IAEA BRIEF
for policymakers
2017/2

Water

Integrated Management of Water Resources Using Nuclear Techniques

The IAEA-Supported Sahel Project in Africa: A Case Study

SUMMARY

1. Water is a finite but reusable resource. It must be managed carefully to ensure sustainable human development.

2. Water scarcity in the Sahel region is exacerbated by inadequate management practices and declining resource quality, which is a threat to food security, human health and the environment.

3. Nuclear techniques such as isotope hydrology can be used to find, assess and map groundwater sources. The data obtained enables evidence-based decisions on resource management to be taken, supporting sustainable exploitation.

4. In Africa, the IAEA has supported a regional technical cooperation (TC) project, which promotes the integrated management of shared groundwater resources in the Sahel region. The project aims to contribute to lasting socio-economic development.

5. The aquifers in the Sahel region are shared by many countries and this project is an excellent example of successful cross-country cooperation in addressing water challenges.

Limited access to safe drinking water is still common in the Sahel area. When groundwater sources are not available, the use of unsafe surface water sources may lead to numerous health issues.

(Photo: D. Calma/IAEA)

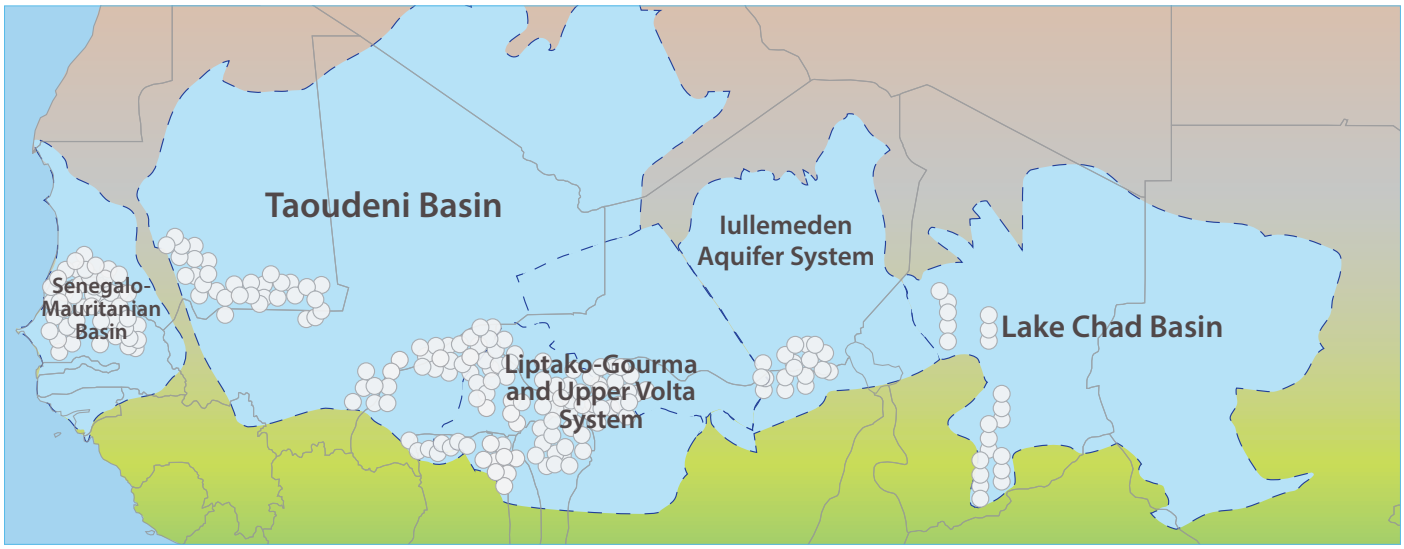
INTRODUCTION

Ensuring the availability and quality of water is a fundamental development challenge for countries everywhere. If countries are to manage the growing, competing demands for fresh water, it is essential that they have tools to understand the water resources at their disposal. The IAEA has been pioneering the use of isotope hydrology as a scientific tool to assess groundwater resources and to generate information on aquifer geometry and on groundwater availability and renewability. Increasing demands for water for agriculture, industrial pollution and climate change are also placing a heavy burden on water resources.

Over half of the world's population of 7.5 billion currently rely on groundwater aquifers.

THE CHALLENGES FACING THE SAHEL REGION

Home to 135 million people, the Sahel stretches from West Africa to Central and North Africa, an area of more than 7 million square kilometres. One of the biggest challenges the region faces is access to



Location of the five aquifer basins and systems studied in the Sahel. The dots show where scientists collected water samples.
Image: IAEA

clean water. Potable water is essential for the people of the Sahel, not only for drinking, but also for food production and sanitation.

The Sahel region lies within a unique climatic zone, characterized by unstable weather conditions. In recent decades, the region has suffered from extreme drought, which has resulted in severe water shortage. The region's limited water resources must meet competing demands from urban areas, agriculture and industry.

WHAT IS THE SAHEL PROJECT?

The IAEA, through the regional TC project RAF/7/011, 'Integrated and Sustainable Management of Shared Aquifer Systems and Basins of the Sahel Region', has assisted 13 Sahel countries in using nuclear technology to determine the origins, flow paths and renewal rates of the main groundwater systems and to assess the groundwater's quality.

By building capacities in water sampling and isotope hydrology, the IAEA has enabled the countries to study the features of the main aquifers as well as the interaction between water bodies, and to assess the vulnerability of groundwater to pollution and the impact of climate change on water availability. These factors all affect the quality and availability of fresh water in the Sahel region.

The project was initiated in 2012 to respond to the critical issue of inadequate water resource management in the Sahel region, and supports a comprehensive approach to integrated sustainable groundwater management. It brought together a wide range of stakeholders and development partners, national governments, river basin authorities and local authorities in the Sahel region.

Activities under the project covered five major transboundary aquifer systems (the Iullemeden Aquifer System, the Liptako-Gourma-Upper Volta System, the Senegalo-Mauritanian Basin, the Lake Chad Basin and the Taoudeni Basin) shared by 13 African Member States: Algeria, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal and Togo.

PROJECT GOALS

Build capacity for the use of isotope techniques to assess and manage groundwater resources.

Support the provision of necessary equipment and other materials, together with expert assistance for field sampling campaigns, laboratory analysis and data interpretation, in order to enhance sustainability and self-reliance.

Address key gaps in the methodology, data and capacity that are needed to support strategic planning decisions, using appropriate technical approaches and focusing on the contribution of isotope hydrology techniques to sustainable water management in cooperation with the IAEA.

IAEA SUPPORT

Isotope hydrology techniques provide unique information on water resources through the use of 'fingerprints' of water, contributing key information on the age, origin and renewal rate of groundwater, as well as its vulnerability to pollution, salt water intrusion and climate change, in a cost-efficient, accurate and effective way. These techniques allows for targeted evaluations of water quality, and offer invaluable, objective information in support of sustainable water resource management.

All counterparts were equipped and trained in the use of field and groundwater monitoring equipment to conduct basic hydrogeological surveys. Four hydrochemical and stable isotope laboratories in the region were strengthened, leading to increased self-reliance in conducting laboratory analyses. Water professionals were trained in basic hydrogeological techniques, sampling, chemical analysis, operation of stable isotope analysers and hydrological mapping techniques to the interpretation of isotope results and related hydrological and geochemical data.

GLOBAL COOPERATION

The Sahel project was implemented in partnership with 13 countries, and in cooperation with the UNESCO, relevant river basin authorities (the Niger Basin Authority, the Lake Chad Basin Commission, the Volta Basin Authority, the Liptako-Gourma Integrated Development Authority, and the Organization for the Development of the Senegal River), and the German Federal Institute for Geosciences and Natural Resources.

The IAEA, through its TC Fund, and with contributions from the Republic of Korea, Sweden, Japan, New Zealand and the USA through the Peaceful Uses Initiative, as well as in-kind contributions from Australia, ensured the effective implementation of the project.

MAJOR RESULTS

- The project provided a first, broad overview of groundwater characteristics in the Sahel region. Five aquifer basin reports will be made available on the IAEA website. Human and technical capacity has been developed for the management of the shared water resources.
- The data collected will enable the policymakers to take evidence based decisions in an informed and responsible manner on shared water management.
- In some areas (such as the Lake Chad Basin), the source of groundwater recharge has been established for the first time, which is key in developing policies to protect groundwater from pollution.
- Large quantities of good quality groundwater have been identified in several areas, which is of critical importance to the drought-prone area.
- Areas where groundwater has been contaminated appear to be isolated at present. Efforts are required to limit pollution to keep the available potable groundwater resources safe for human activities.
- The relationship between surface water and groundwater in many areas is now better understood, especially in: a) the Iullemeden Aquifer System b) the southern watershed of the Lake Chad Basin and, c) the area around the Niger River of the Liptako-Gourma Aquifer.
- In the hard rock/basement aquifers of the Liptako-Gourma Upper Volta System, groundwater has been found to exist in small independent pockets. Major new findings have been obtained regarding recharge and flow patterns in some areas including: a) the eastern and north-eastern parts of the

Sample preparation for tritium analysis of groundwater, Isotope Hydrology Laboratory, Ghana Atomic Energy Commission. (Photo: D. Calma/IAEA)

Maastrichtian aquifer on the southern side of the Senegal River (Senegal); b) the shallower aquifers (Quaternary, Continental Terminal and Eocene) on the northern side of the Senegal River (Mauritania); and, c) the southern boundary of the Lake Chad Basin.

- New information on the geographical boundary of saline groundwater and the salinization process in the Senegalo-Mauritanian transboundary basin shared by Senegal and Mauritania was obtained.

NEXT STEPS

A follow-up project for the Sahel region incorporating the IAEA Water Availability Enhancement (IWAVE) methodology is being designed by the IAEA and other partners. The new project will build on the achievements of project RAF/7/011 and seek to improve the management of groundwater resources in the Sahel countries by translating the hydrological data generated through the first project into policies, and by using the network of counterpart institutions established to make a decisive contribution to the characterization, management and monitoring of groundwater resources using isotope hydrology and other conventional techniques.

RECOMMENDATIONS FOR STAKEHOLDERS

- Study the final reports of the project and implement the recommendations to improve their groundwater management.
- Expand their use of isotope techniques to enhance the integrated management of water resources at the national and regional level.
- Promote cooperation to ensure the integrated development of water resources, and provide institutional frameworks at the regional level.

REFERENCES

1. Integrated and Sustainable Management of Shared Aquifer Systems and Basins of the Sahel Region, IAEA website: www.iaea.org
2. Report on: Final Coordination Meeting of project RAF/7/011 Integrated and Sustainable Management of Shared Aquifer Systems and Basins of the Sahel Region, Accra, Ghana (28 November to 2 December 2016)
3. Connecting the dots: linking technical cooperation projects on transboundary groundwater resources in Africa, IAEA Department of Technical Cooperation

IAEA Briefs are produced by the Office of Public Information and Communication
Editor: Aabha Dixit • Design and layout: Ritu Kenn
For more information on the IAEA and its work, visit www.iaea.org
or follow us on
or read the IAEA's flagship publication, the IAEA Bulletin, at www.iaea.org/bulletin

IAEA, Vienna International Centre, PO Box 100, A-1400 Vienna, Austria
Email: info@iaea.org • Telephone: +43 (1) 2600-0 • Facsimile +43 (1) 2600-7