Representative Endorsement for Project Concept

As the RCA NR of *(RCA GP)……Pakistan……*, **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: DR. GHIYAS UD DIN
Director International Cooperation
(RCA National Representative)
Pakistan Atomic Energy Commission
Islamabad

Date: 23rd Dec. 2021.