United Nations
Educational, Scientific and
Cultural Organization

International
Hydrological Programme

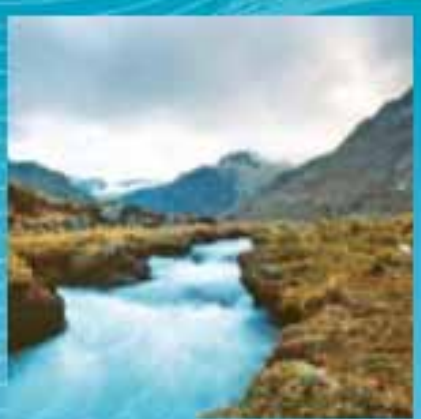
IHP-VII

WATERDEPENDENCIES

Systems under Stress and Societal Responses

[2008-2013]

STRATEGIC PLAN



International Hydrological Programme
Division of Water Sciences

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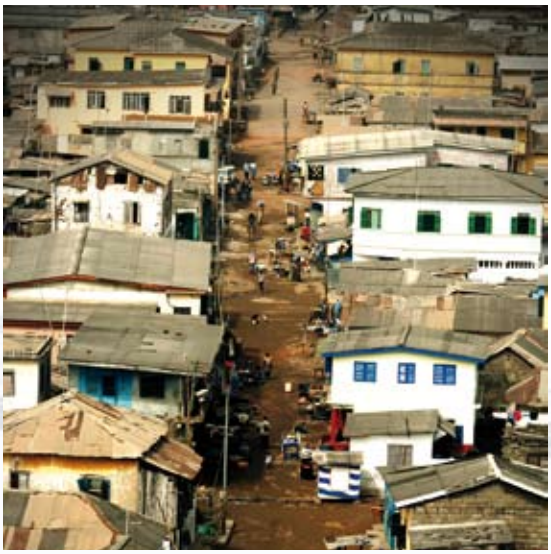

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STRATEGIC PLAN

INTRODUCTION

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.

A New Six-year Phase: IHP-VII

Water Dependencies: Systems under Stress and Societal Responses

The new 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, and contribute to the objectives of the International Decade for Action «Water for Life» (2005-2015).

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, 26 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, second and third 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).

Structure of the Strategic Plan

The Strategic Plan for IHP's VIIth Phase was formulated by a task force of experts,[1] with inputs received by the IHP National Committees on their thematic priorities. The structure is set out in seven sections:

(A) Establishing the baseline conditions for IHP – Three decades of hydrology
(B) Assessment of the coming decade – Hydrology for environmental sustainability
(C) Setting the targets for IHP Phase VII – Water, central to global ecosystems
(D) Transition from Phase VI to Phase VII – Continuity with change
(E) Making IHP-VII action-oriented and policy-relevant – Support to the global agenda
(F) The themes and focal areas of Phase VII
(G) The next steps

1. See Annexes I and II for more information.

(A) ESTABLISHING THE BASELINE CONDITIONS FOR IHP

THREE DECADES OF HYDROLOGICAL EFFORT

It is now widely accepted that water in its many manifestations is of principal concern to most economic sectors of all countries, and is fundamental to global sustainability, thanks in a large part to the three decades of IHP's scientific leadership. IHP's policy relevance, and through it, the research conducted at national, regional and global levels, was the baseline from which IHP-VII would go into operation. The success of the outputs of the previous six phases of IHP can be summarized by the widespread recognition of the quantified hydrological cycle being at the heart of integrated water resource management (IWRM).

The quantitative definition of the various components of the hydrological cycle –frozen freshwater, surface water and groundwater– provides a powerful engine that drives all the processes in IWRM.

A large number of other partners from related sciences have joined forces with IHP to form a wide constituency, which allows for continuous improvement of the assessments. In recent years the number of partners, all striving to interlink the various components and sub-components of the hydrological cycle, IWRM and environmental sustainability, has increased exponentially. The World Water Assessment Programme (WWAP) is hosted and led by UNESCO, with the contribution of twenty-six UN Agencies. WWAP has issued three major World Water Development Reports (WWDR, 2003, 2006 and 2009), with the active cooperation of UNESCO-IHP.

The sheer number of submissions to any global forum devoted to water, such as the World Water Forum (WWF) or the Stockholm Water Week is the undisputed evidence of the increasing constituency of water and its centrality in global ecosystems. It may be argued that the success of IHP could have been its downfall, had the science not maintained its policy relevance and orientation. As a programme of a specialized UN agency, IHP has ensured its complementarity and reinforced the areas of its comparative advantage among the many global initiatives. Looking back since the 1970s, the different phases of IHP have operated under the three pillars of hydrological science, water resources assessment and management, and education and capacity building.

Since 1975, six successive phases of IHP have engaged the "water constituency". Such engagement over three decades ensures that understanding the scientific and the quantitative basis of hydrology is essential for sound management of scarce water resources in arid zones and melting freshwaters in the polar regions, in the context of integrating it into social and economic frameworks with their competing demands. The focus of IHP in the early years was on developing techniques, methodologies and approaches to identify and measure the components of regimes in order to better explore hydrological phenomena. By the early 1990s, sustainability in the development of essential water resources, in the face of rapidly changing natural and built environments became an issue of prime concern. By the mid-1990s, IHP's focus shifted to improving the management of increasingly scarce water within the planet's recognizably vulnerable ecosystems, which stretch from the hot arid zones to the frozen landscapes of the polar regions. These transitions can be also noticed in the titles of the IHP themes that have been adopted in the various phases of the programme, as summarized below.
In the course of Phase VI, water has come to occupy a clearer and more central position on the international environmental agenda.

The Johannesburg Summit, the adoption of the Millennium Developments Goals (MDGs), and the launch of the Water for Life Decade can be considered significant markers of the global community's concern for water.

The theme chosen for IHP's Phase VI was an appreciation that water is at the center of interactions between many of the earth's systems; the theme subtitles suggested that earth systems were at risk, and that this gives rise to social challenges. In the current phase, two crosscutting programmes, Flow Regimes from International Experimental and Network Data (FRIEND) and Hydrology for the Environment, Life and Policy (HELP) which are IHP-led initiatives, have also provided a framework for bringing the different audiences of the water constituency together, including scientists, water resource managers, ecologists and policy makers to address locally defined water challenges. Initiatives such as these identified water resources as an undisputed component in ensuring sustainable development and the sound functioning of vulnerable ecosystems.

PREVIOUS PHASES OF UNESCO's INTERNATIONAL HYDROLOGICAL PROGRAMME (IHP)

- **1965-1974 IHD (International Hydrological Decade):** Experimental Basins, World Water Balance and Water Resources of the Earth
- **1975-1980 IHP-I / 1981-1983 IHP-II / 1984-1989 IHP-III**
- **1990-1995 IHP-IV** Hydrology and Water Resources for Sustainable Development
- **1996-2001 IHP-V** Hydrology and Water Resources under Vulnerable Environments
- **2002-2007 IHP-VI** Water Interactions: Systems at Risk and Social Challenges

During 2006 and 2007, an overall UNESCO Science Programme Review was conducted which noted that the world faces new challenges related to unequal economic development, environmental degradation, and globalization. The science of hydrology has been mobilized to respond to these challenges through IHP and its partners. The results of IHP's work corroborate the findings of related sciences that many of the planet's systems – hydrological as well as social and ecological – are strongly interdependent, and that a number of these systems are now under identifiable stress from population growth, urbanization, land conversion or the accumulation of many different anthropogenic pollutants. Global programmes such as the Global International Waters Assessment (GIWA) and the Millennium Ecosystems Assessment (MA) have made the same findings. Stress levels in some regions are so elevated that the global community is now prepared to respond. There is no silver bullet that provides a simple fix to the global water issue, as the conclusion of the 2nd UN World Water Development Report (WWDR, 2006) states. Only through creating the necessary links and synergies, can the issues be addressed appropriately. In the 2nd WWDR, these linkages are "water and poverty", "water and governance", and "water and environment". Here then is the baseline for making the transition from IHP-VI to IHP-VII, for the years 2008 to 2013.

(B) ASSESSMENT OF THE COMING DECADE

HYDROLOGY FOR ENVIRONMENTAL SUSTAINABILITY

The Mission Statement of UNESCO's Medium Term Strategy for the years 2008-2013 states that "as a specialised agency of the UN, UNESCO contributes to the building of peace, alleviation of poverty, sustainable development and inter cultural dialogue through education, the sciences, culture, communication and information". The Strategy is built on five overarching objectives that will be translated into fourteen strategic programming objectives. Based on this policy direction and the focus provided by the strategy, IHP is one of the concrete thematic and policy responses in a problem-based approach to major challenges at the global, regional and local levels, with an emphasis on Africa and gender equality. Although the organization-wide programming is based on biennial sectoral priorities, IHP Phase VII is conceived to be operational through the full Medium Term. IHP forms part of the Major Programme II – Natural Sciences, and is to be principally conducted under the Biennial Sectoral Priority 1, though it will also contribute to other sectoral priorities.[2] The focus of this Major Programme is on the contribution of science and technology to poverty eradication, peace and sustainable development. To respond to these, IHP aims to promote research and capacity building for the sound management of natural resources.

Several key drivers need to be considered therefore, in making an assessment of the needs in the coming decade. In the midst of the decade in which the Millennium Development Goals are to be achieved, water is linked to poverty alleviation when it is supplied to everyone, when basic sanitation is available and basic health is assured. Water is also linked to the environment, through transboundary sharing, pollution, water-related disasters and its increasing scarcity. There are challenges: water and governance is linked through lack of adequate financing, its poor valuation and the need to adopt, often intricate, integrated resource management principles. Many of these concerns have to be placed in the context of the rapidly amplifying impacts of globalization, a measurable warming up of the planet, and a consideration of water in its various manifestations in global ecosystems. Clearly, then, water-related education for sustainable development is essential. The subsequent sections consider these issues before introducing and setting out the specific targets for IHP's VIIth Phase.

The impacts of globalization

For the vast majority of the partners in the water constituency, water in the hydrological cycle acts as the essential "bloodstream" for all terrestrial and coastal systems. Although well understood by specialists in the past, it is now much more widely accepted that water provides environmental services, in addition to being a vital resource, both in the built (human) and the natural environments.

At the local scale, water may be a reason for potential conflict, especially in the water-scarce regions of the world, but it is also a reason for significant and sometimes unexpected cooperation.

In assessing the needs of the coming decade, the underlying presumption was that in nature there are few discontinuities, but rather an evolution of changes. By observing the nature of these changes and the rate at which they occur, it might be possible to assess the needs to which IHP must respond. The past few years have been characterized by widespread and accelerated global changes. When translated from the more general application, the often repeated dictum that "we live in a globalized world" signifies that in the current geopolitical socio-economic arena, the intensity of interactions is on the increase, in a way that has never happened in the past. Interactions taking place on one side of the globe can be rapidly translated into far-reaching impacts somewhere else. A decision by a multinational enterprise with agro-interests in another part of the world can mean major changes in

2. Biennial Sectoral priority 2 is concerned with fostering policies and capacity building in science, technology and innovation, with a special emphasis on basic science and energy; Biennial Sectoral priority 3 is concerned with contributing to disaster preparedness and mitigation.

crop, land use and demand for water. Each social or economic interaction involving international relations results in multiple dealings which are also related, with every interaction bringing with it a multiplicity of further related changes that are transposed into modifications in land use, demand and new pressures on natural resources, energy needs, and so forth. Thus there is an exponential increase in these types of changes at the global and local scales. Superimposed upon these scale-related changes is the time factor; the pace of change taking place frequently leaves natural and anthropogenic systems with much reduced resilience to recover if the impact is significant. The science of hydrology, expressed through IHP, must therefore be capable of giving scale-related, timely and appropriate policy-relevant advice, while at the same time dynamically developing tools and methodologies that will meet such regularly changing challenges.

In its response to these new demands at the global level, IHP's role is to promote the study, observation and quantification of uncertain global impacts that arise from the continuing expansion of human populations and infrastructure (cities, road networks, dams, canals, and irrigation schemes). Some such inadequately quantified global impacts include the release of frozen water from melting glaciers, the changing balance of global sediment transport and the increasing pollutant accumulation in the aquatic environments. At the local scale, IHP's role is more complex since it involves the interrelations with the physical, social and economic aspects of water.

Water in its various manifestations

Water is fundamental to ensuring environmental sustainability, one of the Millennium Development Goals. From such a vantage point, IHP should ensure that the important function of the ecohydrological "services" in the planet's life support system are addressed in several key areas, not least in water for food security and human survival, and in alleviating water health-related problems. Water is also the raw material for generating hydropower, leading to competition for its services. As global temperatures rise, the melting freshwaters in the frozen polar and high mountainous regions will be released into the hydrosphere with uncertain impacts. At the catchment scale, IHP's role in water environment management cannot be forgotten; these include studying the impacts of the release of frozen water in tundra regions (and possible associated methane release), erosion, dilution of waste, and translating land-use activities into ecologically sustainable activities involving secure habitats for aquatic biota. In addition, at this scale also known as the landscape level, water is much more of a finite resource, and so sharing it wisely between water-dependent activities of a social and economic nature is a challenge that IHP cannot ignore. IHP Phase VII will therefore clearly define its position in the "constituency of water" to help address scientific aspects of quantitative hydrology through to its role at the landscape level.

Release of frozen freshwater into the hydrosphere

The largest store of freshwater on the planet is contained in the polar frozen regions. This resource far exceeds all the remaining freshwater. Average temperatures are rising globally but in the Antarctic Peninsula region, the temperature has risen 2°C in the past 50 years. In the early Pleistocene (55 million years ago), the Arctic Sea water temperatures were closer to 20°C. In 1996 in the northern hemisphere, Greenland was losing about 100 km^3/year in mass from its ice sheet; by 2005, this had increased to about 220 km^3/year. Although a complete melting of the Greenland ice sheet is uncertain, if this took place, it would be equivalent to a 7m rise in sea level. Permafrost melt in the northern land masses have potentially significant impacts, including the possible release of methane – a very potent greenhouse gas – into the atmosphere. The Arctic Region is intimately tied to the global climate system, and potential disruptions from the changing hydrological balance there have the potential to generate worldwide changes – albeit over long timescales, much longer than the scale of IHP Phase VII. The most powerful link would possibly be via the thermohaline circulation – the global conveyor belt taking warm water along ocean surfaces and returning colder water at greater depth. The IHP National Committees of the affected regions have highlighted problems with a potential global impact that are being considered in the course of the International Polar Year 2007-8.

The UN Decade of Education for Sustainable Development

For the period 2005-2014, UNESCO has been designated as the lead agency within the United Nations system for the UN Decade of Education for Sustainable Development (DESD). The decade provides a new and forward-looking framework for intersectoral cooperation within UNESCO, notably for water education across its whole programme. The Action Plan for the UN Decade includes several thematic programmes, one of which is devoted to "Education for Sustainable Water Management". To be effective, programmes related to sustainable development should link water education to social and cultural values. IHP is designated to play a pivotal role in the development of the UNESCO intersectoral strategy on education for the sustainable management of freshwater resources. The contributing partners for this include UNESCO's Education, Culture, and Social & Human Sciences Sectors as well as UNESCO-IHE. The entry of UNESCO-IHE Institute for Water Education into the Organization in July 2003 has considerably strengthened UNESCO's capacity to respond effectively in this regard.

Water education is the strategic entry point in developing a new ethic for water governance and management.

This assertion follows from the recognition that education is the most effective means a society has to confront the challenges of the future since it is education that will shape the world of tomorrow. Education is therefore a key dimension of the international response to sustainable development and the world water crisis. Water education will have to occur at all levels to equip people with the skills, knowledge, and values needed to both protect the resource as well as maximize their own potential use of it. Doubtless the full resources of UNESCO will have to be mobilized to provide such education at the appropriate levels, as part of primary and secondary school curricula through to education of decision makers, policy adopters and the public at large. This has been deliberated on by the Working Group on Water Education and Capacity Building for Sustainable Development,[3] whose findings and input have been incorporated into the IHP Strategic Plan for Phase VII.

The Working Group has advised UNESCO, IHP and its partners on key issues, initiatives and strategies for raising awareness and advancing water education for the community, via the mass media and other communication channels, and for the school education, and technical and vocational education and training (TVET) sectors. It is operating under the leadership of UNESCO-IHP and will lead activities towards, and contribute to, an implementation strategy for Thematic Programme 8 on Education for Sustainable Water Management of the UNESCO Action Plan for DESD, with a particular focus on the Millennium Development Goals and the International Decade for Action "Water for Life".

UNESCO IHP Centres

Education, training and capacity building will continue to be a priority in Phase VII of IHP, including technical training, building public awareness and the transfer of technology. In recent years, IHP has generated growing interest in its approach at national and regional levels, and has developed an international network of collaborating scientific institutions. This network of institutions or centres has now reached a point where it can play a substantial role in influencing behavioral change in water use and management. Coordination among UNESCO water education-related networks has been strengthened through a strategy among UNESCO Centres, Chairs and Institutes which ensures that they contribute to the implementation of activities under IHP at global, regional and local levels. The strategy has been developed around the principle that these centres provide significant training to prepare scientists and technicians for the future, while also broadening appreciation of the water cycle's importance and its inter-relationship with other systems. A task force will ensure that activities which UNESCO and its water education centres are undertaking become more visible. The same effort will be made for UNESCO Chairs and Regional Centres.

3. The Group on Water Education and Capacity Building for Sustainable Development, (GWESD) was set up in response to 166 EX/Decisions 3.6.1 and IHP-IC resolution XVII-12.

UNESCO-IHP: Complementarity and comparative advantage within the UN system

Since 2000, 26 agencies of the UN system have been cooperating under the World Water Assessment Programme (WWAP). UNESCO has hosted the programme's secretariat and contributed to the preparation of the first (2003), second (2006) and third (2009) World Water Development Reports (WWDR). There are also a number of other important initiatives underway. These will improve cooperation and joint activities within the UN system under the aegis of the UN-Water group. Cooperation will also be fostered within the framework of the International Water for Life Decade. It can therefore be anticipated that UNESCO's work in water sciences will require tighter coordination with other UN agencies, organizations and programmes. The close cooperation with the World Metereological Organization (WMO), the Food and Agriculture Organization (FAO), the International Atomic Energy Agency (IAEA), the United Nations Economic Commission for Europe (UNECE), the United Nations Economic and Social Commission for Western Asia (UNESCWA), the United Nations University (UNU), the World Health Organization (WHO), the United Nations Environmental Programme (UNEP) and the Global Environmental Facility (GEF) that was already established during the VIth Phase of IHP will be strengthened in Phase VII.

Practical assessment of needs relative to IHP

When the three pillars of hydrological research – education for sustainable development, wide scale training and capacity building, and sensitive water resources management – are translated into a practical needs assessment for the coming decade, they still remain the foundations upon which to build the next phase of IHP. The issues represented by these pillars remain relevant now at the full range of scales: global through to local, and even at the micro level in places. IHP thus needs to retain the scale-relevant structure, while at the same time ensuring that the crosscutting issues provide the framework for the actions.

(C) SETTING THE TARGETS FOR IHP PHASE VII

WATER, CENTRAL TO GLOBAL ECOSYSTEMS

In formulating the concept for IHP Phase VII, a broad view was taken of the targets and audiences that IHP would need to address in the years 2008 to 2013. These targets arose from the concerns that were expressed in many contexts and took into account the different audiences that will be engaged and subjected the proposed structure of IHP to a peer review. As a result of this process there were no substantive changes, though several new subtleties were introduced which have been incorporated into the theme titles and their focal areas. For completeness of this report, the main points for IHP targets are reintroduced below.

Social and economic issues in water management

In order to mainstream social and economic issues in IHP's work on hydrology, cooperation among hydrologists, practitioners, and socio-economists needs to be strengthened, especially in the debate on the "right of access to water" and "water as a common good". These are issues that have been addressed in the 2nd World Water Development Report, which also noted that water is a fundamental right and that rapid socio-economic and environmental changes are making the water crisis more severe in certain areas. IHP-VI made a good start in this area by launching the HELP, Water Ethics and From Potential Conflict to Cooperation Potential (PCCP) projects.

It is crucial to develop greater cooperation among disciplines to build bridges between hydrology, economics and the social sciences.

Cooperation is also necessary to ensure sound financing for natural resources management, which in turn can lead to socio-economic benefits at the national level. Moreover, strengthening cooperation would make it easier to include the water sector in national economic development plans, many of which are now formulated as Poverty Reduction Strategy Papers (PRSPs).

IHP will therefore continue to contribute to the debate on economic and financial issues linked to water. The implementation of integrated water resources management (IWRM) is often constrained by the inadequate and "sectoral" flow of funds, mainly because investment policies fail to recognize the full spectrum of true environmental costs and benefits. For example, financing for flood alleviation projects is rarely linked to direct financing for integrated basin management (basin-wide forest replanting, soil conservation, erosion reduction measures, etc.) or to the affordability levels of populations. Similarly, investments in major road-rail projects that create a new linear feature, frequently cutting across a river basin, and thus creating not just a barrier, but also a pathway that can cross the natural hydraulics, often do not include investment components to integrate them into the hydrological regime. Furthermore, financing for the sustainable management of the hydrological unit, the basin, can be frustrated by the difficulty of finding concordance between administrative units (which provide the necessary socio-economic base, both at the national and the international scale) and the river basin, which forms the unit for natural resources management.

Water governance for sustainability

It is said and was emphasized in the 2nd WWDR that the water crisis is essentially a crisis of governance, as experienced through the fragmented nature of water management. Institutions often 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. For example, the way certain economic instruments are being used for environmental management provides a case in point. While they can be very useful, there are significant shortcomings in the manner in which they have been applied. The free market economic system treats water, a common pool resource, as a good to be priced and traded (given the trend towards privatization and commercialization), which, by its nature, ignores the value of aquatic environments as

a habitat for biodiversity and other services noted earlier. The ultimate consequence is the degradation and depreciation of nature's capital. Experience has shown that practitioners and decision makers often lack a common platform for addressing these kinds of issues. As a consequence, water is not viewed in holistic terms. Rather, it is treated simply as a raw material for society's needs under conditions of high uncertainty and complexity, where all competing demands cannot possibly be met over the long term. The definition of good water governance remains elusive, but notions of ethical use, cultural diversity, transparency, equity, and accountability all come into play to achieve sustainability. The science of hydrology and its practical applications have much to contribute to this developing issue. Thus governance for sustainability will be one of the themes for IHP-VII.

Water for life support systems

The planetary life support systems require a reliable supply of wholesome water. This subjective statement can be turned into objective requirements when it is related to human health. The relationship between water consumption and human health has been demonstrated in many studies. Less well defined is the impact of changes in catchment water quantity and quality on the health of populations. With the anticipated increased reuse of water within the basin, an understanding of the health consequences of water in the supply system that is found "before the pump" is needed. Alteration in water dynamics at the basin level can impact the health of organisms, for example through the passage of endocrine disrupters through the basin. The waterlogging of communal living areas may lead to health problems. Methodologies are needed for a common understanding of how integrated river basin water resources management can contribute to the improved health of populations. A better understanding of the fate of contaminants and pathogens passing through the water cycle of basins would also benefit from integrated studies. The scientific knowledge gained would provide insights to help achieve the Millennium Development Goals.

Ecohydrology for sustainability

Earlier phases of IHP implicitly recognized ecology as an integral component of land habitat hydrology. IHP Phase V adopted a theme to investigate "ecohydrological processes in the surficial environment". Now there is a need for an explicit ecohydrology platform in IHP-VII, one that incorporates environmental sustainability at the landscape level.[4] Such an approach would broaden IHP's constituency and promote efforts to strengthen soft engineering solutions to supplement hard engineering. As noted above, this calls for improved understanding of water-landscape level management of the environment, taking full account of the interactions among ecosystems[5] and their dependent habitats. Agrobiodiversity and the related sustainable land use is one example of the types of issues that need to be emphasized. When food production, and the environmental services that support it, are disconnected in terms of land management, the subtle changes that result from this can have far-reaching, long-term impacts, such as the reduction in the recharge potential for aquifers. These changes can be also associated with nutrients (biogeochemistry) and water cycles that feed the systems. For example, modifications resulting from land use changes can be the source of such impacts. Human life-support activities may generate more or less unavoidable environmental problems due to the physical and chemical landscape manipulations they involve. In the worst case, these actions can affect ecosystems to the point where they are unable to deliver ecosystem services, such as fresh water, productive soils or maintenance of valuable biodiversity – with direct consequences for livelihoods, vulnerability and security.

Groundwater resources integrity

While "integrated watershed and aquifer dynamics" was one of IHP's themes during Phase VI, there is still insufficient attention being given to the long-term management of groundwater resources and its scientific underpinnings. The large storage capacity of groundwater resources – many of which are transboundary – can play a crucial role in supporting

4. The Millennium Project's Task Force 6 on environmental sustainability identifies "environmental management at the landscape level" as one of the problems requiring urgent action (see www.unmillenniumproject.org).

5. An ecosystem is defined as a dynamic complex of plant, animal and micro-organism communities and the abiotic environment interacting as a functional unit, with humans forming an integral part.

adaptation measures for coping with impacts from climate variability, global changes, hydrological extremes and natural disasters. The accelerated use of groundwater resources in the absence of good long range management has already caused serious local problems in many places. To a large extent, this is partly due to both the existing lack of scientific knowledge about aquifers and the lack of investment in developing appropriate groundwater resource management strategies. The need to examine groundwater more closely has now been recognized. For example, the Global Environmental Facility's (GEF) focal area of "international waters"[6] and its Scientific and Technical Advisory Panel (STAP)[7] have decided to stress groundwater resources in their own future programmes, especially with regards to small island developing states (SIDS), in cooperation with UNESCO. In IHP-VII, there will be a new emphasis on groundwater resources and their sound management at all scales, continental through to SIDS. This would include formulating science-based policies and principles, preparing appropriate regulations to curb overexploitation, developing technologies and policy instruments that would help to replenish overdrawn systems, and the sustainable management and use of groundwater resources. Closer attention should be paid to transboundary aquifers, non-renewable groundwater resources, enhancement of aquifer recharge, adaptation measures to climate variability, groundwater quality, groundwater protection, groundwater-dependent ecosystems and urban groundwater management.

Urban water management for increasing demands

Over half of the world's population will live in cities by the year 2010, with a large segment in an increasing number of megacities. Urban water problems are growing more complex and acute all over the globe. The developing world is faced with uncontrolled expansion of large cities confronting extreme conditions: a dense population further exacerbated by high rates of rural migration, large income disparities, and the explosive growth of periurban areas. Widespread mismanagement of water resources, growing competition for the use of freshwater, degraded sources – sometimes by pollutants of unpredictable effects – only heighten the depth of these problems. Cities in the developed world also face critical challenges, including deteriorating infrastructure, a degrading environment and an inability to confront extreme events successfully. Improving freshwater management to provide better access to safe drinking water and basic sanitation, as called for by the MDGs, particularly in urban areas in developing countries, now commands a greater sense of urgency and is seen as a necessary precondition for health and success in the fight against poverty, hunger, infant mortality and gender inequality. These problems can only be addressed properly through a concerted effort which involves scientific, social and institutional approaches. New paradigms for improved urban water management are emerging – reflecting integrated management of all components, and emphasizing more efficient water use and reuse, as well as solutions tailored to specific physical and socio-economic settings. IHP has already made significant inroads into urban water management in IHP-V and IHP-VI. Now, in light of the obvious and growing needs to tackle urban water problems the world over, particular emphasis shall be placed in this area in IHP-VII through the Urban Water Management Programme (UWMP).

BOX 1
URBAN WATER MANAGEMENT PROGRAMME (UWMP) IN IHP

IHP has an active and continuously evolving programme which aims to develop approaches, tools, guidelines and capacity building means to allow cities to assess their urban water situation and to adopt more effective urban water management strategies and practices. IHP-V began to address integrated urban water management (IUWM), which included nonstructural measures for flood management, surface and groundwater management, and urban drainage modelling in different climates. During IHP-VI, the outlook was broadened and nine major topics were addressed:

- Data requirements management for integrated urban water management
- Processes and interactions in the urban water cycle
- Towards sustainable urban groundwater management
- Integrated urban water system interactions: complementarity among urban water services
- Integrated urban water modelling and management under specific climates
- Urban water security, human health and disaster prevention
- Urban aquatic habitats in integrated urban water management
- Socio-economic and institutional aspects in urban water management
- Urban water education, training and technology transfer

This approach will be continued and expanded in IHP-VII.

6. The GEF IW focal area is devoted to the sound management of transboundary water, marine or terrestrial, and has established a partnership with the UNESCO-led ISARM Programme.

7. UNESCO was requested by the STAP of GEF to provide expert consultations on the significance of groundwater in GEF operations. Groundwater will be explicitly emphasized in future GEF financing in all of its focal areas, with the exception of the ozone layer. Final reports on this can be accessed from www.gefweb.net under STAP documents.

A new emphasis on water education for sustainable development

Education, training and capacity building will retain a strong emphasis in IHP-VII. This need is reinforced through UNESCO's Action Plan for the UN Decade of Education for Sustainable Development (DESD). As this is to be a "One UNESCO" Action Plan, its overall goal is to integrate values inherent in sustainable development into all aspects of learning that will encourage changes in behavior for a sustainable, economically viable and just society. The expected results of the DESD activities will be evidenced by an increase in the number of senior decision makers in Member States committed to DESD, undertaking demonstration projects and, in the course of periodic reviews, evidence that countries are addressing the objectives of Education for Sustainable Development. The Thematic Programme 8, of the Action Plan Education for Sustainable Water Management, is led by IHP, and the IHP-VII Strategic Plan will be the primary driving force for this responsibility. The expected results of this Thematic Programme include delivery of capacity building activities in each of UNESCO's regions, completion of demonstration projects and publication of books, case studies and briefing papers. An example of an important activity related to this work was the recent launch of the First Regional Flagship Project on Water for Associated Schools Project Network (ASP-net) schools in the Arab region. The meeting was held in Abu Dhabi, United Arab Emirates (UAE) and it brought together the ASP-net, National Coordinators and teachers from UAE, Egypt, Jordan, Kuwait, Lebanon, Oman, Palestine and Qatar. In the Strategic Plan for IHP-VII, these types of initiatives will be complemented by education at tertiary levels and education for decision makers.

Convergence of cross-disciplinary dialogue between specialists

One important target for IHP will be to organize cross-disciplinary dialogues that can help in solving global problems through a common effort, using contributions from natural scientists (physical and biological), social scientists and policy makers. Theory suggests that cross-sectoral and integrated approaches put forward in cross-disciplinary forums where the trade-offs between different freshwater ecosystem services can be considered, are more likely to contribute to sustainable development than many existing sectoral approaches. This is not an easy task for specialists engaged in a narrow field of research. Each discipline relies on its own semantics to facilitate internal dialogue which creates barriers to a cross-disciplinary convergence of ideas. Cooperation and dialogue among stakeholders, water specialists, policy makers and the general public are inevitably affected by implicit assumptions and specialized language which can become an invisible hindrance to broader cross-disciplinary dialogue. One of the objectives of the education component of IHP-VII thus aims at addressing this still intangible but important barrier.

(D) TRANSITION FROM PHASE VI TO PHASE VII

CONTINUITY WITH CHANGE

IHP-VII has been designed to make a seamless transition from Phase VI's "water interactions" to "water dependencies". Research results of the previous three decades of scientific hydrology suggest that water interactions in practically all terrestrial ecosystems are water-dependent. There is good scientific evidence that within the natural, as well as the built systems, there are interdependencies connected by water. Further, there is a direct causal link between the quantity and quality of the water delivered to an ecosystem that may be undergoing stress. Experience shows that switching the water regime of an aquatic ecosystem by a small amount results in a changing balance of its components. Given time, the in-built resilience of the system will adapt to the switched regime and to the stress imposed. A more radical switch intuitively suggests that an ecosystem may not be able to mobilize its resilience to the stress and readapt, with the result that it will collapse. The quantitative transition point between small to large switches in stress levels remains elusive in large ecosystems, though in smaller ones such interactions can be quantified and demonstrated. Consequently, in addition to water dependencies, the notion of stress and its management has become an important component of environmental management and is to be used in IHP Phase VII.

Phase VI's "systems at risk and social changes" has identified and characterized the scope and type of risks, and the consequent stresses being experienced, as exemplified in the Millennium Ecosystem Assessment.

The social changes that take place when systems are at risk include human migration from rural to urban habitats, an increase in urbanization and the associated decline in the productivity of land that may have been abandoned.

Such social changes create new challenges faced by all stakeholders, especially those dependent on water as an essential life support system linked to productive landscape ecosystems. Phase VII would thus seek to address the linkages between the systems under stress and the societal responses to these stresses. Evidence from the most affected communities indicates that local actions are being taken, which are effective and consist of adaptation measures against the most serious impact of global changes, including that of climate. Communities in many arid zones have started to work together to operate rainwater harvesting, managed aquifer recharge and other measures to reduce erosion and replenish exhausted aquifers. There is similar evidence at the global level and the shared water resources and related conflict resolution initiatives are some globally relevant societal responses to which IHP already contributed substantially in Phase VI. In addition the UN system-wide triennial WWDR, in which IHP-VII has a pivotal role, provides a measure of the state of water globally.

The transition from Phase VI to Phase VII is thus based on the principle of *continuity with change*, with IHP building on lessons learned from results achieved in earlier phases of the programme.

IHP's Phase VII is entitled: "Water Dependencies: Systems under Stress and Societal Responses". The Task Force reviewed the contributions made by IHP's National Committees and the other partners during consultations held from July to September 2006. A large majority of the comments and suggestions made by Member States were incorporated into the scope of the various themes.

With regards to education for sustainable development, the contributions made by the Working Group were incorporated into the structure of the IHP-VII Strategic Plan. At the heart of this contribution was the "Issues in World Water and their Educational Implications" (5 April 2007) paper, which was used extensively to develop theme 5. To be effective, the new water education programmes will have to create

a new generation of water managers and decision makers who are able to apply a holistic, integrated multidisciplinary approach to water resources as the main foundation of economic development. At the same time, appropriately structured sub-tertiary water education programmes are needed to promote community-wide understanding of, and commitment to, sustainable water use and its management for sustainable development. These concerns represent the two thrusts of the water education for sustainable development activities within IHP-VII.

The review process for the Strategic Plan also included a peer review group. Members of the group were asked two key questions to test the validity of the themes: what was missed in the scope of the themes and what was redundant? This type of "gap and superfluities" assessment is a recognized approach in strategy evaluation. By applying this approach and involving a peer review group, the Strategic Plan for IHP-VII was further refined.

The final output is presented in the following sections and is summarized in Table I.

(E) MAKING IHP-VII ACTION-ORIENTED AND POLICY-RELEVANT

SUPPORT TO THE GLOBAL AGENDA FOR SUSTAINABILITY

The headline tasks of IHP-VII can be related to the three pillars of IHP through the following activities:

- *promoting leading edge research that provides timely and appropriate policy-relevant advice to Member States;*
- *facilitating education and capacity development as a response to the growing needs linked to sustainable development;*
- *enhancing governance in water resources management to achieve ecosystem sustainability.*

The theme titles and focal areas for each theme are further elaborated to be more action-oriented while taking into consideration all the audiences of the IHP-VII Strategic Plan. These audiences can be grouped into four categories: governments, the scientific community, international agencies and committed stakeholders, such as water users represented by NGOs. While the first and second categories seek policy-oriented research actions in the IHP-VII Strategic Plan, the third category looks for activities that provide complementarity between their programmes and those of IHP. Finally, the fourth category would like to see tangible benefits at the local level.

Since IHP remains a dynamic demand-driven programme it is anticipated that in the course of each biennium, some thematic and focal areas may be revised at the request of Member States. A final round of consultations was conducted at the outset of the biennium in order to finalize the Implementation Plan as requested by Member States. This allowed for a period of advocacy and consolidation within the Regional Groupings of IHP and took place before the UNESCO General Conference in November 2007.

Figure 1 provides an overview of the linkages between themes and the crosscutting programmes, FRIEND and HELP. Table 1 provides an overview of the core component themes and focal areas of IHP- VII.

BOX 2
IHP-VII HEADLINE TASKS

- *Integrating interdependencies of water sciences and policy making through research and education, underpinned by culture and communication;*
- *Understanding water interdependencies in physical, biological and social environments;*
- *Promoting participatory decision making in interdependent water-related health, food and energy systems and security in a changing world.*

Building upon the previous three pillars of the International Hydrological Programme (IHP) and focusing on the demands arising from a rapidly changing world, creating partnerships and initiatives for greater synergies, the IHP-Phase VII will maintain its comparative advantage in promoting and leading international hydrological research, facilitating education and capacity building for enhanced water management towards meeting the UN Millennium Development Goals on Environmental Sustainability, Water Supply, Sanitation, Food Security and Poverty Alleviation.

It will add value to research and experience adapted to local needs by providing a policy-relevant context and harvesting the knowledge of researchers, educators, practitioners, and policy makers so as to maximize the value of scientific outcomes and engender confidence in innovation and reform. It will provide a solid scientific underpinning for the UN Decade of Water for Life.

Outcomes of IHP-VII should establish pathways and benchmarks for water management in the decades to come. They should contribute to sustaining human and environmental health wherever water-dependent systems are under pressure and effective societal responses are not yet in place. The results achieved during the VIIth phase of IHP should strive to be practical so that both scientific communities and civil society can apply and benefit from them.

(F)
THE THEMES AND FOCAL AREAS OF PHASE VII

THEME 1: ADAPTING TO THE IMPACTS OF GLOBAL CHANGES ON RIVER BASINS AND AQUIFER SYSTEMS

Background and challenges

Global changes brought on by climate change, urbanization, ozone depletion, population growth, expansion of infrastructure, migration, land conversion, and pollution are all altering the earth and the way it functions. No single institution or country can face the challenges these changes pose alone. But IHP, the only intergovernmental programme on water sciences in the UN system, can foster the cooperation needed to bring all players together, whether they are Member States, research institutions, UN agencies, NGOs, or national and international associations. The mission under IHP-VII will be to strengthen scientific understanding of the impacts from global changes on water systems, and to link these findings to policies for promoting sustainable management of water resources.

It is important to realize that most of the world's river basins and aquifer systems are poorly gauged or completely ungauged. In addition, the hydrological monitoring network is declining. While the pressure on available water resources is increasing (particularly in sensitive areas), it is becoming more difficult to obtain reliable predictions of hydrological variables resulting from global changes. Moreover, the most widely used tools in applied hydrology and water resources management depend on hydrometric (gauged) data. Major difficulties arise when applying these tools to river basins and aquifers for which little or no hydrometric data are available, or where the hydrological boundary conditions have been changed. The challenges in this respect are to reduce predictive uncertainty and to develop new prediction methods (less based on historic data sets) that can take into account influences and feedbacks from various global changes and then apply this information to support decisions for managing water resources in a sustainable way.

Because global changes cut across disciplinary and national boundaries, some form of interdisciplinary and international cooperation is needed to study and address these issues. Under IHP-VII, UNESCO and WMO will jointly coordinate and implement several activities, such as the World Climate Programme (WCP). The UNESCO-IAEA Joint International Isotopes in Hydrology Project (JIIHP) will also contribute to this theme, fostering the valuable application of isotope techniques for surface and groundwater resource assessment and management. Another valuable initiative is the Cooperative Programme on Water and Climate (CPCW) in The Netherlands. Close cooperation with the International Association of Hydrological Sciences (IAHS) and the Prediction in Ungauged Basins (PUB) project is also envisaged.

During Phase VII, particularly stressed areas (such as arid and semi-arid regions, the polar regions, glaciated mountainous regions, and urban and coastal regions) will be assessed and, as a result, Member States can develop mitigation strategies and policies based on institutional synergies to diminish these stresses. Issues of international interest and impacts within drainage basins and aquifer systems will get more attention. Lessons learned from the FRIEND programme, regional trends and data sets will be compared, making use of HELP and International Groundwater Resources Assessment Centre (IGRAC) facilities and databases. Regional trends will be

evaluated and case studies will be developed with the support of IHP's Centres and Chairs, as well as other agencies. This will also lead to a better integrated approach for managing frozen water, surface and groundwater resources that takes into consideration interdependencies with other systems and users (society, ecosystems, among others). UN agencies and existing international research programmes will be asked to cooperate with IHP and UNESCO centres in coordinating these efforts.

Focal area 1.1 - Global changes and feedback mechanisms in hydrological processes in stressed systems

Objectives

IHP-VII will spell out the effects of global changes, as well as their feedback in hydrological processes. These include urbanization, land use changes, population increase and all other changes that may affect water availability and demand, including both quantity and quality. Consideration will be given to processes such as erosion, sedimentation, landslides, snowmelt floods and mudflows in the context of glaciated mountainous regions, as well as their development and mitigation of risk arising from such changes. The focal area will address the impacts of global changes on coastal zones, small islands, present permafrost zones and glaciated areas, and megacities.

Activities

- Development of indicators that may be used for assessing the effects of global changes of different origins on water resources and hydrological systems.
- Development of methods of identifying adaptation measures for global changes in different hydro-climatic zones.
- Evaluation of changes in global dynamics in hydrological systems under stress, from drought in arid zones and rising temperatures in cold regions.
- Consideration of processes such as thaw in permafrost, erosion, sedimentation, landslides and mudflows in the context of highland development and risk mitigation.

Outputs

- Documentation of best practices and capacities to prevent and/or remediate impacts of global changes on the hydrological cycle and water resources in stressed systems, with a particular focus on developing countries and stressed regions in Africa.

BOX 3
A NETWORK OF FRIENDS

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

FRIEND (Flow Regimes from International Experimental and Network Data) is an international IHP research programme that helps to set up regional networks for analyzing hydrological data. It aims to develop better 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 modelling, processes of streamflow generation, sediment transport, snow and glacier melt, climate change and land use impacts.

Initiated by four Northern European countries some twenty years ago, FRIEND has since developed into a worldwide network of eight regional programmes (Europe, the Mediterranean, Southern Africa, Asia Pacific, the Nile, Western and Central Africa, the Hindu Kush-Himalayas, including Central Asia, and Latin America and the Caribbean), with the participation of 141 countries from around the world. It is one of IHP's most important crosscutting programmes, and will continue to enjoy a high level of support from member countries during Phase VII.

FRIEND at work

The FRIEND network aims to integrate research at the regional level; projects such as ARIDE (Assessment of the Regional Impact of Droughts in Europe) and ASTHyDA (Analysis, Synthesis and Transfer of Knowledge and Tools on Hydrological Droughts Assessment through a European Network) are two examples. It also supports capacity building in hydrological research for FRIEND regions.

The European (EURO) FRIEND has evolved into a well-developed network of hydrologists who are implementing an active research programme in five project areas: European Water Archive; Low Flow; Large-Scale Variations in Hydrological Characteristics; Techniques for Extreme Rainfall and Flood Runoff Estimation; and Catchment Hydrological and Biogeochemical Processes in a Changing Environment.

Sharing information

Over the last decade, EURO FRIEND participants produced more than 410 publications, including journal and conference papers, contract reports, software, and spatial and temporal databases. This research is being transferred to the user community through national partnerships between research groups and hydrological agencies in the field.

- Cooperative actions with the International Sediment Initiative (ISI) on research of erosion and sediment processes, and their interaction with global changes.
- Evaluation of the impacts of global changes on coastal zones, small islands, and megacities.

Benchmarks

- Setting up inter-regional networks in cooperation with other UN system organizations, and international and national associations.
- Publication of guidebooks with examples of best practices for coping with global changes in different hydro-climatic regions.

Focal area 1.2 - Climate change impacts on the hydrological cycle and consequent impacts on water resources

Objectives

This focal area seeks to assess the impacts of climate change on the hydrological cycle within the broad spectrum of global changes, including changes associated with rising global temperatures. More specifically, it aims to facilitate and support local research and capacity in developing countries, and to develop capacities for management to cope with climate change impacts on water resources in cold climates and high altitudes. Climate change is believed to account for only about one-fifth of the impacts of global change, but is the dominant impact on hydrological systems in some environments. The impacts of global change in arid and semi-arid regions are addressed in a separate focal area.

Activities

- Participation of IHP Focal Points and National Committees in the development of case studies and the dissemination of guidelines.
- Development of methods to assess the impacts of climate change and analysis of associated uncertainties.
- Development of indicators to assess the impacts of climate change on water resource systems.
- Improved understanding of the spatial and temporal aspects of impacts of climate change on water resources through improved access to remote sensing imagery.
- Development of networks to exchange information on best practices in cold climates, including changes in snow, ice and glacier mass balances; and setting up networks between Nordic countries and other countries with similar conditions, focusing on the impacts of climate change in cold climates.
- Improved understanding of the modifications in the hydrological cycle resulting from global changes in the cold regions.
- Maintaining and strengthening links with the Prediction of Ungauged Basins (PUB) initiative and

BOX 4
A NEED FOR HELP

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

HELP (Hydrology for the Environment, Life and Policy) was established in 1999 as a joint UNESCO and WMO (World Meteorological Organization) initiative, and is led by IHP. The programme was conceived 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. Since then it has grown into a global network of some 67 basins, with four regional coordinating units (RCUs): Australia and South East Asia, Latin America and the Caribbean, North America and Europe.

HELP activities focus on assessment, research and implementation. For example, this work may involve synthesizing existing knowledge; simulating future change scenarios (e.g. in land use, demography, socio-economics, water cycle, and 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.

HELP is by definition an interdisciplinary programme that takes a comprehensive approach to water basin management. HELP activities are contributing to our understanding of a wide range of interrelated issues: water and climate; water and the environment, water quality and human health; water and food; and water and conflict.

The difference HELP makes

Being part of the HELP network makes it possible for people in different regions around the world to share experiences in the implementation of integrated water resources management. Some HELP basins have been implementing IWRM for more than four years and can offer experiences and guidelines to others. The HELP network can also provide advice on how to dialogue with different stakeholders, and improve communication between several water-related communities (i.e. scientists, lawyers, basin managers, economists, stakeholders) in order to better integrate land and water resources management. HELP benefits from widespread support and has been adopted by many UNESCO Member States.

improving modelling of gauged and ungauged basins.
- Development of methods to mitigate impacts from the continuous worldwide decline of hydrometric networks (gauging stations, monitoring wells, etc.) and to predict the effects of climate changes with more certainty.
- Maintaining and strengthening links with HELP and FRIEND.
- Strengthening and improving links with observation and modelling programmes (the World Climate Research Program's Global Energy and Water Cycle Experiment (WCRP-GEWEX), Arctic-HYDRA and the UNESCO-ESA TIGER initiative in Africa (European Space Agency programme focusing on the use of space technology for water resource management).

Outputs

- Guidelines and case studies from the established network of IHP Focal Points and National Committees.
- Documentation of best practices on methods for risk assessment and on coping strategies to prevent and/or remediate impacts from climate change on surface water and groundwater systems.
- Compilation of case studies with lessons learned, related to mountainous areas (publications, training courses, and seminars).
- Improved capacity in monitoring and collecting water quantity and quality data.
- Valuation of snow and ice resources in the stabilization of global climate changes.

Benchmarks

- Collaboration with the PUB initiative, HELP and FRIEND.
- Contributions from IAHS, the International Association of Hydrogeologists (IAH), and the International Centre for Water Hazard and Risk Management (ICHARM).
- Contribution from strengthened links with observation and modelling programmes (WCRP-GEWEX and the UNESCO-ESA TIGER initiative in Africa).
- Cooperation with database centres at regional and international levels. Support provided by IGRAC on related groundwater issues, in coordination with the IHP National Committees.

BOX 5
ARCTIC-HYDRA

As recently noted by the IHP Intergovernmental Council (16th Session, Resolution XVI-6), the Arctic is especially sensitive and vulnerable to human and climate impacts. Arctic warming and its consequences have regional and worldwide hydrological implications.

The Arctic Hydrological Cycle (AHC) Monitoring, Modelling and Assessment (Arctic-HYDRA) core project has been established within the International Polar Year (IPY) 2007-8 to enhance our understanding of hydrological processes in cold regions. The scientific goals of Arctic-HYDRA are: to characterize variability in the AHC and to examine linkages between atmospheric forcing and continental discharge to the ocean; to assess the historical response of the Arctic Ocean to variations in freshwater input from rivers and net precipitation over the ocean; to attribute to specific elements of the AHC or to external forcing the sources of observed spatial-temporal variability in the land-ocean-ice-atmosphere system; and to detect emerging changes in the contemporary state of the AHC in near real-time, and to place such changes into a broader historical context.

Given the scope of these goals and the relatively short timeframe of the IPY, Arctic-HYDRA also forms part of the parallel longer term (10-15 year) objectives of the International Conference on Arctic Research Planning II (ICARPII) Working Group 7 (WG7) project "Terrestrial Cryospheric & Hydrologic Processes and Systems". The project is also supported by the World Meterological Organization's Hydrology and Water Resources program (WMO HWR), Commission for Hydrology (CHy) and Commission for Basic Sciences (CBS), and the World Climate Research Programme's Climate and Cryosphere project (WCRP/CliC). Arctic-HYDRA also has the active participation of all Arctic Council member countries. Noting that the scientific, institutional, and political legacies of the International Geophysical Year (IGY) 1957-8 endured for decades, many to the present day, the Arctic-HYDRA core project is expected to take hydrological science and monitoring in the Arctic to a new level, and will therefore hopefully be one of the legacies of the IPY, with implications well beyond the 2008-13 timeframe of IHP-VII.

The Arctic-HYDRA project and its planned continuation under the ICARPII WG7 umbrella fits particularly well within the objectives of IHP-VII, given the considerations and facts above, and noting that IHP-VII focal area 1.2 is concerned with global changes and feedback mechanisms of hydrological processes in stressed environments.

Focal Area 1.3 - Hydro-hazards, hydrological extremes and water-related disasters

Objectives

This focal area addresses both natural and human-induced catastrophic events that could adversely influence human health and life with the aim of mitigating, reducing and/or preventing certain disasters. A disaster is said to occur when an extreme event coincides with a vulnerable

physical and socio-economic environment, surpassing society's ability to control or survive the consequences. Extreme hydrological events should be considered as part of integrated water resources management at the catchment scale. Persistent and pervasive droughts, which result from hydro-climatic extremes, are slow processes whose impacts are a feature of an area's vulnerability. Other water-related hydro-hazards include tsunamis and hurricanes. In high altitude regions, snow melt can result in catastrophic emptying of lakes dammed by ice, resulting in severe social and human losses. Factors that aggravate water-related disasters such as erosion, sedimentation and landslides, include changing global dynamics in aquatic environments, degradation of ecosystems, especially fragile ecosystems susceptible to accelerated sea-level change, coastal sediment imbalance, and accumulation of pollutants.

Activities

- Support of capacity building in member countries in order to gain and advocate better understanding and handling of hazards, vulnerabilities and benefits involving floods and other water-related disasters.
- Propose effective methodologies for identifying and establishing an inventory of surface and groundwater bodies less vulnerable to natural and man-made impacts in selected pilot regions and present relevant case studies.
- Publish guidelines for the identification, investigation, development and management of strategic surface and groundwater bodies to be used in emergency situations that result from extreme climatic and geological events, as well as in the case of conflicts.
- Promote cooperation by riparian states of transboundary basins to facilitate integrated and coordinated basin management with respect to combating hydro-hazards, and hydrological extremes and disasters.
- Improved predictability of hydrological extremes by using new measurement technologies and promote local use of satellite information for river basin management. Development of linkages with the International Flood Initiative (IFI) of UNESCO, IAHS and WMO.
- Development of linkages with ICHARM.
- Establishment of an international network to address Groundwater Resources Management in Emergency Situations (GwES).

BOX 6
INTERNATIONAL FLOOD INITIATIVE (IFI)

The preparatory meeting of the International Flood Initiative (IFI) was held on 12-14 July 2004 in Tsukuba, Japan with the purpose of drafting a concept paper (the Tsukuba paper). A parallel concept paper was drafted (the Geneva paper) by a WMO task team on 28-30 July 2004 in Geneva, Switzerland. WMO and UNESCO then combined the products of these meetings. The revised concept paper, the Joint UNESCO/WMO Flood Initiative, also called the JUWFI paper (documents IHP/IC-XVI/Inf.14 and Inf.14. Add.) was adopted at the 16th session of the IHP Intergovernmental Council (September 2004) and the 12th session of WMO CHy (October 2004), respectively. Another preparatory meeting was held on 10-11 December 2004 in London (Ontario), Canada to incorporate comments and suggested amendments made at the IHP Council and WMO CHy, as well as from UNU, ISDR and IAHS.

After consultation with other agencies, IFI was formally launched by the Director-General of UNESCO in the presence of the Executive Heads of WMO and UNU during the UN World Conference on Disaster Reduction (WCDR) held on 18-22 January 2005 in Kobe, Hyogo, Japan. The concept paper was further revised at the inaugural UNESCO/WMO joint IFI meeting held in cooperation with UNU, ISDR and IAHS, in Geneva, Switzerland, on 21-22 March 2005.

The International Centre for Water Hazard and Risk Management (ICHARM) was chosen to act as the IFI Secretariat. Accordingly, in April 2005, the ICHARM Secretariat was strengthened. Extensive preparatory activities for the establishment of the Centre were undertaken, with the formal launch taking place in the first year of the International Decade for Action "Water for Life" (2005-2015), as well as the United Nations Decade of Education for Sustainable Development (DESD) (2005-2014).

At the 4th World Water Forum, the "Collaborative Approach among International Agencies for Effective Flood Risk Management: International Flood Initiative (IFI)" session was held on 20 March 2006. The session was convened by the Public Works Research Institute (PWRI), UNESCO and WMO.

Current partners of IFI are as follows:

- UNESCO IHP http://www.unesco.org/water/ihp/index.shtml
- ICHARM http://www.icharm.pwri.go.jp/centre/index_e.htm
- WMO http://www.wmo.ch/index-en.html
- IAHS http://www.cig.ensmp.fr/~iahs/
- UNU http://www.unu.edu/
- UNISDR http://www.unisdr.org/
- IIASA http://www.iiasa.ac.at/
- IAHR http://www.iahr.net/site/index.html
- PWRI http://www.pwri.go.jp/eindex.htm

This interagency initiative with a wide range of intellectual and professional partners will continue during the IHP-VII period.

Outputs

- Documentation of best practices on risk assessment and a compilation of case studies of representative critical water-related disasters (urban, rural, small islands).
- Inventory of strategic surface and groundwater bodies to be used in emergency situations that result from extreme climatic and other events.
- Partnership with Global Environmental and Ocean Sciences (GEOS) established and linked with UNESCO's IFI, ISI, and GwES initiatives.
- Toolkits for assessing hydrological components of hydro-hazards and extreme hydrological events.
- Adaptive strategies for environmental security, ecosystem protection and maintenance of productive capacity.

Benchmarks

- Networking on water hazards and risk management, coordinated by ICHARM.
- Data collection, case studies, and seminars organized at the regional level.

Focal area 1.4 - Managing groundwater systems' response to global changes

Objectives

Groundwater is the largest store of freshwater. It provides a buffer to short-term variations in precipitation and maintains river baseflow. In many areas and for most of the year, it is the only locally available source of rural as well as urban water supply. Uncontrolled water use leads to overexploitation, falling water levels and baseflow to rivers and wetlands, with consequent ecological degradation. Unless protected, groundwater quality deteriorates from saline intrusion, uncontrolled wastewater disposal and pollution from agricultural and urban activities, and as older waters are accessed.

Both the quantity and quality of groundwater will be impacted by global change (i.e. deforestation, large-scale irrigation, urbanization, sea level rise), with climate change in particular impacting on recharge patterns. Sustainable management of groundwater, in conjunction with surface and other water resources, requires an understanding of the water resources available, the processes controlling their movement and quality, and the rate of change being imposed on them by human activity and climate change. Protection and sustainable use of groundwater is essential, especially through management of both recharge and demand.

BOX 7
INTERNATIONAL SEDIMENT INITIATIVE (ISI)

The IHP Intergovernmental Council approved the International Sediment Initiative (ISI) at its 16th session. The Council endorsed the expansion of the Task Force to form a Steering Committee to plan and execute the proposed programme, and also approved the International Research and Training Centre for Erosion and Sedimentation (IRTCES) of Beijing, China to play a key role in implementing the initiative. The resolution emphasized the development of the decision support framework for sediment management, in order to provide guidance on legislative and institutional solutions, applicable to different socio-economic and geomorphic settings. Hence in response to the importance of sedimentation, ISI was launched by UNESCO as a major activity of the 6th Phase (2002-2007) of IHP.

ISI became fully functional as of 2005. Its activities are based on its overall objectives, aimed at increasing awareness of sediment dynamics and erosion issues in all spheres of water management, and promoting sustainable management of soil and sediment resources at local, regional and global scales. Within the scope of ongoing activities, considerable progress has been achieved in the Global Evaluation of Sediment Transport (GEST Project) and in setting up the Sediment Information System (an establishment of more than a database) in IRTCES, under the auspices of UNESCO, which acts as the technical secretariat of ISI.

The ISI Information System will provide:

(a) Information access: through the creation of a global information resource portal;
(b) Information repository: through the establishment of a sediment database and other information; and
(c) Information development: through the implementation of strategic training activities.

ISI activities in a nutshell are:

- Global Evaluation of Erosion and Sediment Transport (GEST Project);
- Case studies illustrating the socio-economic and environmental risks caused by erosion and sedimentation processes;
- Comprehensive review of global erosion and sediment-related research;
- Education and capacity building for sustainable sediment management;
- International cooperation within the UN system, regional networks, NGOs and other international associations active in this field.

The first International Sediment Initiative Conference was held in Sudan in November 2006. The conference was a first attempt to invite relevant institutes, agencies and individuals from around the world to come up with an initiative to deal with sediment issues and help the international community achieve practical outputs through partnerships, pooling resources, focusing science, coordinating efforts, and sharing information and experiences. More regional workshops are planned.

Activities

- Raise awareness of decision makers, implementers, users and the general public of the importance of groundwater as a store of freshwater in order to encourage improved protection and sustainable use of groundwater – through leaflets, publications, the media, and education and training.
- Assess the impacts of global change (e.g. climate change and human pressures) on groundwater resources and support Member States in addressing regional needs through global coordination.
- Improve the understanding of how groundwater contributes to the global water cycle and evaluate the changes to groundwater storage and groundwater flux (recharge and discharge rates), and bring together county, regional and transboundary assessments via seminars, conferences, etc.
- Better define growing population pressures on groundwater resources, global warming impacts on groundwater recharge rates, rising sea levels and saltwater intrusion, and bring together country/regional assessments via seminars, conferences, etc.
- Improve the understanding of the effectiveness of Rainwater Harvesting as it applies to Managed Aquifer Recharge (MAR), through continued support of initiatives such as those of IAH-MAR and related activities, publication of findings and demonstration projects.
- Better define submarine discharge of groundwater (SDG) to the ocean. Undertake groundwater resource assessment and future forecasting under various population pressures and climate change scenarios.

Outputs

- Documentation of methodological approaches – (I) database and monitoring, (II) satellite GRACE (Gravity Recovery and Climate Experiment), (III) modelling and simulation, and (IV) paleohydrology – to facilitate better management of water resources.
- Implementation of the Groundwater Resources Assessment under the Pressures of Humanity and Climate Changes (GRAPHIC) project to investigate physical fluxes, state variables and their interaction with management of groundwater systems, in coordination with IHP National Committees, ICHARM, IGRAC, GEWEX, GEOS, IUGS, IAHS, UNU-EHS, and Category I and II Centres.
- Evaluation of the availability of renewable and non-renewable groundwater resources, with a particular focus on less developed countries.
- Coordination of small island networks with IHP National Committees on capacity assessment, protection, adaptation and remediation measures.
- Toolkits for assessing the response of groundwater (as a component of the hydrologic cycle) to climate change, urbanization and landscape change at the basin scale.
- Case studies in representative critical situations: semi-arid, hard rock, coastal, small islands, including integrated surface water-groundwater-wastewater management.
- Set up close cooperation between UNESCO-IHP and UNU to develop a joint programme on groundwater resources and human security.
- Adaptive strategies to secure groundwater supplies and protect baseflows, ecosystems, etc., as part of the managed hydrologic cycle (MAR, reuse, demand management, dams, desalination).

Benchmarks

- Information leaflets, publications and media coverage of groundwater-related issues.
- Education, training materials, courses, workshops and conferences.
- Demonstration projects and research catchments relating to monitoring the impacts of global change, effective coastal groundwater management and MAR in a variety of hydro-climatological settings.

Focal Area 1.5 - Global change and climate variability in arid and semi-arid regions

Objectives

Arid and semi-arid regions are particularly vulnerable to small climate changes, with consequences that may have very serious social and environmental effects. Special attention will be given to these regions, making use of results obtained from preceding focal areas, with additional efforts to include factors typical for these regions.

Activities

- Define global changes, including climate change and variability in the hydrological processes of arid and semi-arid regions.

- Improvement in monitoring, data collection, processing and storage systems at regional level.
- Evaluation of the impacts of climate change on drylands, including methods to achieve sustainable land use.
- Prepare guidelines, best practices, and compile case studies.
- Development of regional networks and inter-regional transfer of knowledge with the participation of IHP National Committees and the UNESCO Category II Centres for hydrology in arid zones.

Outputs

- Dissemination of information on water and development for arid zones through the GWADI project.
- Regional network programme developed in Central Asia and SADC countries.
- Guidelines for monitoring hydrological processes in arid and semi-arid regions.

Benchmarks

- Setting up regional networks.
- Adoption of guidelines and best practices by key stakeholders.

BOX 8
WATER AND DEVELOPMENT INFORMATION FOR ARID LANDS (G-WADI): A GLOBAL NETWORK

G-WADI's mission is to strengthen the capacity of arid and semi-arid areas around the globe in managing their water resources through a network of international and regional cooperation. This is accomplished by integrating selected material from existing networks, centres, organizations and individuals. More specifically, G-WADI hopes to:

- improve understanding of the special characteristics of hydrological systems and water management needs in arid areas;
- build the capacity of individuals and institutions, so as to be able to match supply with need;
- broadly disseminate information about water in arid zones to the user community and the public, especially as a basis for improved management;
- exchange experiences through case studies and other means;
- share data to support regional research and the development of global research facilities, and strengthen data networks to underpin sound management;
- raise awareness of the potential use of advanced technologies for data provision and assimilation, and system analysis; and
- promote integrated basin management, and the development and use of appropriate decision support tools.

G-WADI also intends to:

- expand the G-WADI community through greater involvement of UNESCO centres and regional offices, and the development of links in new areas (e.g. in sub-Saharan Africa);
- promote and encourage the participation of the wider scientific community in G-WADI through web contributions and discussions;
- develop web-based access to global data sets and modelling tools of specific relevance to arid and semi-arid zones;
- continue to develop workshops on new thematic areas such as groundwater modelling, water harvesting and aquifer recharge; and
- support new areas of interest, including hydrological models and applications, hydro-climatic forecasting and use of tracers in semi-arid region studies.

THEME 2: STRENGTHENING WATER GOVERNANCE FOR SUSTAINABILITY

Background and challenges

Water is central to promoting socio-economic development, protecting the environment, and achieving the MDGs. Poor management of freshwater resources is characterized by a lack of integration, sectoral approaches, and institutional resistance to change by large public agencies, in the context of increasing competition for scarce water resources. Yet, human and natural water-related systems are interdependent, and they have to be managed in an integrated manner. Moreover, IWRM has to be tailored to consider cultural, ethical and socio-economic elements.

The first World Water Development Report (2003) indicated that many of the solutions to water problems lay in better governance; the second World Water Development Report (March 2006) lists "sharing water" as one of the key challenges that water governance faces. These challenges are connected and should be addressed in a basin-wide, multidisciplinary manner. A primary concern is the sharing of and competition for water resources nationally and internationally[8], which is closely related to good water governance. Balancing the needs of providing water to feed growing populations, for environmental flows and industry, and preventing conflicts over water and developing dialogues on shared waters are some of the challenges. An

8. Studies conducted by many agencies indicate that 276 river basins are transboundary, covering some 45 percent of the world's surface area. Forty percent of humanity lives in a transboundary basin. The situation with transboundary aquifers is analogous and probably more extreme. A global inventory, facilitated by the ISARM Programme is being conducted through the collaboration of several agencies.

important step towards better water governance is raising awareness, providing education and building capacity on water-related issues.

More specifically, if water governance is to be effective, it needs to integrate water management into the economic development of the concerned area, and adopt adequate financing and pricing systems. It also needs to be capable of dealing with problems related to climate variability, sustainable land use and landscape change, including rapidly growing urban areas. Moreover, local, regional and international governance mechanisms should take into account the historical and cultural legacies of a region, e.g. the local traditions and customs. It is also important to provide information to stakeholders and the public at large, and to take their concerns into consideration.

Focal area 2.1 - Cultural, societal and scientific responses to the crises in water governance

Activities

- Develop methods and practices to study the relationship of a population to water, based on its historical, cultural and ethical traditions, and then use these responses to develop effective water governance.
- Fostering public and stakeholder information and participation.
- Developing better understanding, tools and best practices for integrated water resources management, taking into account the management of the total water cycle, covering both surface and groundwater, clean and waste water treatment, and questions of both quantity and quality.
- Developing a better understanding of groundwater, its availability and vulnerability for policy-makers, the public and scientists of other environmental disciplines.

Outputs

- Development of practical systems for public participation and adoption of best practices in the water sector.
- Identification and analysis of critical case studies on water issues, including gender concerns.
- Dissemination of lessons learned from this analysis at all levels.

Benchmarks

- Conducting a series of public participation events.
- Adoption by key stakeholders of the best practices.

Focal area 2.2 - Capacity development for improved governance; enhanced legislation for wise stewardship of water resources

Activities

- Promoting cooperation among water basin authorities, regional basin commissions and institutions; work with the support of the IHP National Committees, international institutions, such as INBO, UNILC, FAO, UNECE, and the EU, in relation to its Water Framework Directive; support to new institutional settings, with the objective of strengthening existing legislation and administrative procedures.
- Capacity building and development of training materials (crosscutting with theme 5).
- Ensure that due regard is paid to cultural traditions and to the development of appropriate technologies.

Outputs

- Case studies and best practices on public and stakeholder participation.
- Organization of training courses, i.e. for lawyers, engineers, and water scientists.
- Comparative studies with FAO and UNESCO-IHP Centre in Dundee.
- Case studies and networking with international and national organizations.

Benchmarks

- Cooperative meetings and exchange of information among basin/river agencies.
- Dissemination of training materials that include traditional cultural approaches.

Focal area 2.3 – Governance strategies that enhance affordability and assure financing

Activities

- Establishment of sustainability targets for water-related development.
- Evaluation of direct costs, external economic effects, water-driven jobs and opportunities for extra income, in cooperation with other UN agencies.
- Promotion of best practices to assist local authorities in their choice of financing options for capital investment (i.e. infrastructure construction, management and maintenance).
- Support partner UN agencies in the promotion of local credit schemes to provide water at an affordable price to poorer communities, aimed at reducing poverty.
- Comparative analysis of several financing systems and the role of water pricing at various levels of development, in cooperation with UN partners and other agencies.

Outputs

- Development of techniques for the establishment of future targets under different climatic conditions and stages of economic development.
- Comparison of tools currently available for meeting such targets.
- Handbook of best practices for planning and financing at all levels to ensure sustainability.

Benchmarks

- Adoption, at pilot scale, of affordability issues in water-related investments by Member States.
- Dissemination of best practices regarding costs and economic externalities.

Focal area 2.4 – Managing water as a shared responsibility across geographical and social boundaries

Activities

- Compilation of reports concerned with different interests and management policies for sharing common resources.
- Development and implementation of cooperative and joint national and international management tools based on previous experience and training for both stakeholders and the general public.
- Assessment of existing approaches for joint multinational use of groundwater and of the interaction between surface water and groundwater.
- Inventory and assessment of vulnerability of regionally integrated aquifer systems.

BOX 9

PCCP: SHARING WATER RESOURCES PEACEFULLY

There are 276 shared water basins that cross over a multitude of natural, socio-economic and political international boundaries. Nearly half the world's population lives in this area, which covers roughly 45 percent of the earth's surface. Competition between stakeholders over limited water resources often arises, creating opportunities for collaboration or conflict.

Following the success of similar projects in earlier phases of IHP, UNESCO launched the From Potential Conflict to Cooperation Potential (PCCP) project as part of the UN-wide World Water Assessment Programme to promote water security in the 21st century. PCCP aims to foster cooperation between stakeholders in the management of shared water resources and helps to ensure that potential conflicts do not turn into real ones. PCCP prioritizes water conflicts which are international in nature, where the tension may even provoke open conflict between sovereign states.

The work

PCCP is active in three areas –research, education and technical assistance– with a focus on the development of tools which anticipate, prevent and resolve water conflicts. Broadly, this work includes developing educational material, helping to build the appropriate institutional frameworks, creating methodologies for the resolution of water conflicts, and developing cooperation. The project also aims to improve legal tools for the management of shared water resources, and disseminates results and best practices.

The people

PCCP's priority target groups are institutions and individuals that manage shared water resources. These include:

- Decision makers in government, who have the obligation to respect, protect and fulfil their citizens' right to water;
- Leading water professionals and policy makers, who can bridge the gap between government and the public, and can raise awareness of the benefits of sharing water resources;
- Civil society networks, whose influence in water management and decision making can be crucial, since they operate at the local level where water conflicts tend to be most intense;
- Educators at several levels, who are training the next generation of transboundary water managers; and
- Students specializing in water-related disciplines, who will be the future water managers, educators and decision makers.

Outputs

- New reports complementing the existing series of reports prepared by ongoing programmes.
- Examples of successful resolution of basinwide problems, through national and international cooperation.
- Increased knowledge of the essential factors in managing basin-wide water resources for the benefit of all parties that rely on these resources.

Benchmarks

- Adoption by countries of internationally agreed norms for the management of shared resources.
- Joint approaches by international financing agencies to technical and financial support of programmes that aim to increase global environmental gains, as defined by agencies such as GEF and the UN.

Focal area 2.5 - Addressing the water-energy nexus in basin-wide water resources

There are multiple demands for water from basin resources in many countries of the world: hydropower energy generation on the one hand and irrigation needs on the other. In the first case, water is required for release to provide power and heating in the cold season, while in the second, the same water needs to be stored for irrigation use in the growing season. Residual water is still required for environmental flows in the river for its aquatic habitats. Experience from regions where this nexus appears can be illustrated through a matrix in which one axis consists of national or international policy, institutional frameworks and investment strategies, while on the other axis, the issue can be addressed on three economic sector levels: the national single economic sector level (irrigation or hydropower), the multi-sectoral level (several demands such as flood prevention, irrigation, power) and the national policy level. Member States are addressing these issues in international fora [9].

9. Quoted from the international conference on Water, Environment, Energy and Society (WEES) held at the National Institute of Hydrology in Roorkee, India on December 2007: *Water is also an important source of energy. Falling under gravity it turns the blades of turbines, which generate electrical energy. Every source of energy generation has an associated environmental cost and a comparative evaluation of various sources is necessary to evolve the strategy to meet energy requirements while causing minimal damage to the environment and society. In the future, considerably more water will be required for domestic use, irrigation, hydropower and other uses. The need for better management of available water resources to meet the basic necessities of an ever-increasing population, industrial activities, and to provide hazard-free water for society, has never been more important.*

BOX 10
WORKING ARM-IN-ARM FOR WATER: ISARM

Transboundary aquifer systems are a vital source of freshwater, particularly under arid and semi-arid climatic conditions. The Internationally Shared Aquifer Resources Management initiative (ISARM) is a UNESCO-led, multi-agency effort aimed at improving the understanding of scientific, socio-economic, legal, institutional and environmental issues related to the management of transboundary aquifers. Partners include the International Association of Hydrogeologists (IAH), the UN Food and Agriculture Organization (FAO), the UN Economic Commission for Europe (UNECE), the Organization of American States (OAS), the International Network of Water-Environment Centres for the Balkans (INWEB), the Sahara and Sahel Observatory (OSS), the UN Economic and Social Commission for West Asia (UNESCWA), the University of Dundee Department of Law, and the Organization for Security and Co-operation in Europe (OSCE).

Work at hand

ISARM's general aim is to foster global cooperation in the sustainable management of transboundary aquifers, which also involves ensuring their environmental, economic, social and political security. The initiative seeks to:

- Establish a network of experts from different disciplines to identify and define transboundary aquifers;
- Promote a scientific, legal, socio-economic, institutional and environmental assessment of transboundary aquifer resources;
- Identify several transboundary aquifers as case studies through regional consultations, have multidisciplinary expert teams conduct detailed studies of the findings in order to learn which issues are relevant to the sound management of transboundary aquifer resources;
- Make policy makers and decision makers aware of the importance of transboundary aquifers, by sharing the lessons learned from case studies with them;
- Promote cooperation among experts from countries that share aquifers, by making the scientific tools, water resource management options and methodologies that apply to transboundary aquifers available to them;
- Widely disseminate existing information on transboundary aquifers, and prepare a bibliography and database of internationally shared aquifers;
- Contribute to the preparation of maps that show potential risks and groundwater vulnerability of transboundary aquifers; and
- Organize an international conference on transboundary aquifer systems to evaluate and compare the results and experience obtained in different regions.

The water, environment and energy nexus becomes more complicated in transboundary basins and still needs to be tackled in many parts of the world including Central Asia, Southern Africa and East Asia.

Activities

- Identifying the key drivers that characterize the multiple demands for water as a resource versus water as a source for energy, drawing on case studies in several regions of the world with differing and contrasting requirements.
- Building the capacity of scientific agencies to address the multiple demands of the hydropower sector in relation to the sustainability of ecosystems in river basins.
- Developing methodologies for stakeholders to address water and energy needs so that they can better coordinate and link the use of resources.

Outputs

- Case studies and regional analyses of examples of the water and energy nexus in water-stressed regions of the world.
- Consultative and participatory seminars and technical meetings to help Member States address the most critical issues concerning the water and energy nexus.
- Development of management tools (e.g. models of hydro-economics and energy demands and constraints) that can be applied to support decision making.
- Creation of operational networks of scientists and hydro-power technical experts to build synergies.

Benchmarks

- Intersectoral coordination for sharing water among different sectors of the economy.
- Development of new agreements, through scientific and technical support at the national level which demonstrate that such multiple demands are being addressed.

THEME 3: ECOHYDROLOGY FOR SUSTAINABILITY

Background and challenges

Earlier phases of IHP recognized the importance of biotic systems as integral components of land-habitat hydrology. IHP-V adopted the theme "ecohydrological processes in the superficial environment" which focused mostly on terrestrial processes. The theme was further developed in IHP-VI which looked at the hierarchy of factors regulating ecological processes (implicitly water quality) in catchments and water bodies of different morphology and climatic zones.

Theme 3 builds on the results achieved in the previous phases of IHP which show that in recent decades, human activities have become the major driver of the earth's biosphere. The deterioration of water quality, overexploitation of freshwater resources, hydrological hazards and the adverse effects of landscape degradation and sectoral management all pose a risk to human health as well as economic and social development. This also affects the functioning of ecosystems and their ability to provide goods and services on which human well being depends. Therefore a better understanding of water as both an abiotic resource and a service delivered by ecosystems is needed. This new knowledge 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. Today, the management approach has to go beyond protection and restoration to recognize the carrying capacity of ecosystems in the face of increasing human impact, as well as find ways of improving and transferring solutions across a variety of environments.

Theme 3 also proposes to address three further issues. First, it will fill existing knowledge gaps by addressing issues related to critical water systems, such as those in arid and semi-arid zones, coastal areas and estuaries, and urbanized areas (crosscutting with theme 4) where ecohydrological processes have not yet been sufficiently addressed, and the problems of environmental sustainability are still pertinent. Second, it will show how better knowledge of the interrelationships between the hydrological cycle and biota can contribute to more cost-effective and environmentally-friendly management. Third, it will provide system solutions and technology transfer.

The overall objectives of this theme are to:

- Contribute to a better understanding of water as both an abiotic resource and a service delivered by ecosystem processes, which will help to identify, quantify and improve the critical interrelationships between water and biota, necessary for sustainability, particularly in critical ecosystems (arid and semi-arid zones, coastal areas and estuaries, and urbanized areas);

- Provide transdisciplinary, cost-effective solutions to water-related issues, including harmonization of structural engineering solutions with ecosystem biotechnologies, in a variety of ecosystems and climatic zones, and address economic and social issues;
- Improve the knowledge on ecohydrology of groundwater-dependent ecosystems;
- Support strategic studies of scenarios, early warning systems and policy relevant options for mitigating impacts.

Focal area 3.1 - Ecological measures to protect and remediate catchment processes

Objectives

Global changes have resulted not only in the degradation of the physical environment but also in considerable modification of landscape processes, including water and biogeochemical cycles and energy flow through ecosystems. In turn, this results in increased risk, deterioration of the environment, a reduction of biological diversity and the ecosystem's ability to provide goods and services. A scientific basis for establishing water management policies is needed to ensure sustainable landscape development that can meet increasing human demands and aspirations while maintaining ecosystem quality and services. Arid and semi-arid regions should be given particular attention. Biota should be seen not only as a protection target but also as a means for controlling hydrological and biogeochemical processes. This focal area addresses measures based on the "dual" control of hydrological processes by regulation of biota and by the evolutionary adaptations developed between them.

Activities

- Managing erosion, sedimentation, landslides, and mudflow by ecological measures.
- Minimizing mobile solvent, nutrient and pollutant transport by ecological measures.
- Managing interdependencies between the water cycle and terrestrial/aquatic biota for restoring biogeochemical cycling and biological diversity.
- Bio-remediation and phyto-technologies for water bodies and landscape rehabilitation.
- Enhancing water retention in the landscape and developing ecohydrological methods for flood and drought mitigation.
- Sustainable landscape development and land use planning.

Outputs

- Inventory of regulatory feedbacks between hydrological and biogeochemical processes across a variety of ecosystems and climatic zones to improve the efficiency of the mitigation of hydrological extremes, water quality, biodiversity, and ecosystem goods and services.
- Setting up criteria for water management policies to ensure sustainable landscape development and planning that addresses ecosystem quality and services.
- Demonstrating the best ecohydrological applications in various ecosystems and climatic zones.

Benchmarks

- Strengthening cooperation with HELP basins and Man and the Biosphere (MAB) to reinforce a network of UNESCO-IHP demonstration projects in ecohydrology for monitoring, research, education and implementation of ecohydrological measures.
- Strengthening cooperation with WWAP, UNEP GEMS/WATER and other worldwide databases for quantification of ecological processes across scales and geographical regions, and assessment of their application potential.
- Elaboration of mathematical models to quantify ecohydrological processes and provide a basis for the development of problem-specific tools under global changes.

Focal Area 3.2 - Improving ecosystem quality and services by combining structural solutions with ecological biotechnologies

Objectives

Existing solutions in water management are based largely on a technical approach which often does not consider the functioning of ecosystems. This over-engineering of the environment raises management costs and in many cases does not ensure sufficient ecological quality and services. Efforts to develop "soft engineering" technologies to complement "hard engineering" solutions need to be strengthened. These should be based not only on the wider application of ecological biotechnologies, but should also

emphasize the potential in harmonizing traditional uses of hydrotechnical infrastructure (e.g. hydropower production, water supply, harvesting/reducing of the risk of flash floods) with ecosystem needs and services (e.g. regulation of water levels by dams for improving quality of water in and downstream of the reservoir, conservation of biodiversity in adjacent ecosystems, improving connectivity between rivers and floodplains). The activities in this focal area aim to actively participate in the elaboration of transdisciplinary, cost-effective approaches to water management at the catchment scale – reducing existing environmental risks and providing economic and social benefits based on ecosystem goods and services (e.g. improving quality of life, increasing employment opportunities through tourism, bioenergy production, biodiversity, and others).

Activities

- Combining structural solutions with ecological biotechnologies for risk mitigation (e.g. floods and droughts, water quality decrease, biodiversity decline).
- Defining sustainability assessment indices, ecosystem carrying capacity and opportunities/ limitations for their enhancement.
- Improving knowledge of the use of hydrological processes-biota interrelations to enhance the efficiency of ecosystem biotechnologies ("soft engineering") to complement structural solutions.
- Assessing the ecological effects of structural solutions (e.g. dams, ditches, channels, hydropower infrastructure) and recognizing their potential to regulate adjacent ecosystems, enhancing ecological gains (e.g. water quality improvement, biodiversity preservation) and creating additional economic and social benefits.

Outputs

- Development of models/tools and operational procedures for harmonizing structural solutions in water resources with ecosystem biotechnologies, including an assessment of their impact on social systems and the economy.
- Creation of an effective system for incorporating transdisciplinary solutions into national legislations, coordinated with IHP National Committees.

Benchmarks

- Setting up a demonstration network of successful cases showing how "hard engineering" technologies can be complemented with "soft engineering" technologies.
- Reporting on additional benefits that can result from the implementation of modified operational procedures for hydrotechnical infrastructure (e.g. dams) in a range of ecosystems, outlining implementation and social, economic and environmental outcomes.
- Training and technology transfer towards increasing the appreciation of harmonized solutions, mainly among hydrotechnicians, engineers and decision makers.

Focal Area 3.3: Risk-based environmental management and accounting

Objectives

Overexploitation of resources, sectoral management, landscape degradation, and modification of the physical structure of the environment all pose risks such as hydrological hazards, landslides, mudflows, water quality deterioration which in turn affect human health, and economic and social development. Management strategies for risk mitigation and disaster management should therefore include profound environmental risk-based assessment, and take into account the uncertainties resulting from increasing global changes. The major objective of this focal area is to establish quantitative techniques for assessing risk-based environmental water requirements and to provide a basis for the elaboration of the respective guidelines.

Activities

- Strengthening risk-based environmental management under uncertainty, especially in the context of global change threats (including climate change) to ecosystems.
- Elaboration of risk mitigation methods, including effects on water quality, biodiversity and ecosystem stability.
- Elaboration of disaster management methods addressing both social and environmental aspects (crosscutting with theme 1).

Outputs

- Establishing principles for risk-based environmental management and accounting, and protective policies.
- Increasing awareness and disseminating information about risk-based environmental management and mitigation.
- Report on the transferability potential of the above methods.

Benchmarks

- Establishing links with observational and modelling programmes/networks for risk and disaster assessment, management and accounting.
- Networking on water hazard and risk management coordinated by ICHARM (crosscutting with theme 1).
- Producing information leaflets, publications and media coverage of environmental risk-related issues.

Focal area 3.4 – Groundwater-dependent ecosystem identification, inventory and assessment

Objectives

Although IHP has undertaken several studies on groundwater/surface water interactions and groundwater-dependent ecosystems, there is a need for further research on groundwater-dependent ecosystems, their identification, inventory and assessment. Ecohydrological research should be strengthened to improve the understanding of groundwater/surface water interactions in the critical areas of catchments (e.g. wetlands, river corridors, ecotone zones) and the role of feedback between ground/surface water and vegetation as a regulatory tool. Special emphasis should be given to ecohydrological processes in critical areas, such as arid and semi-arid zones, and estuaries and coastal zones.

Activities

- Ecohydrological management of groundwater-dependent ecosystems, especially in the critical areas (arid zones, coastal areas, small islands).
- Understanding water linkages between surface/groundwater interactions.
- Understanding water linkages and exchange between freshwater/saline water.

Outputs

- Improved understanding of ecohydrological processes in groundwater dependent ecosystems, and their implication for water resources management.

Benchmarks

- Improved integrated approach for management of surface and groundwater resources considering interdependencies with ecosystems.
- Identifying best practices, risk assessment methods and strategies to mitigate climate change impacts on groundwater-related ecosystems (crosscutting with theme 1).
- Identifying and establishing relevant case studies in selected critical regions for quantification of ecohydrological processes and measures for the management of groundwater-related ecosystems (crosscutting with theme 1).

THEME 4: WATER AND LIFE SUPPORT SYSTEMS

Background and challenges

Human activities and uses of water resources have had a profound effect on the resource stock and quality of water over most of the inhabited world. These stresses threaten the sustainability of societies and are particularly problematic in arid and semi-arid areas, in coastal areas and small islands, and where population density and industrial activity are greatest. Surprisingly, societal responses to warning signs of depleting groundwater levels, dry streams and polluted water have generally been inadequate. While there are some good examples of polluted systems being restored and biodiversity returning, and innovations in water conservation, reuse, groundwater augmentation and desalination, these are still relatively few and their potential applications are constrained by a range of factors. Scientists have not been sufficiently influential in contributing to water management policies in the past, so more must be done now to establish internationally applicable principles for more comprehensive and systematic approaches to sharing resources equitably among users to enable a sustainable balance between supply and demand.

Theme 4 addresses the important need to improve water management for productive purposes. Its four focal areas deal with protecting water quality from natural and anthropogenic sources of contamination; water augmentation methods applicable in the most water-stressed areas; and the particular issues and complexities of achieving sustainable water utilization in urban and rural areas.

This theme aims to contribute to achieving the twin MDGs of providing safe water and sanitation in developing countries and recognizes the need to apply existing knowledge as well as new innovations to water management, particularly in semi-arid and arid regions, urbanizing areas and on small islands. A sound understanding of catchment and aquifer water quality protection by regulators, planners, local government, water utility and industry professionals and, in many cases, whole communities, is central to achieving these goals. A good starting point would be an increased awareness of the importance of managing human, municipal and industrial wastes as well as agricultural chemicals and fertilizers. This needs to be supported by scientific knowledge of local catchments and aquifers, including knowledge of natural sources of contaminants, flow pathways, residence times and attenuation processes and kinetics to define actions needed for water safety plans.

In many locations the indirect and unplanned human reuse of water that occurs via rivers and aquifers is unavoidable or in some cases essential. In a number of settings this is safe, but in others it increases the risk of water-borne disease. Sanitation may also have impacts on ecosystem values and bathing water. Water systems most at risk will be the focus of this theme, including those where the quantity of drinking water supply is already heavily constrained or will soon be by population growth or changes in land use or climate. Existing knowledge and research need to be disseminated and innovative approaches, such as rainwater harvesting, aquifer recharge management and planned water reuse, within the context of water safety plans, need to be utilized to safely augment supply.

In the future, more intelligent water resources management will allow the quantity and quality of supplies to be matched with their uses to avoid unnecessary treatment of water, and enable productive reuse of nutrients in agriculture. This will increase reliance on natural treatment processes and allow investment to be focused on treatment technologies where they add most value and are most effective. Improved water quality protection will be significantly less expensive than treating polluted water, but this will require knowledge and awareness by urban planners and water suppliers. Human health and well being are strongly dependent on readily available and safe water to meet the basic needs of health and food production. For societies under pressure from population growth, urbanization, national and regional conflicts, climate change or desertification, the access to adequate sources of water has been severely impacted through the degradation of these resources and conflicts over traditional and new sources of water. Societies in these circumstances are losing their traditional coping mechanisms and are often poorly served by national and local governments, which in many cases lack the necessary understanding of their specific concerns. Although these needs have the highest priority in international, regional and national development goals and strategies (e.g. poverty eradication and the Millennium Development Goals), governments and their service providers are struggling to move forward from basic water and sanitation infrastructure provision to an integrated development approach.

Critical responses to this situation include appropriate governance, strategic assessments of ways to meet these needs and integrated development actions at all levels. The particular challenge of IHP under this theme is to merge traditional and modern scientific knowledge, information and values into a participatory development programme that addresses access to water resources, their augmentation and the safeguarding of their quality for the support of livelihoods.

A few specific suggestions are:

- cooperate at the basin-scale on freshwater vulnerability assessments that UNEP has initiated in Africa, Southeast Asia and Latin America as strategic entry points for local action;
- utilize the HELP programme to achieve cooperation and develop pilot approaches;
- share information and experiences (key role for the UNESCO Centres);
- IHP National and Regional Committees to participate more actively in water sector issues.

Focal area 4.1 - Protecting water quality for sustainable livelihoods and poverty alleviation

Objectives

This focal area aims to develop and use knowledge of surface water catchments and groundwater systems in order to attenuate microbial, organic and inorganic contamination in these water sources and help protect the quality of current and future water supplies for all their uses. This will take into account natural and anthropogenic contaminants from point and diffuse sources, and contribute to the MDG for safe water supply and sanitation.

Activities

- Provide an inventory of natural contaminants in groundwater resources and geochemicals, and provide an assessment of risk due to human activities (e.g. arsenic, selenium, nitrate, fluoride, radioactivity).
- Develop scientific evidence for reliable and sustainable evaluation of contaminant attenuation rates under environmental conditions relevant for a wide range of surface water and groundwater situations, particularly in relation to human wastes, including pathogenic microorganisms, nutrients, organics and hydrocarbons.
- Disseminate information on methodologies for assessing residence times in aquifers and streams in order to form a scientific basis for developing risk-based preventive strategies, including defining wellhead, catchment and riparian protection zones.
- Provide a scientific basis for planning future water supplies and sanitation, especially in expanding urban areas, coastal and island communities, and water-stressed areas.
- Build public awareness on water quality protection and the role of the community.

Outputs

- Guidelines for the assessment and evaluation of natural and anthropogenic contaminants, for hydrological procedures to identify water quality risks to water supplies, and for the design of protection strategies for existing and proposed future water supplies from rivers, lakes and aquifers.
- A database on attenuation rates of pathogens and contaminants under a range of well-defined environmental conditions as a global resource to assist in risk assessment for water supplies and aquatic ecosystems.
- Case studies of good practice, including implementation of protection zones, management of pollutant sources, and planning for future supplies as an integral part of water safety plans.
- Incorporation of all of the above in curricula, training programmes and regional symposia on hydrology, water resources, water supply and urban planning, and in public awareness programmes conducted at national, city and community levels on steps towards better protection of water supplies.

Benchmarks

- Significant uptake of methods for water protection with targets adopted by Member States in support of the achievement of the water supply and sanitation MDGs, and substantially contributing to the UN Decade of Water for Life.

Focal Area 4.2 - Augmenting scarce water resources, especially in SIDS

Objectives

The work in this focal area aims to identify and evaluate methods of augmenting water supplies in water-stressed urban and rural areas, particularly those subject to climate change or population growth in arid and semi-arid areas or on islands or coasts. Methods include water storage and reuse, using combinations of engineered and passive environmental treatment processes, such as managed aquifer recharge (MAR), where water of various qualities is used to produce safe drinking, industrial or irrigation supplies, or to protect against saline intrusion or land subsidence.

Activities

- Expanding methodologies for harvesting rainwater and increasing water retention in the landscape, in support of strategies for groundwater management, protecting biodiversity, and reducing erosion.
- Improving methods for MAR from various water sources to augment water supplies and protect groundwater quality and downstream human and environmental uses, reducing overexploitation of water resources, and assisting communities to adapt to climate change and population growth.

- Providing scientific support to acknowledge human and environmental health implications of existing unintentional water reuse, and guide planning and implementation of safe water reuse for a wide range of applications within a catchment and groundwater system, considering salinity, nutrients, metals, pathogenic organisms and trace organics, including pharmaceutically active chemicals, endocrine disruptors, personal care products and flame retardants.
- Undertaking research to enhance resilience of water supplies of coastal, island and arid area communities, to mitigate saline intrusion and land subsidence, to flush saline aquifers using low energy methods, such as MAR, to find uses for desalination brines or ways of safely disposing of these in inland areas, and to evaluate the environmental impact of large-scale desalination.
- Identifying means of conjunctive use of different sources of water, in particular surface water and groundwater, finding appropriate combinations of engineered and sustainable environmental treatments to minimize energy requirements, and make water supplies safer and cheaper.

Outputs

- Review of innovation in methods available, including MAR, rainwater harvesting and water reuse for improved urban and rural water management, and report exemplar case studies that document implementation, effectiveness, durability and limitations of these strategies in addressing water scarcity and water quality issues.
- An established network of exemplar sites developed in partnership with local and national bodies.
- Regional training programmes conducted and curricula developed in concert with the relevant UNESCO Centres and Chairs.
- Biennial symposia run in partnership with IAH and associated with international workshops conducted to foster research and dissemination of new knowledge on water issues.
- Guidelines on MAR and water reuse that highlight synergies with complementary natural resources management programmes related to biodiversity, sediments, salinity, land degradation and broader adaptations to climate change for improved water and food security.

Benchmarks

- Significant uptake of MAR and water reuse, substantially contributing to the water supply and sanitation MDGs and the UN Decade of Water for Life.

Focal area 4.3 - Achieving sustainable urban water management

Objectives

This focal area aims to develop scientifically-sound support for the integration of water management in urban areas. Its purposes are manifold. They include sustaining drinking and industrial water supplies, sanitation services, surface water bodies and water-dependent ecosystems, increasing efficiency of water use, improving the quality of life in cities, mitigating the risk of flooding and reducing contaminant discharges into receiving waters. Institutional and capacity building aspects will be incorporated as necessary components in order to formulate and apply effective urban water management strategies (see Box 1, UWMP). Emerging paradigms and novel approaches and tools, particularly those applicable to cities in the developing world, will be duly considered.

Activities

- Generate and document approaches for best practices in integrated management of the water cycle in urban areas and surroundings in different climatic, hydrological and hydrogeological, and topographic settings, for megacities, cities, towns and villages with a range of characteristics, including existing water infrastructure, industries and capacities for adaptation.
- Assess effectiveness of, and explore promising directions for, water management strategies – including water conservation, demand management, pricing, stakeholder involvement, institutional frameworks, wastewater treatment, water reuse and conjunctive use of surface water and groundwater – on stocks and flows of urban water, water security, water quality, flood risk, quality of life and the environmental footprints of urban areas.
- Evaluate strategies to improve the quality of life of periurban dwellers through alternative institutional and capacity building arrangements, and alternative water supplies, stormwater management and waste management practices.

- Evaluate urbanization pressures and methods to assess ecological status for urban waterways, receiving waters, aquatic habitats, groundwater and changes due to improved treatment and management of waste discharges (that is, in order to evaluate the environmental consequences associated with waste discharge from household sewage, industry and stormwater).
- Promote best practices and policies that lead to increased efficiency and sustainability in the use of water and better integration within and across water use sectors through recycling and reuse, and evaluate and take into account the associated environmental, social and economic factors.
- Strengthen capacity building and educational capabilities in urban water management aimed at relevant target groups, including decision makers, planners and practitioners, with a special emphasis on developing countries.

Outputs

- Reports and guidelines on innovative urban water management in a range of cities, outlining implementation and social, economic and environmental outcomes.
- Establishment and evaluation of alternative water systems for improving the quality of life and safety of periurban dwellers.
- Reports and guidelines on monitoring methods and impacts on urban water environments, biodiversity and quality of life of integrated urban water management strategies.
- Analytical tools for the assessment of urban water conditions and for the enhancement of integrated urban water management in various natural and climatic settings.
- Capacity building and educational components, encompassing the design, production and/or incorporation of the appropriate tools and approaches, and enhancing the IHP training and technology transfer platform.

Benchmarks

- Major steps in improving urban water environments, improving the quality of life of urban dwellers, in particular those living in slums and periurban areas, improving the efficiency of urban water use and reducing discharge of waste into receiving waters.
- Dissemination of an expanded knowledge base on improved approaches to integrated urban water management and a strengthened network for this purpose.

Focal Area 4.4 - Achieving sustainable rural water management

Objectives

This focal area aims to develop scientific and public support for water management in rural areas in order to sustain the quantity and quality of drinking water supplies, surface water bodies and water-dependent ecosystems, and meet the water needs of irrigation, aquaculture and industry. Issues of over-allocation, and in some cases lack of allocation policy, are particularly severe in arid and semi-arid areas. Sustaining the value of water resources in these cases requires increased efficiency of water use, and improved management of pesticides, fertilizers and sanitation.

Activities

- Undertaking strategic assessments of the socio-economic role and benefits of water in various forms in different rural environments, and taking into account climatic variability.
- Appropriate archiving, disseminating, and, where necessary, piloting of best practice information nationally, regionally and internationally for the sustainable utilization of water resources in rural areas.
- Application of methods for resource assessment to develop knowledge of sustainable rates of surface water and groundwater utilization, accounting for linkages between resources, and for the development of water sharing policies and participatory procedures to enable over-exploited resources to be brought into balance.
- Development of policies and practices for the management of fossil groundwater based on strategic assessments of its present and future values.
- Specific focus on the safeguarding of water quality to ensure human health and food security in a rural environment, with an emphasis on the impacts of erosion, salinization, poor sanitation, fertilizers and pesticides.
- Systematic advocacy at all levels to anchor best practice knowledge in national and regional governance processes (e.g. guidelines, legislation, participatory processes).

Outputs

- Reports on methods and case studies demonstrating and highlighting best practices and the benefits of effective water management in rural areas, including means of equitably addressing community needs where water resources are over-exploited and setting wise policies for the management of fossil groundwater.
- Development of materials for improved agricultural and aquaculture production in water-stressed areas using recycled water, and protection of water resources from salinization, pesticides and fertilizers in partnership with FAO, Member States and NGOs focused on food security and natural resources.
- Assuring good water quality for drinking and food production, including access to and appropriate technologies for supply development and maintenance.

Benchmarks

- IHP programme accepted as part of national/ regional development programmes.

THEME 5: WATER EDUCATION FOR SUSTAINABLE DEVELOPMENT

Background and challenges

The challenges for IHP, with regards to theme 5, in providing water education for sustainable development have been well articulated in the discussion paper "Issues in World Water and their Educational Implications", prepared by the Group on Water Education, which sets out the drivers of change and their educational implications. The document identifies seven drivers of change: demographic, technological, economic, social, environmental, governance and gender-related. Each of these drivers has an implication for education. IHP Phase VII could not be expected to take direct responsibility for each of these, but will stimulate responsive actions through its partners across UNESCO and the UN System, as well as through its National Committees within Member States. The work that started in the sixth phase of IHP (2002-2007), and led to the substantial extension of IHP's action in the field of water education, through IHE, and with an ever-increasing emphasis on interdisciplinary and multidisciplinary activities, will be consolidated and continued. During the seventh phase (2008-2013), water education, responsive to those drivers of change, will occupy center stage at UNESCO.

The Issues Paper identifies four constituencies for the delivery of water-related education: education for communities of social learning, education for schools and capacity building of teachers, education for vocational training, and education for sustainable communities and mass media professionals. To these constituencies, the IHP Task Force added, education for "innovators and change makers" – NGOs, individuals, and concerned leaders of social movements who have a strong voice and can mobilize public opinion, which in turn influences decision makers. Under theme 5, IHP will formulate and package the findings of all of its hydrological research into appropriate messages for each of these constituencies so that sound science truly influences policies, perceptions, attitudes and behaviors.

IHP-VII will also continue to improve and update the teaching of hydrological sciences and related scientific disciplines to reach these constituencies. It will need to foster the ideas contained in the discussion paper in order to incorporate water education into sustainable development and facilitate convergence of cross-disciplinary dialogue. The relevance of other disciplines to water resources management for sustainable development cannot be overemphasized. The new dimensions of water governance include anthropology, history, sociology, political science, law, engineering and economics. Building up a converging dialogue between natural and social sciences is essential towards better understanding of the possible impacts of global changes, and to better prepare societal responses, set up preventive actions, and develop adaptation measures.

There is also a need for a much wider dissemination of scientific research results and for communication and adoption strategies to be made an integral part of all IHP projects. This can include the preparation of jargon-free project briefs that complement technical reports developed under the other themes which would summarize results and identify major policy implications. Training workshops focused on explaining these results and their policy

implications could also be used, especially for each of the constituencies mentioned, including water professionals, and policy and decision makers in developing countries, with particular support for African countries.

UNESCO-IHE has significantly increased UNESCO's capacity in water education. The institute is the only entity in the UN system that is accredited to confer MSc and PhD degrees. It also delivers water education and training in many other forms, including short courses tailored to specific needs and online courses. During IHP-VII, UNESCO-IHE will coordinate actions with IHP international and regional water-related Centres and Chairs. This will help to further build a strong network of partnerships that could do much to fulfil the professional-level needs in Member States for water education and training.

These tertiary and professional dimensions of water education will be supplemented in IHP-VII to also include a focus on water education for schools, Technical and Vocational Education and Training (TVET), the general community and the mass media. This is a reflection not only of the increasing role of education, training and capacity building within IHP-VII, but also of developments within UNESCO. Firstly, UNESCO is the lead agency within the UN system for the UN Decade of Education for Sustainable Development and secondly, UNESCO's action plan on intersectoral activities on water education is under the leadership of IHP. The action plan involves all of UNESCO's programme sectors to ensure that all forms and levels of education are included and that UNESCO as a whole has a coherent, integrated policy and strategy in water education.[10] The formulation of the focal areas of theme 5, follow the above developments and reflect these new needs.

The theme 5 focal areas respond to the needs of the constituencies identified above and the proposed Work Plan for the Thematic Programme 8 (Water Education for Sustainable Development) of the Action Plan for the UN Decade of Education for Sustainable Development (presented in Annex V of the document IHP/Bur-XL/14).

10. UNESCO's responses to these two developments were reported in the IHP document (IHP/Bur-XXXIX/14, April 2006) that was presented by the IHP Secretariat at the 39th Session of the IHP Bureau, and also in the UNESCO Executive Board document 174EX/Inf.13 (Item 48 of the Agenda 6 April 2006: "Follow-up to 166 EX/decision 3.6.1. Concerning the proposal for the elaboration of an education programme for sustainable management of freshwater resources")

Focal area 5.1: Tertiary water education and professional development

Objectives

This focal area aims to enhance tertiary education and training programmes for water scientists, engineers, managers and policy makers through an extended suite of activities, designed to educate a new generation of water managers and decision makers to apply a holistic, integrated multidisciplinary approach to water resources. The work also seeks to catalyze the wide dissemination of scientific research results and aims to make communication and adoption strategies an integral part of all IHP projects. UNESCO-IHE and the water-related UNESCO Category II Centres will be key partners in the implementation of this part of the focal area.

Activities

- Develop interdisciplinary materials, such as guidelines, briefing papers, prototype professional development programmes and case studies connected with water education for sustainable development, in coordination with other IHP themes and programmes.
- Develop strategies for fostering dialogue across disciplines, especially to ensure that cultural values, local traditions and historical factors are taken into account in water resources development and education.
- Set up a strategy to strengthen collaboration between UNESCO-IHE, the water-related UNESCO Category II Centres and UNESCO Chairs, other UN system agencies and programmes, and existing international water-related education programmes.
- Assess regional needs and priorities in water education and strengthen water education capacities in developing countries.
- Contribute to a UNESCO-IHP international conference and book on water education.

Outputs

- Guidelines to solve problems of communicating interdisciplinary information on water.
- Recommendations for broader curricula, exemplar educational materials and case studies.
- Assessment and pilot studies of regional needs in water education.

Benchmarks

- Increased coordination of university and professional development courses across UNESCO-IHE, the water-related UNESCO Category II Centres and UNESCO Chairs, and other UN system agencies on water-related education programmes.
- Greater interdisciplinarity among university and professional development courses.

Focal area 5.2: Vocational education and training of water technicians

Objectives

This focal area aims to expand the integration of principles and technologies for sustainable water supply and treatment, community-based water and sanitation services, and water conservation into TVET-level training of water technicians.

Activities

- Survey and prepare case studies exemplifying leading practices in sustainable water management in water technician training.
- Analyze case studies and prepare guidelines and briefing papers on sustainable development and sustainable water management for TVET decision makers.
- Conduct workshops to build understanding of guidelines and briefing papers.
- Provide technical support to national demonstration projects in selected Member States on TVET for sustainable water management, establish a process to learn lessons from projects and share these lessons widely.
- Contribute to a UNESCO-IHP international conference and book on water education.

Outputs

- Guidelines for integrating sustainable water management in water technicians training.
- Case studies, best practices and publications on water education within TVET.

Benchmark

- Increase in the capacity of countries and courses to focus on sustainable water management for technicians.

Focal area 5.3: Water education in schools

This focal area aims to build the capacities of primary, middle and high school education systems to make water a significant topic in the K-12 curriculum so that young people have an opportunity to develop an understanding of water issues in both local and global contexts, a commitment to a water ethic, and skills for contributing to sustainable water management in the local community. This will be done by providing technical assistance to the Education Sector of UNESCO and other partners.

Activities

- Provide technical support to the development of interdisciplinary support materials, such as guidelines, briefing papers, and case studies connected with sustainable development, e.g. on leading practices in K-12 water education, curriculum development, and the management of shared water resources, in coordination with other themes and programmes of IHP and other sectors of UNESCO.
- Provide technical support to national demonstration projects in selected Member States on K-12 water education.
- Contribute to a UNESCO-IHP international conference and book on water education.

Outputs

- Guidelines for integrating water education related to sustainable development into the K-12 curriculum, with an emphasis on “learning by doing” or “experiential learning” approaches.
- Prototype education support materials at the regional level.

Benchmarks

- Improved tools for the teaching of water issues in the K-12 curriculum.

Focal area 5.4: Water education for communities, stakeholders and mass-media professionals

Objectives

The aim of this focal area is to build the capacities of water scientists and managers in Member States to utilize a wide range of community education strategies in order to promote community-wide water conservation and sanitation, as well as skills in local co-management of water resources.

This focal area also intends to promote awareness of water issues using mass and community media resources and to keep accurate reporting of water management issues on the top of the media agenda. For this purpose, activities will contribute to the understanding of the importance of world water issues among journalists and producers of radio, television, film, multimedia, and other mass and community media resources, as well as improve their capacity to communicate water issues accurately and effectively.

Activities

- Provide technical support for the preparation of case studies and guidelines based on leading practices in community-based water education.
- Provide technical support for the preparation of case studies and guidelines based on leading practices in mass and community media reporting on water issues and the training of media professionals on water issues.
- Develop a UNESCO-IHP website on community education resources and strategies to assist Member States in promoting community-wide water conservation and sanitation, as well as increasing skills in local management of water resources.
- Contribute to a UNESCO-IHP international conference and book on water education.

Outputs

- Production of guidelines, supported by practical examples, for community-based water education and media reporting of water issues.
- A community education website managed by IHP.
- Demonstration projects on community-based water education strategies in several Member States focused on action learning approaches, and the diffusion of their evaluations.

Benchmarks

- Improved strategies for community-based water education.
- Improved strategies for media reporting of water issues.

(G)
THE NEXT STEPS

The Strategic Plan has been approved by the IHP Bureau. The IHP Secretariat then circulated the approved Strategic Plan to IHP Council Members and received an out-of-session approval by 1 September 2007, which was circulated to the IHP National Committees, UN Agencies, IGOs, and NGOs. This wide circulation enabled the Secretariat to receive proposals for actions, commitments, confirmation of benchmarks and identification of partners who will participate in Phase VII, on the basis of agency complementarity and comparative advantages. Finally, the Secretariat with support from the Task Force, completed the proposed Implementation Plan, including the monitoring and evaluation plan for IHP- VII.

The Secretariat consulted media experts to prepare a short user-friendly brochure describing IHP-VII for the public at large, as recommended by the Bureau. The brochure was released as soon as the 34th session of the General Conference (2007) adopted the IHP-VII Plan.

Preparation of the Implementation Plan

The Implementation Plan allows for flexibility and the possibility to introduce additional elements to address new situations and emergencies, and takes into account the evolving water sector framework and the UNESCO setting. For each Phase VII theme, the Implementation Plan describes and lists methods, partnerships, cooperation possibilities and extrabudgetary fundraising for implementation, in addition to execution details. The Implementation Plan outlines the expected results and evaluation details to ensure that they suit the needs of the stakeholders who will benefit from the deliverables. The aim is to make it easier to identify, execute and evaluate IHP-VII endorsed research and other programmes. For this to be successful, governments need to be involved in the implementation process and strong links should be established between governments and IHP National Committees. To this end, it has been suggested that each country designate a focal point at the ministerial level. IHP National Committees could also establish focal points at the technical level if they wish to take responsibility for the execution of specific tasks related to Phase VII themes and focal areas.

Another consideration addressed in the Implementation Plan is the need to strengthen the role of IHP National Committees in implementing IHP activities at regional level. Considering the magnitude of water-related problems in developing countries, and especially in Africa, a particular effort will be needed to set up North-South and South-South partnerships among IHP National Committees.

In an effort to facilitate monitoring and coordination, efforts have been made to set realistic outputs for the five themes proposed for Phase VII. However, this matter could be given further consideration in light of IHP's success in leveraging support from cooperating agencies. For example, the partnership established with GEF is proving very effective and could provide real benefits to IHP National Committees in developing countries. More associations of this type could further broaden the scope of IHP-VII themes and focal areas.

ANNEX I

BACKGROUND

The IHP-VII Strategic Plan was developed on the basis of a concept discussion paper prepared by a task force of experts established by the IHP Bureau at its 35th session. The Task Force was convened for the first time in early 2004 to appraise independently the past three decades of work of the IHP. It was also asked to assist in putting forward a draft Strategic Plan for the VIIth Phase, with the inputs received by the IHP National Committees on their thematic priorities.

The Phase VII Concept, which gradually evolved into the Strategic Plan for IHP-VII, was subjected to periodic reviews during the 38th (June 2005) and 39th (May 2006) sessions of the IHP Bureau. The Concept, and later the Draft Strategic Plan, has also been widely consulted in several interactions with IHP's National Committees, as well as all of IHP's major partners.

The Intergovernmental Council of the IHP examined the draft Strategic Plan for the Seventh Phase of IHP at its 17th session on 3-7 July 2006, and endorsed it in principle, inviting all Member States to comment on the draft within two months. The Council authorized the Bureau of the IHP to consolidate the draft with the comments made in the course of the Council debate and the later consultations, and to submit it for out-of-session approval. The Strategic Plan prepared by the Chair of the Task Force incorporates these new comments following the Council meeting, and was submitted to the Bureau for consideration at its 40th meeting in June 2007.

The Task Force would like to record its deep appreciation for the support provided by the IHP Secretariat in hosting the meetings and for the very valuable advice on the many issues that are intrinsic to the success of IHP. The Task Force would also like to acknowledge the Secretariat's extensive work involving the process of analysing the wide ranging inputs received from Member States between July and September 2006.

TABLE 1
OVERVIEW OF THE CORE PROGRAMME THEMES OF THE SEVENTH PHASE OF IHP (2008-2013)

↘THEME 1: ADAPTING TO THE IMPACTS OF GLOBAL CHANGES ON RIVER BASINS AND AQUIFER SYSTEMS	
Focal area 1.1	Global changes and feedback mechanisms of hydrological processes in stressed systems
Focal area 1.2	Climate change impacts on the hydrological cycle and consequent impact on water resources
Focal area 1.3	Hydro-hazards, hydrological extremes and water-related disasters
Focal area 1.4	Managing groundwater systems' response to global changes
Focal area 1.5	Global change and climate variability in arid and semi-arid regions
↘THEME 2: STRENGTHENING WATER GOVERNANCE FOR SUSTAINABILITY	
Focal area 2.1	Cultural, societal and scientific responses to the crises in water governance
Focal area 2.2	Capacity development for improved governance; enhanced legislation for wise stewardship of water resources
Focal area 2.3	Governance strategies that enhance affordability and assure financing
Focal area 2.4	Managing water as a shared responsibility across geographical and social boundaries
Focal area 2.5	Addressing the water-energy nexus in basin-wide water resources
↘THEME 3: ECOHYDROLOGY FOR SUSTAINABILITY	
Focal area 3.1	Ecological measures to protect and remediate catchment processes
Focal area 3.2	Improving ecosystem quality and services by combining structural solutions with ecological biotechnologies
Focal area 3.3	Risk-based environmental management and accounting
Focal area 3.4	Groundwater-dependent ecosystems identification, inventory and assessment
↘THEME 4: WATER AND LIFE SUPPORT SYSTEMS	
Focal area 4.1	Protecting water quality for sustainable livelihoods and poverty alleviation
Focal area 4.2	Augmenting scarce water resources, especially in small island developing states (SIDS)
Focal area 4.3	Achieving sustainable urban water management
Focal area 4.4	Achieving sustainable rural water management
↘THEME 5: WATER EDUCATION FOR SUSTAINABLE DEVELOPMENT	
Focal area 5.1	Tertiary water education and professional development
Focal area 5.2	Vocational education and training of water technicians
Focal area 5.3	Water education in schools
Focal area 5.4	Water education for communities, stakeholders and mass-media professionals
Crosscutting programmes: HELP, FRIEND	
Associated programmes:	International Flood Initiative (IFI) International Sediment Initiative (ISI) From Potential Conflict to Cooperation Potential (PCCP) Joint International Isotope Hydrology Programme (JIIHP) Internationally Shared Aquifer Resources Management (ISARM) Global Network on Water and Development Information in Arid Lands (G-WADI) Urban Water Management Programme (UWMP) World Hydrogeological Mapping Assessment Programme (WHYMAP)
Education, training and capacity building across all the themes	

ANNEX II

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ANNEX III

IHP PHASE VII THEMES, FOCAL AREAS AND LINKAGE TO ONGOING IHP INITIATIVES, CONTRIBUTION TO MDGS,

	Continuing and strengthened initiatives under IHP Phase VII	IHP Phase VII and Millennium Development Goals
↘THEME 1: ADAPTING TO THE IMPACTS OF GLOBAL CHANGES ON RIVER BASINS AND AQUIFER SYSTEMS		
Focal area 1.1 - Global changes and feedback mechanisms of hydrological processes in stressed systems **Focal area 1.2** - Climate change impacts on the hydrological cycle, and consequent impact on water resources **Focal area 1.3** - Hydro-hazards, hydrological extremes and water-related disasters **Focal area 1.4** - Managing groundwater systems' response to global changes **Focal area 1.5** - Global change and climate variability in arid and semi-arid regions	HELP / FRIEND ISARM PCCP G-WADI ISI IFI	Focus on MDG 7: Ensure environmental sustainability Assess the interlinkage with other MDGs such as: MDG 1: Eradicate extreme poverty and hunger, TARGET 2: Reduce by half the proportion of people who suffer from hunger –especially through IHP focal area I.4 by developing means and policies that will maintain terrestrial ecosystem function and diversity as a prerequisite to the sustainable production of the world's food resources– especially in water-stressed regions. MDG 6: Combat malaria and other water-borne diseases, TARGET 8: halve and reverse the incidence of malaria and other water-related diseases –especially through IHP focal area 1.3– review the feedback mechanisms involved in breeding grounds for malaria-bearing mosquitoes and other organisms that propagate infectious diseases. MDG 8: Global partnership for development, TARGET 14: special needs of landlocked countries and small island developing states –IHP focal areas 1.2 and 1.4 would contribute to achieving these goals through better guidelines from improved predictive models.
↘THEME 2: STRENGTHENING WATER GOVERNANCE FOR SUSTAINABILITY		
Focal area 2.1 - Cultural, societal and scientific responses to the crises in water governance **Focal area 2.2** - Capacity development for improved governance; enhanced legislation for wise stewardship of water resources **Focal area 2.3** - Governance strategies that enhance affordability and assure financing **Focal area 2.4** - Managing water as a shared responsibility across geographical and social boundaries **Focal area 2.5** - Addressing the water-energy nexus in basin-wide water resources	HELP / FRIEND ISARM PCCP G-WADI ISI IFI	The relevance of MDG 7 is stressed: the fundamental importance of water as a dividing line between poverty and prosperity can be noted on the world map of global income distribution –high priority countries for MDGs identified in the Human Development Reports are largely in the arid zones where water scarcity and drought frequency intensify the incidence of poverty, an aspect that could be addressed through IHP focal area 2.3, with the development of methodologies for effective IWRM and secure flow of funds. TARGET 9: Integrate principles of sustainable development into country policies and programmes –IHP focal areas 2.1 and 2.2 should have a key role in *developing* principles that integrate sustainable water resource development into national and sub-regional policies and programmes, especially by providing financing agencies with a scientific basis for their lending and assistance programmes.
↘THEME 3: ECOHYDROLOGY FOR ECOSYSTEM SUSTAINABILITY		
Focal area 3.1 - Ecological measures to protect and remediate catchments processes **Focal area 3.2** - Improving ecosystem quality and services by combining structural solutions with ecological biotechnologies **Focal area 3.3** - Risk-based environmental management and accounting **Focal area 3.4** - Groundwater-dependent ecosystems identification, inventory and assessment	HELP / FRIEND ISARM PCCP G-WADI ISI IFI	MDG 7: Ensure environmental sustainability, TARGET 10: halve the proportion of people without sustainable access to safe drinking water –especially under IHP focal area 3.3; urbanization pressures threaten local water sources; many residents of megacities access local shallow groundwater, poor or absent sanitation contaminates these sources; this situation is replicated in cities, towns and villages, though with decreasing intensity; methodologies for ecological management of wastes in urban conditions could be developed. TARGET 11: Achieve significant improvement in the lives of at least 100 million slum dwellers –IHP focal area 3.3 could focus on increasing the sustainability of water services (non-conventional water) for use by slum dwellers in cities and megacities. Most MDGs involve water's many functions in the planet's life support system • as a basic component for crop production, landscape agent, mobile solvent • issues that are addressed in IHP focal area 3.1.

SUPPORT TO THE WATER FOR LIFE DECADE AND THE UN DECADE OF EDUCATION FOR SUSTAINABLE DEVELOPMENT

IHP and "Water for Life" Decade (2005-2015)	UN Decade of Education for Sustainable Development
Early in the decade, IHP could promote and provide networking resources for experts to develop long-range, large-scale, integrated "water for life" modelling tools, which could deliver early warnings on ecosystem functions to help inform and develop regional policy frameworks. These models would target improvements in global modelling approaches described by Simonovic (2002) –*World Water Dynamics*– and deliver policy-relevant messages for actions by governments, financing agencies and informed stakeholders. Water for Life –in this context is understood to mean the physical resource, its abiotic quality, its biotic resource, water balance and demands, within consistent hydrological units– river basins and aquifer systems.	IHP-VII (2008-2013) will extend IHP's action in water education, with an ever-increasing emphasis on developing the capacity of water scientists, managers and other actors to make interdisciplinary responses to the changing global environment and its impact on water, e.g., increased rainfall variability, natural disasters, etc. This could involve training packages and courses on: groundwater, managing ecosystem health and environmental flows, water modelling, early warning systems and disaster response management. The looming adverse impacts of climate change on Africa and Asia, cf. their vulnerability and adaptative capacity, will require increased capacity building in the areas of water and ethics and water and sustainable livelihoods.
The "actions" component of a future "Water for Life" Decade may well take forward some of the past commitments made by governments. If so, IHP Phase VII could take a proactive role in promoting the "governance" and the "capacity building - knowledge sharing" components of the Bonn Action Plan (2001), which was adopted by Ministers but lacks a time frame. The key actions that IHP Phase VII, theme 2 could take up include: **Water governance** • Ensure water infrastructures are designed to deliver to the poor • Promote gender equality in water and sanitation • Manage water at the lowest appropriate level **Capacity building - knowledge sharing** • Focus education and training on water wisdom • Share knowledge and innovative technologies • Encourage governments to play a more active role in water governance	Education, training and capacity building in this theme could represent a major area of growth in IHP's project development, research and education activities. There could be at least three levels of work in this area. The first level concerns training in international, national and local water law and governance, water and human rights, incorporating cultural factors and gender issues in water sciences and management, and the implications of public versus private ownership of water and sanitation services and the increase in public-private partnerships for water and sanitation. This involves multidisciplinary approaches from studies in anthropology, history, sociology, geography, political and policy sciences, law and economics. Strengthening dialogues between natural and social sciences is necessary to better understand possible impacts from global changes and to better prepare societal responses, set up preventive action, and develop adaptation measures. The second level involves training and capacity building for water managers in participatory and community-based approaches, especially at the village, township and catchment scales. The third is the training of community members in order to enable them to participate effectively in water management.
By the close of the "Water for Life" Decade (2015), the number of megacities in the world will have increased severalfold from the 23 in 2000. The pressure on water as a resource, and water as solvent for waste water, will rise inexorably. Such pressures will extend to other urban centers –possibly the migration to cities will release pressure in rural areas, though poor land management in the interim will have left significant pollutants to threaten ecosystems (e.g. nitrate in unsaturated zones, agrochemicals in degraded land, etc). IHP Phase VII could sponsor and support strategic studies at the opening stages of the Decade –assessing these scenarios, stressing early warning signals and policy relevant options for mitigating impacts on critical ecosystems.	The development of educational and capacity-building activities on ecohydrology provides an opportunity for IHP and its partners to educate a new generation of water managers and decision makers. They will need to be trained to apply a holistic and integrated approach to water resources, creating bridges not only across the ecological and hydrological sciences but also across the social sciences. This needs to involve a degree of up-skilling of some hydrologists, technicians, water professionals, and policy and decision makers who may not be used to working in a transdisciplinary manner, and who may not be used to making decisions based on understanding the complexity and uncertainty that are characteristic of real-life situations.

ANNEX III

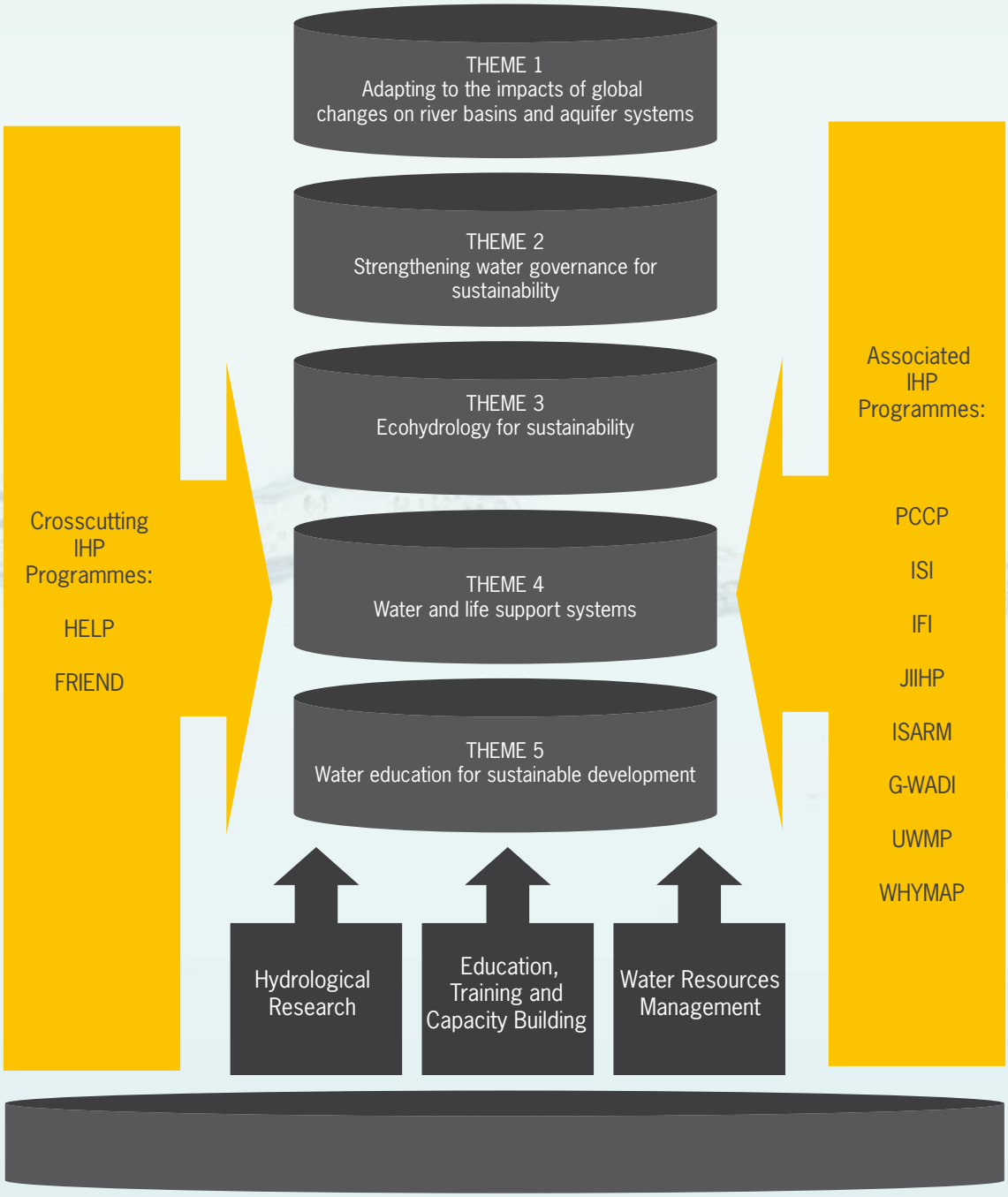
IHP PHASE VII THEMES, FOCAL AREAS AND LINKAGE TO ONGOING IHP INITIATIVES, CONTRIBUTION TO MDGS, SUPPORT

	Continuing and strengthened initiatives under IHP Phase VII	IHP Phase VII and Millennium Development Goals
↘THEME 4: WATER AND LIFE SUPPORT		
Focal area 4.1 - Protecting water quality for sustainable livelihoods and poverty alleviation **Focal area 4.2** - Augmenting scarce water resources, especially in SIDS **Focal area 4.3** - Achieving sustainable urban water management **Focal area 4.4** - Achieving sustainable rural water management	HELP / FRIEND ISARM PCCP G-WADI ISI IFI	Focus on MDG 7: Ensure environmental sustainability Provide sound policy-relevant scientific basis to achieve TARGET 10, especially in connection with human health; water-borne diseases constitute a major obstacle to improving human health –especially in regions where 90% of sewage and 70% of industrial waste are disposed untreated into surface water systems.
↘THEME 5: WATER EDUCATION FOR SUSTAINABLE DEVELOPMENT		
Focal area 5.1 - Tertiary water education and professional development **Focal area 5.2** - Vocational education and training of water technicians **Focal area 5.3** - Water education in schools **Focal area 5.4** - Water education for communities, stakeholders and mass-media professionals	During the sixth phase of the IHP (2002-2007), there was a substantial extension of IHP's action in the field of water education, with an ever-increasing emphasis on interdisciplinary and multidisciplinary activities. During the seventh phase (2008-2013), water education will occupy center stage at UNESCO. Consideration should be given to developing a dissemination and adoption strategy for all IHP projects, e.g., through which technical reports are supplemented with plain language "project briefs" that summarize results and identify major policy and other practical implications. In its role as the lead agency for the UN Decade of Education for Sustainable Development (2005-2014), UNESCO will place special emphasis on water education across a wide range of audiences, as reflected in focal areas 5.1-5.4.	As with water, education is central to all the MDGs. Meeting MDG 7 and its wide range of environmental targets requires a population that is "environmental literate" and more specifically "water literate". The MDG goals related to gender equity, child and maternal health, among others, also require basic water education as a prerequisite.

TO THE WATER FOR LIFE DECADE AND THE UN DECADE OF EDUCATION FOR SUSTAINABLE DEVELOPMENT

IHP and "Water for Life" Decade (2005-2015)	UN Decade of Education for Sustainable Development
The Johannesburg Plan of Implementation (JPOI) initiative targets water and sanitation directly –but health and agriculture are directly linked to water availability and water quality. Assuming that the key issues in the "Water for Life" Decade could be translated as: • water for food security • water for human health • water for ecosystem operations	Like theme 2 on water governance, this theme requires education, training and capacity building across several levels. First, it requires water scientists and managers to understand hydrological systems and threats to their sustainability from global environmental change and human impacts better. Second, it requires specialist training in the management of water supply, and quality to ensure the sustainability of economic activities, human settlements, and health and well being across different ecosystem types. Third, there could be a major emphasis on training for community-based strategies for water and sanitation, especially in fragile environments and for the rural poor.
The Water for Life Decade coincides with the UN Decade of Education for Sustainable Development. This provides an opportunity to make education integral to the former and water integral to the latter. While a limited amount of educational materials have been prepared for the Water for Life Decade, this provides an opportunity for IHP to take a leading role and ensure that all appropriate activities in its water education programme are co-branded with the Water for Life Decade and linked to its materials and those of other partners in UN-Water.	IHP is taking the lead in the development of a UNESCO-wide strategy for water education at all levels. It is doing this by taking responsibility for Thematic Programme 8 Water Education in the UNESCO Action Plan for the Decade of Education for Sustainable Development. Themes 1-4 in IHP-VII relate to the Decade of Education for Sustainable Development through activities at the tertiary and professional level (as above). These will be complemented under Theme 5 by activities directed at schools, TVET, the general community and the mass media.

FIGURE 1
OVERVIEW OF THE RELATIONSHIPS BETWEEN THE CORE THEMES OF IHP-VII, AND THE CROSSCUTTING AND ASSOCIATED PROGRAMME COMPONENTS



ANNEX IV
HOW IHP WORKS

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.

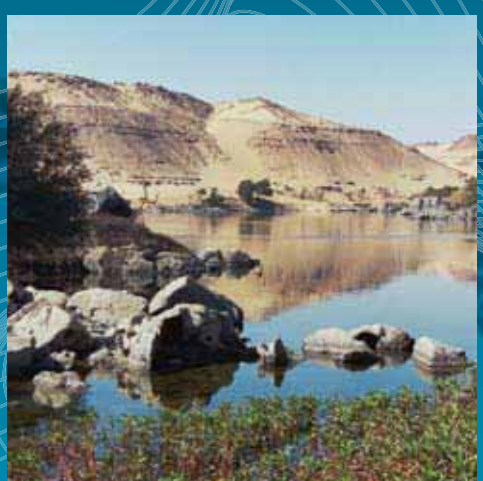
UNESCO hosts the IHP Secretariat and provides seed funding that is multiplied many times over through cooperation with implementing partners.

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

- **UNESCO's Member States** are at the heart of the work: the IHP Secretariat 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-six agencies of the UN system cooperate through the **World Water Assessment Programme (WWAP)** to provide an ongoing 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.

ABBREVIATIONS AND ACRONYMS

AHC	Arctic Hydrological Council
ARIDE	Assessment of the Regional Impact of Droughts in Europe
ASTHyDA	Analysis, Synthesis and Transfer of Knowledge and Tools on Hydrological Droughts Assessment through a European Network
CHy	Committee on Hydrology (of WMO)
CPCW	Cooperative Programme on Water and Climate
DESD	United Nations Decade of Education for Sustainable Development
EU	European Union
FAO	Food and Agriculture Organization
FRIEND	Flow Regimes from International Experimental and Network Data
GEF	Global Environmental Facility
GEF-STAP	GEF-Scientific and Technical Advisory Panel
GEMS	Global Environmental Monitoring System
GEOS	Global Environmental and Ocean Sciences
GEST	Global Evaluation of Sediment Transport
GEWEX	Global Energy and Water Cycle Experiment
GIWA	Global International Waters Assessment
GRACE	Gravity Recovery and Climate Experiment
GRAPHIC	Groundwater Resources Assessment under the Pressures of Humanity and Climate Changes
G-WADI	Global Network – Water and Development Information for Arid Lands
GwES	Groundwater Resources Management in Emergency Situations
HELP	Hydrology for the Environment, Life and Policy
HWR	WMO's Hydrology and Water Resources program
IAEA	International Atomic Energy Agency
IAH	International Association of Hydrogeologists
IAHS	International Association of Hydrological Sciences
ICARPII	International Conference on Arctic Research Planning II
ICHARM	International Centre for Water Hazard and Risk Management
IFI	International Flood Initiative
IGO	Intergovernmental organization
IGRAC	International Groundwater Resources Assessment Centre
IHD	International Hydrological Decade
IHP	International Hydrological Programme
INBO	International Network of Basin Organizations
INWEB	International Network of Water-Environment Centres for the Balkans
IPY	International Polar Year
IRTCES	International Research and Training Centre on Sedimentation and Erosion
IRTCUD	International Network of Research and Training Centres for Urban Water and Centres for Urban Drainage
ISARM	International Shared Aquifer Resources Management
ISDR	International Strategy for Disaster Reduction
ISI	International Sedimentation Initiative
IUGS	International Union of Geological Sciences
IWA	International Water Association
IWRM	Integrated water resources management
JIIHP	Joint International Isotopes in Hydrology Project (UNESCO-IAEA)
JPOI	Johannesburg Plan of Implementation
JUWFI	Joint UNESCO/WMO Flood Initiative
MAB	Man and the Biosphere
MAR	Managed Aquifer Recharge
MDG	Millennium Development Goal
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organization
OAS	Organization of American States
OSCE	Organization for Security and Co-operation in Europe
OSS	Sahara and Sahel Observatory
PCCP	From Potential Conflict to Co-operation Potential
PRSPs	Poverty Reduction Strategy Papers
PUB	Prediction in Ungauged Basins
PWRI	Public Works Research Institute
SADC	Southern African Development Community
SDG	Submarine Discharge of Groundwater
SIDS	Small Island Developing States
TIGER	An initiative led by the European Space Agency focusing on the use of space technology for water resource management in Africa
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-IHE	UNESCO-IHE Institute for Water Education
UNESCWA	United Nations Economic and Social Commission for Western Asia
UNILC	United Nations International Law Commission
UNITWIN	University Twinning and Networking Scheme
UNU	United Nations University
UNU-EHS	United Nations University-Institute for Environment and Human Security
UWMP	Urban Water Management Programme
WCDR	World Conference on Disaster Reduction
WCP	World Climate Programme
WCRP	World Climate Research Programme
WHO	World Health Organization
WHYMAP	Worldwide Hydrogeological Mapping Assessment Programme
WMO	World Meteorological Organization
WSSD	World Summit on Sustainable Development
WWAP	World Water Assessment Programme
WWDR	World Water Development Report



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