ISOTOPES IN GROUNDWATER RESOURCES DEVELOPMENT (RAF/8/022) F2 New

CORE FINANCING

YEAR	Experts		Equipment	Fellowships		Scientific Visits		Training	Sub-contracts	Misc. Comp.	Total
	m/d	US $	US $	m/d	US $	m/d	US $	US $	US $	US $	US $
1995	14/ 0	159,600	80,000	-	-	-	-	35,000	90,000	-	364,600
1996	14/ 0	168,000	80,000	-	-	-	-	40,000	120,000	-	408,000
1997	6/ 0	75,600	550,000	-	-	-	-	30,000	90,000	-	745,600
1998	4/ 0	52,800	175,000	-	-	-	-	-	30,000	-	257,800

First Year Approved: 95

OBJECTIVES: To apply isotope hydrology in combination with other investigations to practical problems for the further development and management of water resources in arid and semi-arid zones of Africa.

BACKGROUND: Water resources are essential for the achievement of sustainable development. When fresh water availability falls below a certain level, chronic water scarcity becomes one of the main limiting factors to economic development, human health and well being. Among the countries currently facing water shortages are, particularly, those in arid and semi-arid regions of Africa. Adverse climatic conditions, recurrent droughts and continuously growing population have put intense pressure on the use of groundwater resources. However, there is still insufficient knowledge of the aquifers, some of which are of a fossile nature or very poorly renewed, so that water resources are being over-exploited. Detailed knowledge of flow patterns, natural and modified by withdrawal, is necessary for the rational development of groundwater resources, especially in the case of deep confined aquifer systems. In the case of shallow unconfined aquifers like wadi underflows, it is of primary importance to assess the average renewal rate of the system and to investigate whether recharge occurs on an annual basis or if it is due to exceptional rainfall. Determination of the area of recharge is, of course, a major requirement for the evaluation of pollution risk by irrigation returns and overflows around the wells and the boreholes. For all types of aquifers in zones of internal drainage where the only discharge process is by evaporation, it is important to evaluate such diffuse discharge, which produces soil salination. The scarcity of groundwater in areas located on low permeable geological terrain implies the utilization of surface waters through artificial reservoirs. However, soil erosion and related sediment transport controlled by present hydroclimatic conditions often induce a sedimentation rate which reduces the capacity of the surface reservoir. Furthermore, under high evaporation, water from dams and reservoirs easily becomes saline and, when sodium enriched, cannot be used indefinitely, especially for irrigation purposes. This emphasizes the need for careful evaluation of groundwater resources in alluvial beds and the importance of studies for artificial recharge. In view of the nature of the hydrological problems in arid and semi-arid regions, isotope techniques are increasingly recognized as indispensable tools for water resource assessment and development in these regions, when combined with other hydrological methods in an integrated manner. Although not able to detect and delineate groundwater resources, isotope techniques can provide unique information for assessing dynamics and balance of aquifers including recharge conditions and vulnerability to pollution and over-exploitation. Problems in assessing, developing and proper managing of water resources where the use of isotope techniques is indispensable include identification of the origin and dynamics of groundwater (palaeowater resources); evaluation of recharge and discharge of aquifers; evaluation of mixing between surface (river, lake) and groundwater; definition of aquifer vulnerability to pollution and over-exploitation; determination of water balance of reservoirs; evaluation of possible enhancement of local groundwater resources. A Regional Planning Seminar on Water Resources Assessment in Arid and Semi-Arid Regions of Africa was held in September 1993 in Rabat, Morocco, to prepare the outline of the present regional project, based on the Model Project criteria, so as to plan practical end user oriented activities pertaining to the water sector within the African region. Subsequently, missions by outside experts were undertaken to the countries concerned (a) to assess the feasibility of the activities proposed by the countries and their integration into ongoing programmes within the water sector, (b) to assess the relevance of the planned activities to practical solutions of water management problems in

the countries, and (c) to determine the local inputs required for the successful implementation of the planned activities. The important issue of utilizing isotope hydrology for groundwater management in arid and semi-arid zones of Africa was discussed by the Board of Governors in June 1994 (GOV/INF/738). The project will be a suitable framework for strengthening regional capabilities and improving regional co-operation in the use of isotope hydrology. The technique will be used to assess recharge rates and water balance, as well as pollution problems in some areas. The results will permit optimum management of water resources in these areas.

PROJECT PLAN: It is expected that Algeria, Egypt, Ethiopia, Libya, Mali, Morocco, Niger, Senegal, and Sudan will co-operate in the regional project, which is envisaged to be implemented in two phases over a period of four years. The sub-project activities to be carried out under phase I (1995-96) are as follows: EGYPT: Assessment of the recharge rate from the Nile Aquifer to the Western desert fringes and study of agricultural pollution. The determination of induced recharge is essential for development and reclamation of about 120,000 acres at Wadi El Farigh, west of the delta, and Samalut, Ensna and Qena, west of the Nile valley. Study of the origin of agricultural pollution affecting 10,000 acres at El-Fashn will be undertaken. The results will be used by the Water Research Institute of the Ministry of Public Works and Water Resources for the establishment of a water management programme. ETHIOPIA: Assessment of water regimes with emphasis on the Moyale region and vicinity (population about 3 million) which suffers recurrent drought. The results are essential for a water management programme by the Ethiopian Water Works Construction Authority. MOROCCO: Assessment of balance of terms of some South Atlasic aquifers for optimum management of water resources. These aquifers - at Tafilafel, Guelmim and Afendul Lahajar - supply drinking water for several population centres (of about half a million inhabitants) as well as water needs for irrigation. The studies are expected to yield information on estimated evapotranspiration, infiltration rate, origin of salinity, mixing ratio between aquifers and determination of most suitable recharge sites. The results will be utilized jointly by the Drinking Water National Board, the Water Resources Regional Directorates for the exploitation of the aquifers, the Agriculture Provincial Directorates and the Land Utilization Boards for the agricultural development of the regions under study. SENEGAL: Re-assessment of water resources to upgrade the water supply for Dakar and vicinity. It is planned to determine the balance terms characterizing aquifers at Thiaroye, Sebikotane - Pont-Mbour and North Seaboard as well as the infrabasaltic aquifer. The results will be used to update existing mathematical models and to enable rational resource management by the Ministry of Water Resources. In addition, activities in other countries are expected in 1997-98. At the same time, efforts will be devoted to setting up two central laboratories in the region capable of offering analytical and consultancy services to end users and which could play a major role in promoting the use in Africa of isotope techniques in water resource development projects. The project will mainly be implemented by participating countries. Agency support is crucial for provision of analytical services and guidelines for field work and data interpretation. Local training on specific field measurement and sampling techniques will also be organized. It would be necessary to appoint a technical expert in the region. An annual meeting will be held between the participating institutions to assess the progress of the project, to discuss results and revise detailed plans if needed.

REGIONAL AND NATIONAL COMMITMENT: Scientific and support staff; analytical laboratory facilities; drilling and sampling equipment.

AGENCY INPUT: Expert and consultancy services for the planning, co-ordination, implementation and evaluation of project activities; equipment, consumables and supplies for field, laboratory and specific analytical services; training through the organization of regional scientific seminars, workshops and exchange of scientists and qualified technicians.

IMPACT: In the short term the data obtained from hydrological studies will be used in estimating recharge rates and water budgets in the countries concerned, which would lead to the development of guidelines for water policy and optimum management of the existing resources. Accordingly, the water authorities and other end users can undertake regional development plans. The project will create a long term impact by strengthening capacity building and experience in the integration of isotope hydrology within water resource assessment and development programmes in a number of countries in the region. Close co-operation between atomic energy organizations, research institutes and water authorities in participating countries will be maintained. Strengthening regional co-operation is essential for better understanding of regional water resources since hydro-climatic conditions are common to the region.