UNESCO IHP
Groundwater Protection
From 1975 to 2007
Budapest, Hungary, 8-11 November 2001

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At the 31st Session of the UNESCO General Conference, Member States have decided to give priority to water resources. The IHP of UNESCO will be the principal mechanism for contributing to the priority issues.

UNESCO activities on water resources have an historical background that goes back to the 1965 when the International Hydrological Decade was initiated.

The International conference on the results of the International Decade and on future programmes in Hydrology held in Paris in September 1974 marked the end of the International Decade and the start of the new long-term International Hydrological Programme (IHP) of UNESCO. IHP was formed in 1975 and was intended as an expansion of the decade activities to cover various applications of hydrology to water management and its environmental implications. Following the priorities of the Decade, focus was given to groundwater resources at the very beginning of the IHP. Since 1975 many publications have focussed on aspects related to pollution and protection of aquifers (see attached Annex I). Particular focus has been given to training and education concerning groundwater resources related issues, especially in developing countries.

Main achievements

As a result of the IHP 5th Phase (1996-2001) three new guidebooks will be published at the beginning of 2002 with the following titles :

1. Groundwater Contamination Inventory
2. Strategy for early warning groundwater quality monitoring systems
3. Urban Groundwater Pollution

Considering that the sources of groundwater contamination are many and varied, the objective of the first book is to present a methodology to set up an inventory of groundwater contamination sources and to provide a guide for planning, conducting and evaluating the inventory.

The inventory is an indispensable part of any comprehensive groundwater protection strategy. Before appropriate protection measures can be designed and implemented, groundwater contamination and its sources must be identified and assessed and their threats to groundwater quality determined. An inventory of the number, type, and intensity of potentially contaminating activities can serve a twofold purpose for groundwater protection.

The results of a comprehensive, detailed inventory allows water managers to prioritize contamination sources according to intended purposes (e.g., the level of risk to public drinking water supplies) and to develop different management strategies to deal with these sources, thereby safeguarding the public health and protecting groundwater in general.

The guidebook conceptualizes the preparation of contamination source maps and presents a model legend in a clear and comprehensive format. The legend is intended to facilitate the preparation of contamination source maps in a standardized form, which conform to the legend for groundwater

vulnerability maps and to the legend for hydrogeological maps, both developed within IHP-IV. It also describes supporting maps, such as a map of existing contamination of groundwater; groundwater vulnerability map; land use map; or significant recharge area map, which can be used in combination with the contamination source maps to derive a potential groundwater contamination problem map.

The second book illustrates and provides guidelines to set up a strategy for early warning groundwater quality monitoring systems and it will later be better illustrated by one of its authors.

The third guidebook "Urban groundwater pollution" will put emphasis on water quality, management and integration of urban water issues, rather than on conventional hydrogeological issues of quantity, resources and well design.

A large part of this book deals with case studies but, rather than describing individual cities in detail, it will describe representative environments. Each chapter will cover several cities to draw out the common threads across cultures and continents. It will illustrate:

- Mature industrial cities (Lerner & Trowsdale)
- Urban areas of sub-Saharan Africa; weathered crystalline aquifer systems (Barrett & Taylor)
- Cities overlying karst and karst-like aquifers (Appleyard)
- Shallow porous aquifers in Mediterranean climates (Cape Town, Perth) (Sililo)

It includes:

- Hard rock environments (probably Australian examples)
- Rapidly-urbanizing humid-zone cities (e.g. Jakarta)
- Rapidly-urbanizing arid-zone cities
- Alluvial urban environments
- Modern arid cities in Arab States (e.g. Riyadh, Kuwait, Dubai)

We are now entering into a new phase of the IHP programme, which will commence in 2002 and end in 2007. This 6th phase is characterized by new attention to be given to the interest of civil society and politicians on water resources. The IHP overall message is to look at "Water interactions: systems at risk and social challenges".

An holistic and integrated approach has been the underlying basic concept of the new IHP VI programme. The concept, thus, includes the notion of investigation of water science and policy "at the margin" , such as surface water and groundwater, global watershed and river reach scales, quantity and quality; water bodies and aquatic ecosystems, science and policy, water and civilization. Along with the development of society's approach towards water, the overall concept of the IHP-VI is an "integrated water resources management.

Five themes are foreseen under IHP-VI, namely:

- Theme 1 Global Changes and Water Resources
- Theme 2 Integrated Watershed and Aquifer Dynamics
- Theme 3 Land Habitat Hydrology
- Theme 4 Water and Society
- Theme 5 Water education and Training

The main focus will be on an integrated approach to freshwater resources that have to be handled as a whole (including both surface and groundwater resources) in their assessment, development and management with due consideration of inherent interaction. In this context, an "Experts Group Meeting" with the participation of invited experts from different regions of the world as well as representatives of related international non-governmental scientific organizations (IAH, IAHS) was

organized 17-19 May, 2001 at UNESCO Headquarters in Paris, to discuss and review the comments and feedback received from IHP National Committees and to prioritize activities to be included in the plan of IHP-VI in the field of "Groundwater".

The recommendations of the Experts Group was to give particular attention to groundwater protection, to artificial recharge, to groundwater in arid and semi-arid areas and the equitable sharing of transboundary groundwater systems. Therefore the following 8 activities have been identified to have the highest priority :

- Guidelines for delineation of protection zones around public groundwater supplies and management policy.
- Development of groundwater policy and management for wetlands protection and biodiversity conservation.
- Effects of global changes on groundwater recharge, especially in arid and semi-arid regions in relation to water resources management.
- Methodologies for risk assessment of wastewater re-use on groundwater quality.
- Development of methodology (data acquisition and analysis) for studying responses of aquifers to extreme hydrological events.
- Study of the dynamics of groundwater flow and chemistry in closed basins including long-term effects, especially in arid zones.
- Evaluation of the impact of land-based sources of pollution on coastal zone resources.
- Methodology for enhancing communication between water specialists, decision makers and communities to strengthen public participation in groundwater protection.
- In the context of sustainable development the main aims of IHP-VI are to reduce the vulnerability of hydro-systems and to improve the efficiency of water management at the basin scale.

Particular focus will also be given to groundwater recharge, including water-quality aspects and investigation of processes of groundwater pollution, the use of artificial recharge and evaluation of the state of the art with regard to the recharge of aquifers from surface basins and water spreading including use of reclaimed water and consideration of the variations of water quality.

Proposed Activities for Groundwater Component of the IHP-VI

Theme/Focal Area	Activities proposed for IHP-VI Groundwater component	Tot. o Of Acti	Related program to individual activities
1.Global Changes and Water Resources			
1.1 Global distribution of resources: Water supply and water quality Related Programmes: FRIEND, HELP	1) Methodological support to assess spatial and temporal distribution of quantity and quality of total freshwater resources. 2) Global assessment of groundwater resources including contemporary state of their quality. 3) Worldwide inventory of fossil and/or salinity affected water resources. 4) Standardization of national groundwater quality monitoring methods. 5) Inventory of national groundwater data policies, protocols and resolutions for international data exchange. 6) Production of an integrated isotope and chemical meta-database for precipitation and groundwater.	1 2 3 4 5 6	IGRAC JIIHP
1.2 Global estimation of water withdrawals and consumption Related Programme: HELP	1) Global inventory of surface and groundwater major water engineering works and their role in satisfying water demand. 2) Mapping and inventory by sources of domestic, industrial and agricultural water use and consumption. 3) Development of water scarcity and availability indicators as well as criteria of sustainability based on regionally relevant standards.	7 8 9	WWAP
1.3Integrated assessment of water resources in the context of global land-based activities and climate change Related Programmes: FRIEND, HELP	1) Analysis of the impact of extreme events on total freshwater resources. 2) Assessment of the impact of land use conversion on available groundwater resources. 3) Effects of global changes on groundwater recharge, especially in arid and semi-arid regions in relation to water resources management. 4) Evaluation of the impact of surface water conservation works on groundwater regime. 5) Groundwater protection policy, management and remediation for the agricultural, industrial and mining sectors. 6) Identification of the origin, transport mechanisms and mitigation of natural groundwater pollutants (Arsenic, Fluoride, Aluminum, Nitrogen and others). 7) Methodologies for risk assessment of waste water re-use on groundwater quality.	10 11 12 13 14 15 16	

2. Integrated Watershed and AquiferDynamics			
2.1 Extreme events in land and water resources management Related Programme: FRIEND	1) Development of methodology (data acquisition and analysis) for studying responses of aquifers to extreme events. 2) Methods for the study of early signals of groundwater contamination. 3) Identification and management of groundwater resources for emergency situations as a result of extreme hydrological events. 4) Assessment of groundwater vulnerability in areas of climatic extremes.	17 18 19 20	
2.2 International River Basins and Aquifers Related Programme: FRIEND	1) Establishment of guidelines for transboundary aquifer resources management. 2) Improvement of the management of shared river basins through understanding groundwater interactions.	21 22	ISARM
2.3 Endorheic Basins Related Programme: FRIEND	1) Development of scientific strategies for rational use and management of water resources of closed basins. 2) Management strategies for controlling the chemical composition and mineralization of water in closed basins. 3) Study of the dynamics of groundwater flow and chemistry in closed basins including long-term effects, especially in arid zones.	23 24 25	
2.4 Methodologies for Integrated river basin management Related Programmes: FRIEND, HELP	1) Development of specific river basin assessment methodology for water pollution control and management for a range of geographic and geohydrological water use situations. 2) Guidelines for artificial recharge and conjunctive use of groundwater resources. 3) Development of decision support system (DSS) and management information system (MIS) at the basin scale especially for transboundary basins and aquifers. 4) Guidelines for delineation of protection zones around public groundwater supplies and management policy.	26 27 28 29	
3. Land Habitat Hydrology			
3.1 Drylands Related Programmes: FRIEND, HELP	1) Integrated water resources management under arid and semi-arid climatic conditions, including non-renewable resources. 2) Sustainable development of alternative water resources and their safe integration in the (local) hydrological system. 3) Use of isotope techniques in water resources management with particular emphasis on drylands. 4) Guidelines for improved utilization of remote sensing data for applications in groundwater hydrology in	30 31 32 33	JIIHP

	vulnerable environments.		
3.2 Wetlands Related Programme: FRIEND	1) Development of groundwater policy and management for wetlands protection and biodiversity conservation. 2) Use of isotopes to quantify groundwater interaction with wetlands.	34 35	 JIIHP
3.3 Mountains Related Programmes: FRIEND, HELP	1) Development of reliable methods for estimation of recharge/discharge regime of groundwater in mountain areas.	36	
3.4 Small Islands and coastal zones Related Programme: FRIEND	1) Consolidation of methodology and management Strategies for groundwater-surface water interactions in coastal zones. 2) Evaluation of the impact of land-based sources of pollution on coastal water resources. 3) Use of isotopes for quantification of submarine groundwater discharge at coastal zones.	37 38 39	 JIIHP
3.5 Urban areas and rural settlements Related Programme: FRIEND	1) Study of urban groundwater problems in various climatic and hydrogeological environment.	40	
4. Water and Society			
4.1 Water, civilizaion and ethics			
4.2 Value of water	1) Water use economic efficiency according to water sources.	41	
4.3 Water conflicts: Prevention and Resolution Related Programme: HELP	1) Methods of enhancing community participation in water projects and management. 2) Methodology for enhancing communication between water specialists, decision makers and communities to strengthen public participation in groundwater protection.	42 43	
4.4 Human security in water-related disasters and degrading environments Related Programmes: FRIEND, HELP	1) Social, economic and health impact of natural contaminants in groundwater.	44	
4.5 Public awareness	1) Screening of existing documentation and development	45	

raising on water interactions Related Programmes: FRIEND, HELP	of public awareness tools specifically for groundwater resources and their interactions.		
5. Water Education and Training			

Having these concerns UNESCO will put in place a framework for close cooperation with UNECE to support UNECE guideline applications in other regions of the world and for the organization of the training courses and seminars as well as thematic maps preparation. .