



United Nations
Educational, Scientific and
Cultural Organization



International
Hydrological Programme

IHP-VII

WATERDEPENDENCIES

Systems under Stress and Societal Responses
[2008-2013]



International Hydrological Programme
Division of Water Sciences

IHP-VII

WATER DEPENDENCIES

Systems under Stress and Societal Responses
[2008-2013]

THE CONTEXT

Water: central to global ecosystems

Freshwater is a key resource for human health, prosperity and security. It is as essential to sustainable development as it is to life – and beyond its functions in the hydrological cycle, it has social, economic and environmental values that are interconnected and mutually supportive.

A growing water crisis

Yet lack of safe water and adequate sanitation is the world's largest cause of illness. Far more people endure the largely preventable effects of poor sanitation and water supply than are affected by war, terrorism and weapons of mass destruction combined.

Challenges will increase significantly in the coming years as population growth continues. The urban population in developing countries is growing dramatically – particularly in periurban areas – generating more demand for the already inadequate water supply and sanitation infrastructure and services.

More than half the world's population relies on freshwater that accumulates in mountainous regions. These areas are under pressure from deforestation, agriculture and tourism – all of which are placing unsustainable demands on water.

Arid and semi-arid areas face the greatest pressures to deliver and manage freshwater resources globally. It has been estimated that some 40% of the world's population were suffering water shortages by the mid-1990s. In less than 25 years, two-thirds of the world's population will be living in water-stressed countries.

Floods affect an estimated 520 million people across the world in a single year, resulting in up to 25,000 deaths annually. Climate change is likely to bring more extreme weather events.

Considering the finite nature, increasing demand, and deteriorating quality of freshwater, the need to protect and manage these resources properly is crucial. Increasing access to domestic water supply and sanitation services is also a key entry point for efforts to help developing countries fight poverty and hunger, reduce child mortality, promote gender equality and protect natural resources.

IHP: UNESCO's Intergovernmental Scientific Cooperative Programme in Hydrology and Water Resources

The International Hydrological Programme (IHP) is the only intergovernmental programme of the UN system devoted to water research, water resources management, and education and capacity building. The programme, tailored to Member States' needs, is implemented in six-year phases – allowing it to adapt to a rapidly changing world.

Since its inception in 1975, IHP has evolved from a strictly scientific programme to one that is also management and policy-oriented, and takes into account social, economic and cultural dimensions while still retaining a solid scientific core. IHP has over 165 National Committees and focal points that contribute to the implementation of the programme.

A New Six-Year Phase: IHP-VII

Water Dependencies: Systems under Stress and Societal Responses

The seventh phase of IHP will continue to promote and lead international hydrological research, facilitate education and capacity development, and enhance governance in water resources management. The aim of these efforts is to help meet the UN Millennium Development Goals (MDGs) on environmental sustainability, water supply, sanitation, food security and poverty alleviation.

The results achieved during this phase will be action-oriented and policy-relevant so that all of IHP's audiences – governments, the scientific community and civil society – can benefit from them.

Support to the Global Agenda for Sustainability

In order to assist countries in better managing water resources towards meeting the MDGs, UN organizations need to play a strong role in providing technical support, and facilitating capacity building, knowledge sharing and advocacy functions. IHP-VII will aim to produce policy-oriented results that translate into tangible benefits at the country level. Steps will be taken to ensure coordinated and effective action on the ground with the many organizations involved in water resources management.

IHP has reinforced the areas of its comparative advantage among the various other global initiatives. Since 2000, 24 agencies of the UN system have been cooperating under the World Water Assessment Programme (WWAP). UNESCO hosts the programme's secretariat and has contributed to the first and second World Water Development Reports (WWDR) produced on a triennial basis.

Other important initiatives will improve cooperation and joint activities within the UN system under the aegis of the UN-Water coordinating mechanism and the framework of the International Water for Life Decade. The close cooperation that IHP already enjoys with WMO, FAO, IAEA, UNECE, UN-ESCWA, UNU, WHO, UNEP and GEF will be further strengthened in this phase.

UNESCO also serves as lead agency for the UN Decade on Education for Sustainable Development (2005–2014).



IHP-VII AT A GLANCE

THEMES AND FOCAL AREAS

Theme 1: Adapting to the impacts of global changes on river basins and aquifer systems

- 1.1 - Global changes and feedback mechanisms of hydrological processes in stressed systems
- 1.2 - Climate change impacts on the hydrological cycle and consequent impact on water resources
- 1.3 - Hydro-hazards, hydrological extremes and water-related disasters
- 1.4 - Managing groundwater systems' response to global changes
- 1.5 - Global change and climate variability in arid and semi-arid regions

Theme 2: Strengthening water governance for sustainability

- 2.1 - Cultural, societal and scientific responses to the crises in water governance
- 2.2 - Capacity development for improved governance; enhanced legislation for wise stewardship of water resources
- 2.3 - Governance strategies that enhance affordability and assure financing
- 2.4 - Managing water as a shared responsibility across geographical and social boundaries
- 2.5 - Addressing the water-energy nexus in basin-wide water resources

Theme 3: Ecohydrology for sustainability

- 3.1 - Ecological measures to protect and remediate catchment processes
- 3.2 - Improving ecosystem quality and services by combining structural solutions with ecological biotechnologies
- 3.3 - Risk-based environmental management and accounting
- 3.4 - Groundwater-dependent ecosystems identification, inventory and assessment

Theme 4: Water and life support systems

- 4.1 - Protecting water quality for sustainable livelihoods and poverty alleviation
- 4.2 - Augmenting scarce water resources, especially in small island developing states (SIDS)
- 4.3 - Achieving sustainable urban water management
- 4.4 - Achieving sustainable rural water management

Theme 5: Water education for sustainable development

- 5.1 - Tertiary water education and professional development
- 5.2 - Vocational education and training of water technicians
- 5.3 - Water education in schools
- 5.4 - Water education for communities, stakeholders and mass-media professionals

Education, training and capacity building activities are developed across all the themes.



PROGRAMMES

Cross-Cutting Programmes

- **FRIEND** (Flow Regimes from International Experimental and Network Data). An international research programme that helps to set up regional networks for analyzing hydrological data through the exchange of data, knowledge and techniques at the regional level.
- **HELP** (Hydrology for the Environment, Life and Policy). A new approach to integrated catchment management by building a framework for water law and policy experts, water resource managers and water scientists to work together on water-related problems.

Associated Programmes

- **IFI** (International Flood Initiative). An interagency initiative promoting an integrated approach to flood management which takes advantage of the benefits of floods and the use of flood plains, while reducing social, environmental and economic risks. Partners: the World Meteorological Organization (WMO), the United Nations University (UNU), the International Association of Hydrological Sciences (IAHS) and the International Strategy for Disaster Reduction (ISDR).
- **ISI** (International Sediment Initiative). An initiative to assess erosion and sediment transport to marine, lake or reservoir environments aimed at the creation of a holistic approach for the remediation and conservation of surface waters, closely linking science with policy and management needs.
- **PCCP** (From Potential Conflict to Cooperation Potential). A project facilitating multi-level and interdisciplinary dialogues in order to foster peace, cooperation and development related to the management of shared water resources.
- **JIIHP** (Joint International Isotope Hydrology Programme). A programme facilitating the integration of isotopes in hydrological practices through the development of tools, inclusion of isotope hydrology in university curricula and support to programmes in water resources using isotope techniques.
- **ISARM** (Internationally Shared Aquifer Resources Management). An initiative to set up a network of specialists and experts to compile a world inventory of transboundary aquifers and to develop wise practices and guidance tools concerning shared groundwater resources management.
- **G-WADI** (Global Network on Water and Development Information in Arid Lands). A global network on water resources management in arid and semi-arid zones whose primary aim is to build an effective global community to promote international and regional cooperation in the arid and semi-arid areas.
- **UWMP** (Urban Water Management Programme). A programme that generates approaches, tools and guidelines which will allow cities to improve their knowledge, as well as analysis of the urban water situation to draw up more effective urban water management strategies.
- **WHYMAP** (World Hydrogeological Map). An initiative to collect, collate and visualize hydrogeological information at the global scale to convey groundwater-related information in a way appropriate for global discussion on water issues.



IHP-VII THEMES

Theme 1: Adapting to the Impacts of Global Changes on River Basins and Aquifer Systems

Global changes brought on by population growth, urbanization, land use changes, migration, and pollution are all changing the earth and the way it functions. The impacts of climate variability and change are likely to further exacerbate these drivers. No single institution or country can tackle these challenges alone. But UNESCO can foster the necessary cooperation to bring all players together, whether they are governments, research institutions, UN agencies, or NGOs. The programme's mission is to strengthen the scientific understanding of these impacts on water systems and to link scientific conclusions to policies for promoting sustainable management of water resources. Special attention will be given to arid and semi-arid regions, which are particularly vulnerable to climate change, with consequences that may have very serious social and environmental effects. Because global changes cut across disciplinary and national boundaries, interdisciplinary and international cooperation will be needed to study and address these issues.



CLIMATE CHANGE IMPACTS ON THE HYDROLOGICAL CYCLE

A focal area under this theme is concerned with assessing the impacts of climate change on the hydrological cycle within the broad spectrum of global changes. It aims to facilitate and support local research and capacity in developing countries and to develop management abilities in coping with climate change impacts on water resources in cold climates and high altitudes. Activities planned under this focal area include the development of:

- Case studies and dissemination of guidelines
- Methods to assess the impacts of climate change and analysis of associated uncertainties
- Networks to exchange information on best practices in cold climates, including changes in snow, ice and glacier mass balances
- Methods to mitigate impacts from continuous worldwide decline of hydrometric networks (gauging stations, monitoring wells, etc.) and to predict the effect of climate change with more certainty



MANAGING GROUNDWATER SYSTEMS' RESPONSE TO GLOBAL CHANGES

Groundwater is the largest store of freshwater; over 95% of our usable freshwater resources are stored in aquifers as groundwater. In many areas for most of the year, it is the only locally available source for rural as well as urban water supply. Unless protected, groundwater quality deteriorates from saline intrusion, pollution from agricultural and urban activities, and uncontrolled wastewater disposal, as well as when older waters are accessed.

Activities include:

- Assess the impacts of global change on groundwater resources and support Member States in addressing regional needs through global coordination
- Improve understanding of how groundwater contributes to the global water cycle and evaluate the changes to groundwater storage and flux
- Better define growing population pressures on groundwater resources, global warming impacts on groundwater recharge rates, rising sea levels and saltwater intrusion
- Raise awareness of decision makers, implementers, users and the general public of the importance of groundwater as a store of freshwater to encourage improved protection and sustainable use.

Theme 2: Strengthening Water Governance for Sustainability

The water crisis is primarily one of governance: institutions lack the capacity to overcome conflicting approaches in the use and allocation of water from within one basin or aquifer system – both at the national and transboundary level. This lack of integration, sectoral approaches and institutional resistance all contribute to the fragmented management of freshwater resources. Yet water-related systems are interdependent and have to be managed in an integrated manner. Many solutions to water problems lie in better governance, with sharing water as one of the key challenges to be addressed. Raising awareness, providing education and developing capacity with regard to water issues are all important steps towards better water governance.

Theme 3: Ecohydrology for Sustainability

Without sound water resources management, human activities can upset the delicate balance between water resources and environmental sustainability. A better understanding of water as both an abiotic resource and a service delivered by ecosystems is needed. This understanding would make it possible not only to identify and quantify the critical linkages that regulate the interrelationships of hydrology and biota, but also to see how the control of these linkages may contribute to environmental sustainability. The management approach has to go beyond protection and restoration. It has to recognize the carrying capacity of ecosystems in the face of increasing human impact and find ways to improve and transfer solutions across a variety of environments.

Under this theme area, IHP will fill existing knowledge gaps by addressing issues related to critical water systems, such as in arid and semi-arid zones, coastal areas, estuaries and urbanized areas where ecohydrological processes have not yet been sufficiently addressed. It will also show how better knowledge of the interrelationships between the hydrological cycle and biota can contribute to more cost-effective and environmentally-friendly management. Finally, it will provide system solutions and technology transfer.



PCCP: SHARING WATER RESOURCES PEACEFULLY

There were 276 transboundary water basins in the world at last count, covering around 45 percent of the globe's surface – a necessary resource for nearly half of the world's population. Competition often arises between different stakeholders over limited water resources. Though some analysts predict more conflicts over water in the future, many countries successfully share river basins and other water resources, showing that water can be a powerful catalyst for international cooperation.

UNESCO's From Potential Conflict to Cooperation Potential (PCCP) facilitates multi-level and interdisciplinary dialogues in order to foster peace, cooperation and development related to the management of shared water resources.

Activities include:

- Education and training: developing region-specific educational materials and organizing multidisciplinary training courses;
- Research: focusing on the causes of water conflicts, and the best practices as well as innovative techniques to manage them; and
- Process support: providing parties facing difficulties managing their shared water resources with international fora in which to establish dialogue and exchange knowledge and experience related to water management and security.

More information available at: <http://www.unesco.org/water/wwap/pccp/>



Theme 4: Water and Life-Support Systems

Human use of water resources has had a profound effect on the resource stock and quality of water over most of the inhabited world. These stresses threaten the sustainability of society and are particularly problematic in arid and semi-arid areas, coastal areas and small islands where population density and industrial activity are greatest. Yet societal responses to warning signs of depleting groundwater levels, dry streams and polluted water have generally been inadequate.

IHP will address the need to improve the management of water for productive purposes. The focal areas under this theme deal with protecting water quality from natural and anthropogenic sources of contamination; water augmentation methods applicable in the most water-stressed areas; and the issues and complexities of achieving sustainable water utilization in urban and rural areas.



URBAN WATER MANAGEMENT PROGRAMME

Urban water problems are growing around the world. Rapid urbanization and the formation of megacities exacerbate these problems further. Access to safe drinking water and basic sanitation in cities in developing countries is now seen as a necessary precondition for the attainment of the MDGs; it is also instrumental in the fight against poverty, hunger, infant mortality and gender inequality.

New paradigms need to be developed and applied to solve these increasingly acute water problems. IHP addresses water-related issues in cities by aiming to develop scientifically sound support for water management in urban areas.

Outputs include:

- UNESCO Urban Water Management Book Series (over 10 volumes consolidating the research results of IHP's network) promoting science and knowledge for sustainable urban water management, water education and capacity building
- Reports and guidelines on innovative urban water management in a range of cities
- Establishment and evaluation of alternative water systems for improving the safety and quality of life of periurban dwellers
- Analytical tools for the assessment of urban water conditions and for the enhancement of integrated urban water management in various natural and climatic settings

Theme 5: Water Education for Sustainable Development

Water education is the strategic entry point in developing a new ethic for water governance and management. However, there are many challenges in providing water education for sustainable development. If the MDG target on water is to be met, a threefold increase in the number of trained water professionals is needed in Africa, and a twofold increase in Asia, according to an initial estimate by UNESCO-IHE. Educational programmes will thus have to shape a new generation of water managers and decision makers who are able to apply a holistic and multidisciplinary approach to water resources.

IHP's action in the field of water education – primarily through UNESCO-IHE Institute of Water Education, IHP National Committees, water-related Centres operating under the auspices of UNESCO and UNESCO Chairs – was substantially extended in the previous phase of the programme. The increasing emphasis on cross-disciplinary activities will be consolidated and continued in the current phase. Education about water issues will have to occur at all levels to equip people with the knowledge, skills and values to play a role in protecting the resource. In addition to the tertiary and professional dimensions of water education, IHP will also focus on policy makers, schools, vocational education and training, mass media and stakeholders in an effort to promote water sustainability. There will be a concerted effort to improve linkages between those engaged in water education at the tertiary level and those working on school, vocational education and training, and community levels. Best practices in water education will be compiled and promoted globally. The wider constituency under this theme also reflects UNESCO's role as the lead agency within the UN system for the UN Decade of Education for Sustainable Development.

IHP-VII

CROSS CUTTING PROGRAMMES



FRIEND: Flow Regimes from International Experimental and Network Data

The analysis and dissemination of hydrological data on a regional scale is becoming more important than ever, as uses of inland waters become more diverse and demanding, and droughts, floods and snowmelt remain a constant threat.

- FRIEND is an international research programme that helps set up regional networks for analyzing hydrological data. It aims to improve understanding of hydrological variability and similarity across time and space – through the mutual exchange of data, knowledge and techniques at the regional level.
- FRIEND research covers a diverse range of topics including low flows, floods, variability of regimes, rainfall/runoff modeling, processes of streamflow generation, sediment transport, snow and glacier melt, climate change and land use impacts.
- FRIEND also provides support to researchers and operational staff of hydrological services in developing countries, thereby contributing to their capacity to assess and manage their own national water resources.
- From a relatively modest beginning in 1985, FRIEND has developed into a worldwide network of eight regional programmes. Hydrologists from over 145 countries participate in the programme.
- Education and capacity development are important components of the FRIEND programme; over 400 participants attended more than 28 courses conducted in 50 countries.



HELP: Hydrology for the Environment, Life and Policy

Although there has been much progress in data collection and the prediction of climate variability and change, less has been done to translate these advances into information useful to water managers and policy makers worldwide.

- HELP was established in 1999 to develop a new approach to integrated catchment management by building a framework for water law and policy experts, water resource managers and water scientists to work together on water-related problems. It has since grown into a global network of some 33 basins with four regional coordinating units.
- HELP activities focus on assessment, research and implementation. This work may involve synthesizing existing knowledge; simulating future change scenarios (e.g. in land use, demography, socioeconomics, water cycle, supply/demand for different catchment states); checking model predictions; defining gaps in scientific knowledge; and developing a technical implementation strategy by hydrologists, basin stakeholders and managers.



IHP-VII HOW WE WORK

UNESCO's work in the water sector is built on three tracks: hydrological science for policy relevant advice; education and capacity building responding to the growing needs of sustainable development; and water resources assessment and management to achieve environmental sustainability.

UNESCO hosts the IHP Secretariat and provides seed funding that is multiplied many times over through cooperation with implementing partners.

UNESCO's water family operates as a global network that works together to implement the organization's strategic goals.

- ✳ **The IHP Secretariat** is at the heart of the work: it serves UNESCO's 190 Member States, through the IHP National Committees, other governmental bodies, and academic and research institutions in the implementation of the programme.
- ◆ **UNESCO-IHE Institute for Water Education** – an integral part of UNESCO – is the educational arm.
- ✳ Twenty-four agencies of the UN system cooperate through the **World Water Assessment Programme (WWAP)** to provide an on-going global assessment of the state of the world's freshwater resources. The programme is hosted and led by UNESCO.
- 🌐 **UNESCO's Regional and Cluster Offices** assist in the implementation of IHP in the regions.
- ★ **Water-related Institutes and Centres** under the auspices of UNESCO work on relevant thematic and geographic priorities in their areas of expertise. Since Member States have realized the potential of these centres, the network has been rapidly expanding.
- 🌐 **UNESCO's Water-related Chairs** are established as teaching or research positions at universities or research institutes around the world.





The UNESCO-IHE Institute for Water Education is the largest water education facility in the world and the only institution in the UN system authorized to confer accredited Masters degrees. The Institute is instrumental in strengthening the efforts of other universities and research centres to increase the knowledge and skills of professionals working in the water sector.

- In its 50-year history, UNESCO-IHE has awarded more than 13,500 Masters diplomas to students from 162 countries.
- UNESCO-IHE offers Masters programmes in 15 water-related specializations, awarding some 200 M.Sc. degrees each year.
- Approximately 70 Ph.D. candidates are currently registered at UNESCO-IHE, conducting research that will further water resources management work in their home regions.
- Ninety-eight percent of UNESCO-IHE graduates return to their home countries.
- Nearly half of UNESCO-IHE students come from Africa, about thirty percent from Asia, with the balance from Latin America and OECD countries.

More information available at: <http://www.unesco-ihe.org/>

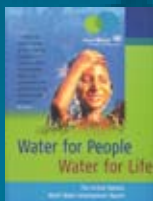


The World Water Assessment Project (WWAP), founded in 2000, is the flagship programme of UN-Water.

Housed in UNESCO, WWAP monitors freshwater issues in order to provide recommendations, develop case studies, enhance assessment capacity at the national level and inform the decision-making process.

Its primary product, the World Water Development Report (WWDR), is a periodic, comprehensive review providing an authoritative picture of the state of the world's freshwater resources released every three years. The 3rd United Nations World Water Development Report: "Water in a Changing World" will be launched in March 2009 at the 5th World Water Forum in Istanbul, Turkey.

More information available at: <http://www.unesco.org/water/wwap>



1st United Nations World Water Development Report: "Water for People, Water for Life", launched in March 2003 at the 3rd World Water Forum, Kyoto, Japan

2nd United Nations World Water Development Report: "Water, a shared responsibility", launched in March 2006 at the 4th World Water Forum, Mexico City, Mexico



© UNESCO-IHP june 2008

Photographs:

Cover: ©Asif Akbar / ©istockphoto.com-Sean Warren
 ■ p.1: ©istockphoto.com-Mark Rigby / ©istockphoto.com-Tobias Helbig ■ p.2: © wilhjelm ■ p.3: ©istockphoto.com-Archana Bhartia
 ■ p.4: ©istockphoto.com-Vera Bogaerts ■ p.5: ©istockphoto.com-Peter Zaharov ■ p.6: ©istockphoto.com-Peeter Viisimaa ■ p.7: ©Manta Sidhu / ©istockphoto.com-Klaas Lingbeek van Kranen

Text: Bozena Blix

Design: Maro Haas, Le Pré St Gervais - France

Printed by SEP Nimes - France on Cyclus Offset 100% Recycled Paper



Contact information

INTERNATIONAL HYDROLOGICAL PROGRAMME (IHP)

UNESCO/Division of Water Sciences (SC/HYD)

1 rue Miollis

75732 Paris Cedex 15

France

Tel: (+33) 1 45 68 40 01

Fax: (+33) 1 45 68 58 11

Email: ihp@unesco.org

<http://www.unesco.org/water/ihp>

