

GROUNDWATER POLLUTION IN AFRICA



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Groundwater Pollution in Africa

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Preface by UNEP

At the Millennium Summit in 2000 and during the 2002 World Summit on Sustainable Development in Johannesburg, world leaders recognized the vital importance of surface and subterranean fresh water to human development, and committed themselves to a precise, time-bound agenda for addressing the world's current and future water resource and sanitation needs. This commitment formed a strong basis for discussion at CSD-13 on developing strategies to achieve the goal of universal safe drinking water supply, as well as providing a policy framework to leverage national and international support in pursuit of this goal.

Groundwater is of particular importance in Africa, where numerous countries rely on a combination of hand-dug wells and public boreholes for their drinking water. Although groundwater use is generally less visible than surface supplies, it increasingly provides the main source of agricultural irrigation in rural areas, as well as a vital safety net for dry-season food security. In urban centres, groundwater is an important source of affordable municipal and private freshwater supplies.

In the past two or three decades, rapid urbanization across Africa has led to the growth of large areas of unplanned sub-standard housing in most cities. Residents of such areas usually resort to groundwater as a source of inexpensive, high-quality domestic water supply. However, the uncontrolled expansion of this kind of housing, together with increasing sewage and effluent leakage, indiscriminate waste disposal, and uncontrolled industrial and commercial activities all lead to the increasing pollution and deteriorating quality of groundwater – and to mounting public health problems.

In 2000, the United Nations Environment Programme (UNEP) and the United Nations Education Science and Cultural Organization (UNESCO), with the support of the United Nations Economic Commission for Africa (UN-ECA) and the United Nations Programme on Human Settlements (UN-Habitat), launched a collaborative effort to assess the vulnerability of groundwater in several African cities. The assessments had one primary goal: to assist policymakers to make informed and appropriate decisions for protecting their groundwater. Under the title *Urban Pollution of Surface and Groundwater Aquifers in Africa*, the project's initial two-year phase addressed the issue of aquifer vulnerability and the need to protect the quality of key groundwater resources. This was followed in 2003–05 by a second phase, *Assessment of the Pollution Status and Vulnerability of Water Supply Aquifers of African Cities*, which focused on monitoring and assessing the pollution threats arising from unplanned developments, open sewers, leaking septic tanks and latrines, and uncontrolled industrial and commercial activities. This phase also involved capacity building and networking between governments, local authorities and university researchers in the participating countries.

All of these activities have been aimed at alleviating the detrimental effects of human activity on Africa's groundwater resources, by providing accessible and reliable academic and public information. Aquifer stress now constitutes a genuine crisis in some African countries, where towns and cities are often wholly dependent upon groundwater resources. It is clear that a proper scientific diagnosis and prioritization of the problems affecting each aquifer are critical in order to design an effective urban groundwater protection strategy. This in turn is dependent upon the methodical collection and reliable interpretation of accurate groundwater quality and exploitation data. The establishment of a continent-wide monitoring network of aquifer surveillance will contribute to effective



A handwritten signature in black ink that reads "Adnan S. Khan". The signature is written in a cursive style.

groundwater protection by enabling the consistent assessment of the extent, rate and progress of aquifer degradation across the region.

The UNEP/UNESCO project initially covered six French-speaking countries and one English-speaking country in West Africa (Benin, Côte d'Ivoire, Niger, Ghana, Mali, Burkina Faso and Senegal), before expanding to encompass an additional four English-speaking countries in East and Southern Africa (Ethiopia, Kenya, Zambia and South Africa) in 2004.

This publication provides an assessment of the current status of both shallow and deep-seated aquifers in some of the most groundwater dependent cities in these 11 countries. It also provides vital information on the methodologies developed for the monitoring, management and sustainable use of Africa's urban aquifers. In the first two years, this involved a uniform methodology for sample collection and analysis, together with basic measures for pollution reduction, while in the second phase more sophisticated techniques were developed for water sampling, vulnerability mapping, the interpretation of results, and their dissemination to governments, policymakers and the general public.

It is becoming increasingly clear that the availability of groundwater resources will have a critical impact on the success of future efforts to alleviate poverty across Africa. The Water Agenda of the New Partnership for Africa's Development (NEPAD) and the constitution of the Africa Ministerial Council on Water (AMCOW) exemplify positive recent developments in the pursuit of this objective. At the 2003 Pan-African Implementation and Partnership Conference on Water, African ministers pledged their commitment to the coordinated, multi-sectoral development of the continent's water resources in order to provide sustainable supplies for urban development, agricultural and industrial uses, low and flat lands management, and other activities covered by new Integrated Water Resource Management (IWRM) policies. In November 2005, this commitment was further advanced at South Africa's University of the Western Cape, where an international groundwater workshop brought together some of the continent's leading scientists, water authorities and NGOs with key international supporters to develop strategies to manage and protect Africa's groundwater resources.

The information and recommendations contained in this publication build upon the pollution and risk assessments carried out by the UNEP/UNESCO project, as well as groundwater protection experiences in a number of developing and developed countries, and attempt to develop a groundwater protection strategy specifically designed for Africa's physical and socio-economic environment. It is our hope that this information will go some way towards assisting policymakers, institutions and other stakeholders in addressing what remains one of the greatest challenges facing the future of this continent.

Achim Steiner,
United Nations Under-Secretary General and
Executive Director, United Nations Environment Programme

Message from UNESCO

Dr. A. Szöllösi-Nagy

Director of Water Science, UNESCO, Paris

This book is largely based on the investigation or review of the situation of aquifer's water supply in sub-Saharan African cities, from the UNEP/UNESCO project on 'Assessment of Pollution Status and Vulnerability of Water Supply Aquifers of African Cities'. Strategically this project resulted in the setting up of groundwater monitoring networks in the eleven participating countries and provided groundwater quality information through various aquifer vulnerability maps and bulletins. National water managers and planners were thereby provided with information pertaining to water quality trends and status in both space and time for resource planning, management purposes and policy formulation for groundwater protection and contamination prevention.

Degradation of groundwater is one of the most serious water resources problems in Africa. Groundwater is vulnerable because of its relation to surface water and land use activities where pollution often occurs. Groundwater is particularly problematic in areas where the aquifers provide a large part or are the sole source of water supply. Because groundwater movement is usually slow, polluted water may go undetected for a long time. In fact, most contamination is discovered only after drinking water has been affected and people become sick. By this time, the volume of polluted water may be very large, and even if the source of contamination is removed immediately, the problem is not solved. Although the sources of groundwater contamination are numerous, the solutions are relatively few, and the focus must be on prevention of the problem.

The UNEP/UNESCO project is aligned with the focus of the Sixth International Hydrological Programme (IHP) of UNESCO (2002–2007) on 'Water interactions: systems at risk and social challenges'. Water is an integral part of the environment and its availability is indispensable to the efficient functioning of the biosphere. Water is of vital importance to all socio-economic sectors – human and economic development simply is not possible without a safe, stable water supply. IHP VI seeks to contribute to our knowledge of the state of global freshwater systems, stresses the importance of a holistic, integrated groundwater management approach, and emphasizes the social, economic, cultural and environmental value of water.

Therefore, it is a great pleasure for UNESCO/IHP to be part of this important endeavor and we are very pleased to present this book, as a concrete outcome of the fruitful cooperation between UNESCO, UNEP and the UNESCO Chair on Groundwater based at the University of the Western Cape over the course of the project. We believe that in order to achieve and maintain an acceptable standard of living, access to a safe, reliable source of clean drinking water is essential. The content of this book has highlighted a range of groundwater pollution problems and clean drinking water will become a viable objective only by keeping our valuable water resources as pollution – free as possible. The challenge now is to develop an improved understanding of groundwater water quality and respond to the growing need for improved water services.

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This book contains a selection of papers that initially originated from an eleven-country UNEP & UNESCO project, entitled 'Assessment of pollution status and vulnerability of water supply aquifers of African cities'. A call for papers resulted in submissions from across the African continent and beyond. Several organizations and project management teams are thanked for their support and input over a number years, during and after the project. The support of the following organisations is gratefully acknowledged and has facilitated the realisation of this book:

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- UN Development Account
- UNEP – United Nations Environment Programme
- UNESCO – United Nations Educational, Scientific and Cultural Organization
- UN HABITAT – United Nations Human Settlements Programme

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- Introduction to groundwater protection in Mombasa, Kenya by UWC (Prof. Y. Xu) and the University of the Free State (Dr. B. Usher)
- Groundwater interaction with surface water by UWC (Prof. Y. Xu, Prof. L. Raitt, Dr. A. Thomas, Mr. A. Scheepers) and CSIR (Mr. J. Zhang)
- Modelling and its calibration at UWC by USGS (Dr. M. Hill and Ms. C. Tedman)
- Assessment of fractured rock aquifer at UWC by USGS (Dr. A. Shapiro) and staff of the UNESCO Chair at UWC
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