

Programme G. WATER RESOURCES

Rationale: The 1992 United Nations Earth Summit in Rio de Janeiro concluded that “the holistic management of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programmes within the framework of national economic and social policy, are of paramount importance for action in the 1990’s and beyond”. The Commission on Sustainable Development (CSD) in its second (1994) and sixth (1998) sessions, and the 1997 Special Session of the UN General Assembly called for a concerted effort to develop more integrated approaches to water management and for a stronger focus on the needs of poor people and developing nations. Reflecting upon the increased water demands in the future, the World Water Vision, launched at the Second World Water Forum in The Hague in March 2000, states that “this increase in water withdrawals implies that water stress will increase significantly in 60% of the world, including large parts of Africa, Asia and Latin America. Will this lead to more frequent and more serious water crises? Assuming business as usual, yes”.

Through the sustainable use of water resources basic needs can be met, vulnerabilities can be reduced, and improved and secure access to water can be created. Correct policy decisions necessarily depend upon the quality of knowledge available to decision makers, and the complexity of water issues creates a need for policies that maintain and extend the knowledge base. Isotope and related nuclear techniques are effective and unique tools for obtaining hydrologic information for a broad range of water resource management issues. The Agency is the lead UN agency in this area and provides the basic means of using these techniques in the form of global reference data and isotope reference materials. A wider use of isotope hydrology in the developing Member States for water resources development and management requires the development of technology and human resources as well as financial assistance. The water resources programme of the Agency aims to fulfil these needs. As isotope techniques are more effective when used as an integral part of hydrologic practices, the programme also aims to co-ordinate its activities with other national and international organizations active in the water sector. In particular, collaborative programmes with the WMO, UNESCO, the World Bank, FAO and UNEP are presently active and are to be strengthened in the future. The Agency’s continued involvement in extending the use of isotope hydrology has been duly recognized by the Member States through a number of General Conference resolutions, the most recent being GC(45)/RES/12B. Substantial Member State interest in the programme is indicated also by an increasing number of requests for assistance through the technical co-operation programme.

Objective: To improve the integrated management of water resources, geothermal resources and specific water supply infrastructures through the use of isotope technology.

Outcomes
<ul style="list-style-type: none"> — Enhanced capacity for efficient water resource management and related policy development by Member States through increased use of isotope techniques recommended by the Agency. — Improved capability for efficient management of geothermal resources through increased use of isotope techniques recommended by the Agency. — Increased competence of national scientific and technical institutions to use nuclear techniques in relation to water resources management.
Performance Indicators
<ul style="list-style-type: none"> — Number of isotope methodologies available and developed or improved through the Agency’s projects for integrated watershed management. — Number of Member State institutions provided guidance and assistance through the Agency’s research contracts and technical co-operation projects. — Extent to which Member States can themselves train hydrologists in the use of isotope techniques.

Specific criteria for prioritization:

- Areas where isotope techniques have comparative advantage over other methods;
- Issues or implementation mechanisms where the Agency as an international organization has a unique role;
- Fields of research and application which are of global or regional importance in the context of sustainable water resource management.

Subprogramme G.1. Isotope Methodologies for the Protection and Management of Surface Water Groundwater and Geothermal Resources

Rationale: More than 50% of the fresh water used for drinking and irrigation worldwide is obtained from aquifers. Groundwater development in many countries has been relatively unrestricted and has produced a variety of adverse effects, particularly in areas where groundwater is in fact fossil, or non-renewable, with low rates of replenishment under present day climate conditions. In many cases, groundwater from non-renewable aquifers is being used to increase food production, making both the water supply and food production unsustainable. In coastal aquifers, groundwater use needs to be carefully balanced to avoid the negative effects of

seawater intrusion but with maximum exploitation of fresh groundwater. Surface water resources are also being exploited with dams and reservoirs to meet present water and energy demands and are prone to pollution from waste water discharge and irrigation runoff. Pollution has also adversely affected many groundwater reservoirs. Many of the Member States in Latin America, Africa and Asia are increasingly exploiting geothermal resources for meeting their energy needs. Planners and managers in Member States need an improved knowledge base of hydrological information to make appropriate decisions for the sustainable management of water and geothermal resources. Co-ordinated research, while helping to develop, test and adapt techniques under a variety of hydrogeological conditions, strengthens the capacity of Member State institutions for research and implementation of isotope applications. The Agency's research contracts programme provides an excellent mechanism for bringing together Member State institutions and other UN agencies to jointly study issues of international concern that are beyond the scope of national research institutions.

Objective: To develop appropriate isotope methodologies and Member State capacity for water resources management.

Outcome
— Increased competence of Member State institutions to develop and adapt isotope techniques for water and geothermal resource management.
Performance Indicators
— Increase in the number of isotope methodologies made available and improved for water resources management.
— Number of institutions from Member States provided guidance through CRPs and assistance through the TC programme.

Programme changes and trends: The subprogramme develops and transfers isotope methodologies where isotope techniques make a unique contribution in water and geothermal resource management. Research and development efforts in the 2004–2005 cycle will continue to focus on the impacts of long term exploitation of groundwater, groundwater salinization, processes of pollutant transport in the unsaturated zone, characterization of submarine groundwater discharge, and analytical tools for evaluating the efficiency of sedimentation control measures in surface reservoirs. New research projects will address the sustainability of groundwater, mapping of fossil or non-renewable groundwater resources, and techniques for delineation of groundwater protection zones. Established methodologies for use in surface water, groundwater, and geothermal resource management will continue to be transferred to Member States through the technical co-operation programme.

Two out of four projects in this subprogramme are scheduled for completion before or during the 2004–2005 programming cycle. Project G.1.01 would be completed in 2004 after developing or testing several methodologies for groundwater management. Project G.1.03 on the use of isotopes for dam and reservoir management was to be completed in 2003 but is proposed to be extended through the 2004–2005 cycle. The proposed extension is due to two reasons. First, there are continuing requests from several Member States for technical assistance in this area. Second, the CRP on sediment source characterization had a delayed start because of a lack of suitable research proposals. Building upon the outputs of Projects G.1.01 and G.2.01, particularly through the CRP on isotope monitoring of river discharge, and given the importance of groundwater for freshwater supply, a new project (G.1.05) with emphasis on comprehensive assessment of groundwater sustainability would be added to the subprogramme in this cycle. This project will be implemented in close co-operation with a number of UN agencies and national institutions. In particular, close partnership will be maintained with the UN system-wide World Water Assessment Programme (WWAP) in which the FAO, UNEP, UNESCO, the World Bank, and other agencies are also participating.

Resource changes and trends: Decreases of \$110 000 in 2004 compared with the 2003 adjusted budget and of \$54 000 for 2005 compared with the 2004 budget are foreseen for this subprogramme. These changes are due to redistribution of laboratory activities between subprogrammes and the consolidation of research activities.

Financial resources (2003 prices)

G.1.	2003	2004	2005
Reg. budg.	1 630 000	1 519 700	1 465 400

Project G.1.01: Development and transfer of isotope methodologies for groundwater management

Main outputs: Improved isotope methodologies for characterizing groundwater salinization, for investigating the transport of pollutants through the unsaturated zones and for evaluating the impact of long term exploitation of groundwater, will be provided. Specific reports and documents providing data from benchmark field applications, including guideline methodologies to enable more effective application of isotope techniques for groundwater management by Member States, will be available.

Duration: 2000–2004

Ranking: 1

Project G.1.02: Assistance to Member States for development and management of geothermal resources

Main outputs: The project will result in scientific and technical contribution to the technical co-operation

(TC) projects for improved geothermal resource management through the use of isotope techniques; and guidebooks on specific applications of isotopes in geothermal resource management in order to assist Member States in applying these techniques to assess and manage geothermal resources.

Duration: 2002–2005

Ranking: 6

Project G.1.03: Development of analytical tools for dam leakage and reservoir sedimentation

Main outputs: The main outputs of the project will be: publication of a guidebook and reports on the use of isotope and related tracer techniques to investigate leakage from dams and the evaluation of reservoir sedimentation; and guidance to Member States, through TC projects, on the use of fallout radionuclides for investigating erosion and sedimentation problems in surface reservoirs.

Duration: 2000–2005

Ranking: 5

Project G.1.04: Exchange of information and training in isotope hydrology

Main outputs: The project will produce: symposium proceedings on recent developments and applications of isotope methods in integrated water resources management; printed and CD-ROM teaching materials on isotope hydrology to facilitate the incorporation of the subject into university programmes and teaching curricula; supplementary training tools for isotope hydrology in different languages; and trained personnel through joint workshops with UNESCO.

Duration: 2000–2005

Ranking: 7

Project G.1.05: Isotope methods for the assessment of groundwater sustainability

Main outputs: The project will result in: global map of non-renewable groundwater resources and a related set of isotope indicators of groundwater and watershed sustainability; shared database of isotopic ages of baseflow and adjacent groundwaters in large river basins of the world; document on isotope techniques for the delineation of groundwater protection zones in urban areas, providing a direct link between isotope techniques and the improvement and better management of groundwater aquifers in urban areas.

Duration: 2004–2007

Ranking: 4

Subprogramme G.2. Reference Isotope Data and Analysis for Hydrological Applications

Rationale: The use and development of isotope applications for water resources management requires isotope data for various components of the hydrologic cycle. These data, termed global reference data, and the ability to measure isotope compositions are necessary for the Member States to use and integrate isotope methods into their water resources management practices. The primary components of the earth's hydrological cycle are precipitation, river flow, and evaporation/transpiration from vegetation. The Agency has initiated and maintained (jointly with WMO) a Global Network of Isotopes in Precipitation (GNIP) for the last 40 years. Continued isotopic monitoring of precipitation provides an ability to understand the processes influencing the amount and geographical distribution of precipitation, as well as a baseline input function for other hydrological applications. Runoff accounts for about 35% of precipitation losses from the continents. Isotope monitoring of large river systems provides reference data as an integrated output function for continental runoff and water balance studies and for the analysis of climate and environmental change in large river basins. A network of isotope monitoring stations for rivers is necessary to maximize and broaden the use of reference isotope data for water resources assessment and management. Evaporation and transpiration account for about 65% of precipitation losses on the continents. A global survey of isotope contents of air moisture and leaf water on different types of vegetation may provide an effective tool for improving water balance calculations and assessment of climate change and development impacts. Although critical to the practice of isotope hydrology, these reference data are not collected on a global scale and disseminated in the public domain by any other institution. The role of Agency in providing global isotopic data is well recognized by the isotope hydrology community in both the developed and the developing Member States.

Member States have requested the Agency to strengthen their analytical capacity. This requires assistance in the form of equipment as well as an assurance of the quality of measurements being made. The Agency, as an impartial body, is also the primary source of reference materials for isotope measurements, and the main co-ordinator for interlaboratory comparisons in both developing and developed Member States. The capabilities of the Agency's Isotope Hydrology Laboratory will be enhanced by the addition of a facility for the measurement of helium isotopes, which would allow age measurement of young waters with low tritium content. Building upon the outcomes of project activities in the 2002–2003 cycle, the analytical capability of Member State laboratories will continue

to be improved through capacity building and information dissemination activities.

Objective: To increase the capacity of Member States to accurately perform isotope measurements for hydrological applications and enhance the availability of isotope reference data.

Outcomes
<ul style="list-style-type: none"> — Increased use of reference isotope data and of analytical facilities for research and practical applications in water resources. — Increased availability of isotope data from laboratories in Member States.
Performance Indicators
<ul style="list-style-type: none"> — Number of GNIP stations actively collecting isotope data and the amount of isotope reference data provided by the Agency to Member States. — Number of Member State institutions meeting the Agency's criteria for high quality isotope analyses and providing analyses for national or regional TC projects. — Number of helium isotope measurements integrated into various projects.

Programme changes and trends: The subprogramme is focused on improving the ability of Member States to use isotope reference data for the hydrological cycle and to make isotope measurements. In 2002–2003, the IAEA/WMO network GNIP is being strengthened at national levels and design of a new Agency network for isotope monitoring of rivers has been initiated. Major changes in 2002–2003 included increased focus on improving Member State capability to obtain and use isotope analyses by building a network of laboratories providing high quality isotope measurements. These efforts will continue and the river network design will be completed in the 2004–2005 cycle. As a result, both of the existing projects in the subprogramme will continue through the 2004–2005 cycle. The Isotope Hydrology Laboratory needs to be upgraded to allow the analysis of helium isotopes for hydrological applications. In addition, two new projects will be initiated in this biennium. Project G.2.03 will focus research efforts on developing reference isotope data for air moisture and vegetation in an attempt to link the water and carbon cycles on the earth and improve the modelling of climate phenomena. Project G.2.04 will fully develop the helium isotope analysis facility in support of projects in this subprogramme and projects G.1.01 and G.1.05.

Resource changes and trends: The proposed resources represent an increase of \$240 000 in 2004 compared with the 2003 adjusted budget and a further increase of \$34 000 in 2005 compared with the 2004 budget. These increases are necessary to allow for undertaking critical efforts in establishing new isotope monitoring networks for rivers and leaf moisture in co-operation with international partners. In addition, some of the proposed increased resources will be used to procure a mass spectrometer for

meeting Member State demand for high quality isotope analyses.

Financial resources (2003 prices)

G.2.	2003	2004	2005
Reg. budg.	1 417 000	1 657 300	1 691 600

Project G.2.01: Collection and use of isotope data for precipitation and runoff

Main outputs: The products of this project will be: updated isotope database on precipitation from a global network; report on requirements and design of a similar network for monitoring the isotope composition of rivers; and technical reports to guide researchers and managers in Member States to utilize isotope data in climate studies and modelling.

Duration: 2000–2005

Ranking: 2

Project G.2.02: Strengthening Member State capability for isotope measurements

Main outputs: A guidebook on analytical protocols and quality assurance for stable isotope measurements for isotope hydrology applications, and reference material for making isotope measurements through a network of Member State laboratories will be made available as a result of this project.

Duration: 2001–2005

Ranking: 3

Project G.2.03: Isotope methods for the study of water and carbon cycle dynamics in the atmosphere and biosphere

Main outputs: A TECDOC will be produced on isotope techniques for the assessment of climate change impacts on the water cycle and biosphere, including isotope methodologies for improved characterization of terrestrial CO₂–H₂O exchange processes and their role as a modifier of climate and water resources. New analytical reference standards and improved isotope methods for the labelling of greenhouse gases and for comparison of greenhouse gas partitioning inventories developed by Member States will be available.

Unfunded activities/means of implementation: Global network for monitoring leaf water.

Duration: 2004–2007

Ranking: 8

Project G.2.04: Development of helium isotope applications for water resources management

Main outputs: The project will result in: an operational helium isotope measurement facility; a technical report on helium isotope methods (T³He and ³He/⁴He) capable of improved performance in tritium age dating; new secondary standard for

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helium isotope measurements to benefit laboratory intercomparison in Member States; and trained personnel, through the TC programme, for helium isotope analysis.

Duration: 2004–2007

Ranking: 9