



United Nations Educational,  
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The International Year  
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# A World of **SCIENCE**

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## EDITORIAL

# Water for a **thirsty planet**

**A**s Mikhail Gorbachev put it, 'Just as we are moved by water, we must now move in order to save it.' Water is intrinsic to our lives and to the ecosystems upon which we all depend. Every day, natural disasters such as floods and droughts, and human-made disasters such as pollution, are damaging this resource and claiming human health and life.

As the world population grows, so too is pressure growing on our rivers, lakes and groundwater aquifers. In many parts of the world, competition is increasing between users fighting for their share of clean, usable water. Are agricultural demands more important than using water for energy production? Are demands of urban populations more important than rural needs? Should we allow the natural environment to suffer through changing river flows or tolerating pollution? All water uses are interlinked, so only an integrated approach to water management will work.

Upstream users affect the quantity and quality of waters available to downstream users; and users along the course of a shared river or aquifer must agree on realistic and sustainable use of the resource if conflict is to be avoided. 'If you are looking for reasons to fight', Uri Shamir has said, 'water can provide you with one. But if you seek peace, water makes a good bridge for co-operation.' The examples in the present issue of Lake Titicaca and the Columbia River show how water sharing can work.

In 2000, the Director-General of UNESCO, Mr Koïchiro Matsuura, announced the creation of the United Nations system-wide World Water Assessment Programme composed of 23 agencies and convention secretariats, and hosted by UNESCO. The primary product of this Programme is the *World Water Development Report*, the first edition of which is to be launched on 22 March at the 3rd World Water Forum in Kyoto (Japan).

Another key event later in the Year will be the Pan-African Conference on Water Resources Management in Addis Ababa (Ethiopia), co-organized by UNESCO's International Hydrological Programme.

The International Year of Freshwater is a year of opportunity, a Year in which we, as individuals, communities, countries and as a 'global village' must come to understand the urgency of protecting and reviving our life-sustaining water resources.

W. Erdelen  
Assistant Director-General for Natural Sciences

# The International Year of **Freshwater**



It is no co-incidence that the first *World Water Development Report* is being published by the United Nations during the International Year of Freshwater, which kicked off in January.

‘A global water crisis is threatening the security, stability and environmental sustainability of all nations, particularly those in the developing world’ warns Gordon Young, Co-ordinator of the World Water Assessment Programme which will be producing a *World Water Development Report* every three years as part of a collective on-going assessment of water resources by the United Nations. ‘The International Year of Freshwater will strive to alert people to this crisis’.

The first *Report*, to be launched on World Water Day on 22 March, provides comprehensive evaluation and monitoring of the planet’s hydrological resources. It includes, for example, the first global map of groundwater resources, recently produced by UNESCO, the International Association of Hydrogeologists and the Commission for the Geological Map of the World.

‘Groundwater is going to be increasingly important in the future’, says Andras Szollosi-Nagy, Director of UNESCO’s International Hydrological Programme (IHP).

‘More than one billion people lack access to safe drinking water and more than 2.4 billion are without adequate sanitation. At the World Summit on Sustainable Development in Johannesburg in September, governments pledged to reduce the proportion by half by 2015. To meet this goal, we must better assess and manage groundwater supplies, which offer tremendous potential but are nevertheless extremely vulnerable to pollution and over-use’.

‘There is also an ethical issue’, says Szollosi-Nagy. ‘At the Summit, we stressed that access to water should be recognized as a basic human right. For UNESCO, water is not just a commodity but a common public good. It is, however, essential to recover the costs of providing people with water in order to manage the demand. At the core of any discussion on privatization, there should be a firm legal recognition that the resource is a common public good.’

The IHP strives to provide the scientific studies, policy advice and training required for better management of national and international water supplies. This covers a wide array of issues stretching from the ethical use of fossil water (which can be thousands and even millions of years old) to flood control.

One example of this interaction is HELP<sup>1</sup>, a joint UNESCO/WMO programme launched in 2000 which is forming a global network of catchments to improve ties between hydrology and the needs of society. ‘Real people, real catchments, real answers’ is the programme’s motto. Scientists, managers and policy experts come together at HELP catchments to solve local water-related problems (touching on food security, human health, environment, etc.) and thereby combat poverty. One example of a HELP catchment is the Thukela river basin in South Africa, where balancing the allocation of water between user groups is a key issue<sup>2</sup>.

## We’re slipping backwards

‘Ten years ago, we were in a better position to monitor hydrological conditions than today,’ says Szollosi-Nagy. ‘Many governments reduced monitoring and research budgets. But this short-term approach ends up costing them more, as is so clearly seen with the catastrophic flooding events in Europe last year, for example. There is considerable speculation that the floods were related to climate change. It is too soon to confirm this. However, there is no denying that anthropogenic factors aggravated the situation. To begin with, better monitoring means better predictions. In addition, there is a lack of infrastructure to deal with periodic floods.’

The situation is even worse in developing countries. In 20 years, Africa will lose half of its reservoir capacity to



People living in favelas near the river in Rio de Janeiro, Brazil. Each year around the world, more than 700 million tons of human waste are disposed of into waterways. A further 500 million tons of industrial waste pollute the world’s water





*Women carrying water in Antigua (Guatemala). Only 0.26% of the world's freshwater is stored in lakes and rivers. The remainder exists in the form of groundwater (30%) and ice and snow*

sedimentation. Silt from the rivers is accumulating at dramatic rates and this is exacerbated by erosion resulting from deforestation and poor land management. If the current rates continue, many of the major reservoirs will be so silted up that they won't be able to operate properly, provoking major cuts in electricity, irrigation and drinking water supplies,' warns Szollosi-Nagy, referring to an IHP database that is tracking sedimentation flows in rivers around the world.

### Learning to share resources

There are over 260 transboundary basins around the world. In 2001, UNESCO and the NGO Green Cross International, founded by Mikhail Gorbachev, launched a major project on water diplomacy, entitled From Potential Water Conflicts to Co-operation Potential, within the larger framework of the World Water Assessment Programme. Initially, the project focused on developing innovative approaches to resolve brewing conflicts on five international river basins: Okavango, Volta, La Plata, Jordan and Incomati.

Although shared water resources are a potential source of conflict, they can also provide a solid basis for co-operation. Lake Titicaca is a positive example (see p. 13), as is the Columbia River system shared by the USA and Canada<sup>3</sup>.

The Columbia River system drains over 670,000 km<sup>2</sup> in western North America. It descends 810 m over less than 2000 km, which places it among the world's leading potential sources of hydroelectric power. On two of the Columbia River's major tributaries, Canada and the USA are both upstream and downstream parties. Two treaties and a joint commission regulate the River's shared management.

1. *Hydrology for the Environment, Life and Policy*  
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 3. [l.salame@unesco.org](mailto:l.salame@unesco.org)

## The IHP and regional co-operation

UNESCO's International Hydrological Programme (IHP) was established in 1974. It is an intergovernmental programme, so UNESCO's Member States play a key role in shaping each phase. The current sixth phase, which winds up in 2007, is devoted to the theme of 'Water Interactions: Systems at Risk and Social Challenges'.

Regional co-operation is an important aspect of the IHP's global programme. UNESCO staff work closely with some 163 National Committees and Focal Points.

The IHP has a network of regional and international centres operating under the auspices of UNESCO. These are a cornerstone of UNESCO's strategy to improve scientific understanding of the water cycle and water resources management:

- Regional Centre on Urban Water Management (Tehran, Iran), formally established in February 2002
- Regional Centre for Training and Water Studies of Arid and Semi-arid Water Studies of Arid and Semiarid Zones (Cairo, Egypt), formally established in December 2001
- UNESCO-IHE Institute for Water Education (Delft, Netherlands), formally established in 2003.

The Water Centre for Arid and Semi-arid Regions of Latin America and the Caribbean (La Serena, Chile) is to start up in 2003 with Flemish funding. Other centres in the pipeline are:

- Regional Centre for the Management of Shared Groundwater Resources (Tripoli, Libya), under the auspices of UNESCO and WMO
- Regional Center on Urban Water Management for Latin America and the Caribbean (Bogota, Colombia)
- Regional Centre for Ecohydrology (Warsaw, Poland)
- Regional Centre on Drought for Sub-Saharan Africa (site yet to be identified)
- International Groundwater Resources Assessment Centre (site yet to be identified).

The IHP and the new UNESCO-IHE Institute for Water Education are planning a strategic meeting in July 2003 on Water-related Education and Human Capacity-building. A 'Type 2' initiative endorsed at the Johannesburg Summit by the name of GOUTTE of Water (goutte being the French noun for "drop") will be launched officially in Delft. The expanded acronym stands for the Global Observatory of Units for Teaching, Training and Ethics of Water. Based on environmental ethics, peace-building and the promotion of excellence, GOUTTE of Water will stimulate education, training, research and innovation through collaboration and exchange programmes. Partners include the Suez group and AMGA, a company which supplies water to the Italian city of Genova.

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 or go to: [www.unesco.org/water/ihp](http://www.unesco.org/water/ihp)



## A community chips in to improve its water supply

In 1999, the coastal village of Maileppet suffered from seasonal outbreaks of diseases due to the contamination of its water. It was one of several villages on the island of Siberut (Mentawai Islands, West Sumatra) to be studied within the preparatory phase of a UNESCO project on water use. Maileppet was chosen for the project's pilot phase, which consisted of building a water supply system in the village with financial support from the Royal Netherlands Embassy in Jakarta.

The participatory 'bottom-up' approach of the project meant that all community members were directly involved in designing and building the water supply system and in developing specific regulations for sound water management and for the maintenance of the whole infrastructure. After the installation of a gravity-type water supply system in June 2000, more than 700 people could rely on easy access to clean water.

This project represents an important example of community-based water management in an indigenous setting. It was implemented in collaboration with the Indonesian Institute of Sciences and a local anthropologist.

Home to 60% of the world population, coastal areas, including small islands, are among the most densely populated regions on Earth. These areas are subject to extraordinarily intensive use by industry, commerce, agriculture, aquaculture and tourism. This causes multiple problems: conflict between different uses of coastal land and waters, overexploitation of resources, discharge of wastes and effluents, increasing risks of storm surge disasters and heightening stress caused by sea-level change and coastal population growth.

UNESCO is co-ordinating the session on Water Management in Coastal Zones and Small Islands at the World Water Forum. The Type 2 partnership on Isotope Techniques for Sustainable Water Resources and Coastal Zone Management, launched by UNESCO, IAEA and other partners at the World Summit on Sustainable Development, will be presented during the session.

For further information in Jakarta: [g.arduino@unesco.org](mailto:g.arduino@unesco.org) or (on the Forum session): [l.mandalia@unesco.org](mailto:l.mandalia@unesco.org)



A local man fixes the tap onto the water tank



Tienfala village, Mali. A child born in the developed world consumes 30-50 times as much water as a child in the developing world

Through the new project, the UNESCO-IHE Institute for Water Education will be providing training in various aspects of shared water management, including institutional arrangements. As a starting point, UNESCO is using an inventory of existing transboundary basins, including the Columbia River, to identify what works and what doesn't in shared basin management.

Over 95% of the Earth's useable freshwater is stored as groundwater. Human dependency on aquifers is intensifying. The pressures of the modern world have led scientists to augment groundwater resources through artificial recharge. A three-year study in this area was launched in July 2002. Based in India and Nepal, the study is being led by the British Geological Survey, in collaboration with government agencies, NGOs, universities and the IHP, and with funding from the UK Department for International Development.

Between now and 2007, the IHP will be establishing guidelines for managing transboundary aquifer resources and shared river basins within its Internationally Shared Aquifer Resources Management (ISARM) programme. A guiding principle will be for surface water and groundwater to be considered as interdependent systems rather than managed separately. A Type 2 partnership, ISARM was launched by UNESCO, the International Association of Hydrogeologists and others at the Johannesburg Summit. At a meeting next June in Peru, the partners will launch an inventory of transboundary aquifers in the Americas, in collaboration with the Organization of American States.

One example of a shared transboundary aquifer is the Kalahari/Karoo multi-layered aquifer shared by Botswana, Namibia and South Africa (predominantly used in Namibia). The aquifer is all the more treasured in that it provides freshwater in a very arid environment. The water is used by local communities of Botswana and South Africa for drinking and for watering stock. In Namibia, it is being used increasingly for irrigation. The major issue for all three countries is to obtain a proper understanding of the aquifer – where is the major



## An early warning system for Africa's polluted urban aquifers

Half of the world's predicted population of 6.5 billion will live in towns or cities by 2010 and the bulk of population growth will be concentrated in the developing world. In Africa, urban growth rates are accentuated by the problems of severe climatic conditions, desertification and poverty, which affect many areas of the continent and cause migration of rural populations towards big towns. As a major source of water in many African cities, urban aquifers will need to meet the growing demand for water. But they will also have to cope with increasing sources of urban pollution, such as organic chemicals, pesticides, nitrates, heavy metals and waterborne pathogens.

As UNESCO programme specialist Emmanuel Naah points out, 'It is economically impractical and may sometimes even be technically impossible to clean up urban aquifers once they become polluted over a large area. Consequently, in the long-term, polluted urban groundwater will either be abandoned, leading to acute water shortages, or require complex and expensive treatment systems to avoid placing public health in jeopardy.'

An IHP project launched from UNESCO's Nairobi Office in 2002 will assess the impacts of pollution on aquifers in 10 African cities: Abidjan (Côte d'Ivoire), Dakar (Senegal), Cotonou (Benin), Accra (Ghana), Ouagadougou (Burkina Faso), Bamako (Mali), Niamey (Niger), Lusaka (Zambia), Addis Ababa (Ethiopia) and Mombasa (Kenya). The project will assess the damage caused by the uncontrolled groundwater development and indiscriminate waste disposal which have accompanied urban expansion and resulted in growing water scarcity and deteriorating water quality.

'The idea is to provide a robust system of monitoring', Naah explains, 'to give legislators and water managers early warning so that they can take timely action against pollution.'

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Only metres from a well in a residential part of Niamey, children and goats clamber over dumped household and human waste



A pond used as a dumping ground for household waste and discarded machinery, Niamey

recharge area located, for example, and would the aquifer be able to sustain large irrigation schemes? – so that it can be effectively assessed, monitored and managed jointly to avoid conflict between irrigation and sustainability. It is ultimately planned to develop a 'groundwater treaty'<sup>4</sup>.

### Where do we go from here?

An important output from the *World Water Development Report* will be the production of indicators of water-related stress. These will provide a simple yet effective means of comparing different countries and regions of the world. One of the 'end-products' of the World Water Assessment Programme, the indicators will eventually provide the basis for recommendations.

This first *Report* emphasizes that wise governance can only come about when the knowledge base is secure. It also

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demonstrates that, while education, indigenous knowledge and scientific technologies can each exist in isolation, there is an increasing focus on finding integrated solutions to water problems, solutions that take into account all aspects of knowledge, both traditional and scientific, taking from one to enrich the other. The San Bushmen of the Kalahari Desert in South Africa, for example, rely on age-old techniques to find water. At selected sip-wells, they compact sand around a straw fitted with grass filters at either end. When water has accumulated, they suck it out through the



## UNESCO rolls out red carpet for Year

To promote the International Year of Freshwater, UNESCO Director-General Koïchiro Matsuura has appointed HRH Prince Talal Bin Abdul Aziz Al Saud, of Saudi Arabia, as the Organization's Special Envoy for Water.

HRH Prince Talal's commitment to humanitarian causes and development have won him international acclaim. He has been a relentless champion of democracy, human rights and particularly the rights of girls and women (he founded the first private girls' school in Riyadh), while holding ministerial positions in the Saudi government.

Today, he is president of AGFUND-Development, the Arab Gulf Programme for United Nations development Organizations, which is tackling the issue of water scarcity through its network of affiliated institutions. AGFUND has so far contributed to 27 water projects worth US\$30 million.

As UNESCO Special Envoy for Water during 2003, HRH Prince Talal is drawing the attention of heads of states, specialists, civil society and youth to the looming world water crisis. Everywhere he travels, whether to major international conferences like the 3<sup>rd</sup> *World Water Forum* in March or to smaller gatherings with community-based organizations, he is emphasizing the need to act. Some 2.7 billion people will face serious water shortages by 2025 if consumption patterns and inefficient use go unchanged.

For further information on the Year, contact:  
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or go to: [www.wateryear2003.org](http://www.wateryear2003.org)

straw and store it in ostrich eggs which are then sealed for later retrieval.

Water management is most effective, the *Report* reveals, when it involves all members of a community. Although, traditionally, women have been excluded from water management policy and project implementation, experience shows that their participation, and even leadership, is beneficial. One illustration of this is Limai, Cameroon, where women raised the necessary investment funds to improve their village's domestic water supply by cultivating a communal field. Once the project was instigated, the village men were invited to participate.

Ultimately, the goal of the International Year of Freshwater is to bring home to each and every one of us that we all have a part to play in averting the looming world water crisis.

Amy Otchet<sup>5</sup>, Eliza Bennett<sup>6</sup> and Alice Aureli<sup>7</sup>

5. UNESCO Office of Public Information

6. WWAP

7. IHP specialist

## SESAME breaks new ground

At a ground-breaking ceremony on 6 January, UNESCO Director-General Koïchiro Matsuura announced the official launch of the International Centre for Synchrotron light for Experimental Science and Applications in the Middle East (SESAME). The ceremony celebrated the acceptance of SESAME's statutes by the seven founding members.

His Majesty King Abdullah II of Jordan laid the cornerstone for the building at Al-Balqa' Applied University, the future site of SESAME, in the presence of Matsuura and other UNESCO officials, members of the Jordan Cabinet, the Deputy Director-General of the Department of Nuclear Sciences and Application of the International Atomic Energy Agency (IAEA), Werner Burkart, and other dignitaries.

SESAME is an independent centre created under the auspices of UNESCO in much the same way that UNESCO assisted in the creation of the European Organization for Nuclear Research (CERN) 50 years ago. SESAME's founding members are Bahrain, Egypt, Iran, Israel, Jordan, Palestinian Autonomous Territories and Turkey. They now form the SESAME Council which, among other responsibilities, will provide the annual operating budget. Kuwait is an Observer. Other countries are expected to join soon. Libya has already asked to become an Observer. Several countries outside the Middle East that were Observers to the Interim Council are also expected to reconfirm their Observer status in the new Council, among them Armenia, Cyprus, France, Germany, Italy, Japan, Russia, the UK and USA.

The SESAME Council replaces the International Interim Council that has met nine times since being formed in 1999. Herwig Schopper, former Director-General of CERN, has been elected to continue as President of the Council with Khaled Toukan, Minister of Education of Jordan, and Dincer Ulku of Hacettepe University in Turkey continuing as Vice-Presidents.

The Government of Jordan is providing the site and has agreed to fund the construction of the building, estimated at



Koïchiro Matsuura unveils the commemorative plaque to applause from HM King Abdullah II of Jordan

© Photo: Royal Photographer, Jordan



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*The future SESAME building*

US\$6–8 million. It will house the upgraded BESSY I light source donated by Germany. The upgraded ring will be in the 2–2.5 GeV range. The building has been designed (see figure) by civil engineers from Al-Balqa' Applied University on the basis of the ANKA synchrotron radiation facility at the Karlsruhe Research Centre. With the bidding process now over, construction is due to begin soon.

Six scientific and technical workshops and courses have been held in the Middle East on topics relating to the project and 30 scientists and engineers from the Middle East have spent up to two years working at synchrotron radiation laboratories in Europe and the USA. Financial support for these activities has come from Members of the International Interim Council, UNESCO, synchrotron radiation laboratories in Europe and the USA, IAEA, International Centre for Theoretical Physics (ICTP), US Department of Energy, Japanese Society for the Promotion of Science and other sources.

The SESAME staff currently consists of a Technical Director and Administrative Director. Other appointments are in progress. Four Advisory Committees (Technical, Scientific, Beam Lines, and Training) report to the SESAME Council.

*For further information, go to: [www.sesame.org.jo](http://www.sesame.org.jo)*

## E-learning comes to **India's blind**

**The first e-learning centre for the blind in India opened its doors on 22 November at the National Council of Education Research and Training in New Delhi, India. The centre is the first in a series of institutions which will ultimately bring distance learning to more than 2 million blind children.**

Ten Braille terminals have been installed in the centre and connected to the ten work-stations on the Local Area Network. A ZOOM text software and Braille printer complete the

equipment. The project officer, Mohamed Miloudi, UNESCO expert in distance education, spent 22 and 23 November training staff at the center, technicians, educators and persons working with visually impaired children how to use the SAID–SYSTEM and WebSAID (which use Windows and Internet respectively). The technologies were also demonstrated to the representatives of each of India's states and to various organizations, such as the National Institute for the Visually Handicapped and Indian Association for Special Education and Rehabilitation. UNESCO New Delhi has contributed US\$115,000 in project costs to the Indian Government.

The Asia–Pacific region has by far the largest number of children with special education needs worldwide. Poverty, accident and malnutrition are some of the causes. Owing to the large numbers, the region has been slow in providing quality education to all children and young persons with special needs.

One in five Indians are school-age children. And one in ten of these 200 million children has special needs. It is estimated that there are more than 2 million blind children in India. It is thus crucial for the country's socio-economic development to introduce more efficient educational and training methods.



*A blind student familiarizing himself with the Braille terminal (his left hand is touching the tactile screen)*

One of the obstacles delaying introduction of Braille technology into India until now has been the cost of the technology. By designing a low-cost technology that can be manufactured within India, Miloudi has overcome that. The new technology gives the blind access to computer software and hardware developed especially for their needs, such as the tactile screen which fixes onto the PC and uses the standard keyboard. The system also repeats aloud each letter typed on computers equipped with speakers. Besides bringing knowledge to their fingertips, the new technology enables the visually impaired to communicate via e-mail to correspondents around the world.

The next step of the Indian project, launched in November 2001, will be to set up an open virtual library containing the courses. Existing educational courses will be adapted and made accessible to the visually impaired, in addition to new courses produced for the Indian market. All will be freely accessible on-line.

'If all goes well, we should see a centre of this type in every Indian state within a few years and a special terminal for the blind installed in every cyber café across the country', says Miloudi. 'The idea is also to replicate the Indian experience in other countries of Asia and the Pacific'.

Since 1996, UNESCO has implemented other projects using Braille technologies in Morocco, Egypt, Saudi Arabia and, most recently, Qatar. The Noor Institute project in Qatar is co-funded by AGFUND and the Commercial Bank of Qatar and was inaugurated by UNESCO's Director-General, Koichiro Matsuura, on 2 January 2002.

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## Avicenna virtual campus prepares for first intake

**On 9 January, the operational stage of the Mediterranean Avicenna campus was launched at a meeting involving Mohamed Miloudi of UNESCO's Division of Science Policy and Analysis and the 'work-package leaders': the Open University (UK), Universidad Nacional de Educación a Distancia (UNED) in Spain and, in France, the Conservatoire national des arts et métiers (CNAM), Centre national d'enseignement à distance (CNED) and Université euro-méditerranéenne sans murs (UM).**

Named after Ibn Sina (981–1037 AD), the most famous physician, philosopher, encyclopedist, mathematician and astronomer of his time, the Avicenna virtual campus involves 15 countries of Western Europe and North Africa. UNESCO is principal co-ordinator of the programme, to which the European Commission contributes €3.7 million through its EUMEDIS<sup>8</sup> programme.

Avicenna comes at a time when the traditional university system in the South can no longer cope with the demand for tertiary education. Strong demographic growth, coupled with economic constraints, has led governments in North Africa and elsewhere to limit enrolment in public universities by quota systems and other means. Only some of the overflow is being absorbed by foreign and private universities.

The first operational stage will consist of staff training in administration and distance teaching methods. Knowledge officers from the participating centres will be trained in how to interact with the media engineers and professors, while tutors will be shown how to interact with students for a given course. The training will be kicked off by a session run by the CNED and international experts in e-learning on 17 March for the directors of all the Avicenna centres. This will be followed by training of the centres' technical and educational experts, including a session on 30 June organized by the CNED.



*The Avicenna knowledge centres in 15 countries*

At a second stage, existing course materials in scientific and engineering disciplines will be adapted to distance teaching, 5% of which will be adapted for blind students. Each centre will then use these as a starting point for production of its own materials. 'Cross-fertilization' of the different contents made available by participating universities will be encouraged and credits gained by students from one centre will be acknowledged by other participating universities. The science and engineering courses and virtual library will be made available to a first intake of some 3000 students in January 2004. Student numbers are projected to rise exponentially.

For further information (in six Mediterranean languages): <http://avicenna.unesco.org>

## The OCEANS programme charts new seas

**The Open Science Conference for the Oceans hosted by UNESCO's Intergovernmental Oceanographic Commission (IOC) at UNESCO headquarters on 7–10 January has moved a step closer towards a major international project which should boost interdisciplinary work in oceanography among physicists, chemists and biologists around the world.**

The conference gathered input from the scientific community to the fledgling Ocean Biogeochemistry and Ecosystem Analysis (OCEANS) programme, which is being designed to further understanding of the ocean's sensitivity to global change within the broader Earth System.

Faced with the daunting challenge of global change, the scientific community has resolved to develop Earth System Science. This effort attempts, for the first time, to conduct an integrated study of the Earth as a single functioning system responsible for the existence and maintenance of life on Earth.

As part of this effort, the International Geosphere–Biosphere Programme (IGBP), Scientific Committee on Oceanic Research (SCOR) and UNESCO-IOC are already co-sponsoring the Global Ocean Ecosystem Dynamics project



(GLOBEC). After appropriate endorsement from its governing bodies, UNESCO-IOC expects to co-sponsor OCEANS along with IGBP and SCOR.

OCEANS will seek to understand the impacts of climate and anthropogenic forcings on the structure, function, diversity and stability of food web dynamics and on elemental biogeochemical cycles. It will also strive to understand – and predict – how these linked systems respond to global change brought about both by natural climate modes, such as the El Niño–Southern Oscillation and North Atlantic Oscillation, and by human activities.

Some parts of the ocean are likely to be particularly sensitive to long-term changes. These ‘hot spots’ often occur in critical domains such as regions of upwelling and deep mixing, continental margins, high-latitude areas, the sediment-water interface, the mesopelagic layer and intermediate waters. ‘Hot spots’ will be subject to intensive study.

The Open Science Conference for the Oceans was co-sponsored by IGBP, SCOR, the International Council for Science (ICSU), US National Science Foundation and UNESCO-IOC.

In the Conference’s wake, a Science Plan containing an implementation strategy is being drawn up with a view to launching OCEANS in 2004.

*Further information, go to: [www.igbp.kva.se/obe](http://www.igbp.kva.se/obe)*

## A life devoted to popularizing environmental science

**Venezuelan journalist Marisela Salvatierra is the winner of UNESCO’s Kalinga Prize for the Popularization of Science 2002. The prize comes in recognition of her remarkable 26-year career in science communication and environmental education in Latin America.**

Ms Salvatierra receives the sum of £2,000 and a UNESCO Albert Einstein Silver Medal. As holder of the Ruchi Ram Sahni Chair, which comprises a token honorarium of US\$2,000, she will travel to India for a period of two to four weeks as the guest of the Government of India. The Ruchi Ram Sahni Chair was introduced by the Government of India in 2001 to mark the prize’s 50th anniversary.

During her stay, Ms Salvatierra will interact with the Indian scientific community, young students and the public at large to

8. Euro-Mediterranean Information Society  
9. Source: National Library of Venezuela

convey her personal message in science popularization and establish ties with India.

‘Science communication opens people’s eyes’, she believes, ‘combats the scourge of pseudo-science and democratizes the benefits of knowledge, since one of the objectives of science popularization is to enable the majority to participate democratically in the discoveries of the minority.’

Ms Salvatierra produces and conducts the weekly radio programme on environmental analysis, Evolution, and directs the Foundation on Environmental Communication Development (Fundecam).

She is a former Professor of Journalism on Environment and Development, and Environmental Education, at the Social Communication School of the Central University of Venezuela. She has been President of the Environmental Commission of Venezuela’s Scientific Journalism Circle and was responsible for environmental issues at the National School of Journalists. She was also a driving force behind the National Programme of Development and Consolidation of Environmental Journalism in Venezuela, which included the design of an environmental training programme for active journalists.

For ten years, she headed the government programme of environmental analysis. She has also worked as Editor-in-Chief of the magazine *Profauna*, as Editor of the technical magazine, *Environment*, and as the Venezuelan correspondent for the Latin American edition of *Environment Watch*.

Ms Salvatierra regrets that the production of scientific literature for children and the general public in her home country is modest. ‘There are currently only 45 titles for children, 40 for teenagers and 450 for the general public’, she notes<sup>9</sup>. Among Salvatierra’s own titles are *Atmospheric Pollution*, *The Process of Environmental Deterioration in Venezuela’s History*, *The Animal Population in Venezuela* and *Why do we get flooded?* from the series Cuadernos Maraven.

The annual Kalinga Prize for the Popularization of Science was created by UNESCO and the Kalinga Foundation Trust in India in 1951 to encourage a dialogue between scientists and the general public. Some six Nobel Prize laureates figure among past recipients.

Each year, applications for the Kalinga Prize must reach UNESCO via the candidate’s National Commission for UNESCO by 15 May.

*For further information, go to:*  
[www.unesco.org/science/pao/global.htm](http://www.unesco.org/science/pao/global.htm);  
*for the list of National Commissions:*  
[www.unesco.org/ncp/natcom/](http://www.unesco.org/ncp/natcom/)

Marisela Salvatierra



## Parliamentarians call for international forum on S&T policy

**Parliamentarian science committees from 31 countries have called for the setting-up of an international forum grouping parliamentary science committees, the scientific community and representatives of civil society.**

The recommendation came on 14 January at the end of a two-day workshop in Helsinki on Science, Technology and Innovation – a Parliamentary Perspective. The three organizers, the Parliament of Finland, ISESCO and UNESCO, have been invited to establish such a forum, in consultation with national, regional and international parliamentarians. The Helsinki Declaration adopted at the workshop lays out the forum's objectives. It will serve to foster closer co-operation among policy-makers, parliamentarians, scientists, journalists, the public and private sectors and civil society at both national and international levels, and support capacity-building by science parliamentary committees in emerging democracies. Given that regulation is a universal necessity, the forum should also stimulate discussion on the merits of harmonizing the guiding principles regulating applications of scientific and technological research.

Speaking from the workshop, Amuriat Oboi Patrick, the chair of a science and technology (S&T) commission set up last year by the Parliament of Uganda, urged all parliaments in African countries to set up S&T committees to increase the effectiveness with which S&T were integrated into socio-economic development.

SciDev.Net<sup>10</sup> reports Patrick as saying that, if such committees were set up across the African continent, they could establish a network for sharing knowledge and experience. Although a significant number of countries in Africa – including Nigeria, South Africa and Kenya – do have such committees, many do not. In addition to inadequate investment in S&T, Patrick identified the problem of limited collaboration and information exchange within and beyond the African continent. 'Africans need to wake up and work together to ensure that, as a continent, they are developing S&T', he said.

Patrick's proposals were supported by Mozambique's Minister for Research and Higher Education, Lídia Arthur Brito, who told SciDev.Net that a forum in which best practice in S&T could be shared was a 'great idea'.

The January workshop has already offered parliamentarians an opportunity to learn 'key analytical lessons' from one another's national and regional experiences. Participants have

10. [www.scidev.net](http://www.scidev.net)

heard for example how the Committee for the Future operates within the Finnish Parliament or the European Parliamentary Technology Assessment Network.

All agreed in Helsinki to focus more on deepening understanding of innovation processes, increasing investment in science education and in research and development and on strengthening the conditions for basic research.

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## Scientists to debate virtues of a European Research Council

**Life scientists are meeting at UNESCO Headquarters on 19 February to share their views on the feasibility of establishing a European Research Council (ERC).**

The aim would be to encourage European scientific research to regain some of the ground it has lost to the USA in recent years, partly as a result of reduced funding. An ERC would complement the existing European Commission Framework Programme and various National Research Council programmes in support of high-quality basic research at the European level.

The prospect was discussed at a meeting last October in Copenhagen (Denmark) under the Danish presidency of the European Commission and has also been debated by the European Molecular Biology Organization (EMBO) and European Science Foundation (ESF). What is missing at this stage is a clear, co-ordinated scientific perspective on the topic.

The meeting is being organized by the European Life Sciences Forum, a coalition of independent organizations, in conjunction with EMBO, the Federation of European Biochemical Societies and UNESCO.

Three Nobel Prize laureates in Physiology or Medicine (Christiane Nüsslein-Volhard, Germany 1995; John Sulston, UK, 2002; Rolf Zinkernagel, Switzerland, 1996), as well as François Gros of the Pasteur Institute (France), will give their personal opinions at a morning session, followed by an open discussion. In the afternoon, there will be panels of prominent life scientists, national funding agencies, international organizations and representatives of the European Commission.

The outcome will be presented to European Commissioner Philippe Busquin and a final report will be circulated widely to ensure that the scientific community is aware of its conclusions.

*For further information, contact:* [m.nalecz@unesco.org](mailto:m.nalecz@unesco.org)  
or go to: [www.elsf.org](http://www.elsf.org)



# Katepalli R. Sreenivasan

## For global scientific excellence

A physicist who has earned an international reputation for his studies of statistical physics and turbulence, Katepalli R. Sreenivasan takes up his duties as Director of the Abdus Salam International Centre for Theoretical Physics (ICTP) in March. More than 4000 scientists from the developing world visit ICTP each year to take part in research and training related to high-energy physics, mathematics, condensed matter physics, the physics of weather and climate and a host of other fields in which physics and mathematics play a major role. Sreenivasan speaks about his hopes and plans for the institution he is about to lead.

### What prompted you to apply for the position of ICTP director?

When I was about 12, my family priest taught me a prayer and said I was to recite it 108 times a day: 100 for myself and eight for the rest of humanity. If I did not find the time for 108 recitations, I should then do 25 for myself and eight for humanity. The point is that, no matter how much or how little one does for oneself, one should always contribute a constant amount to humanity. Coming to ICTP and furthering its causes may be my way of contributing to the rest of humanity.

### What do you view as ICTP's greatest strengths?

On the whole, the science done here is very good. In Italy, the scientific institutions in Rome, especially those in physics and mathematics, may be generally regarded as the nation's best but, according to the opinions I have gathered, ICTP and the rest of the scientific institutions that comprise the Trieste System rank very highly in quality. In the world at large, there are a few other institutions with visitor programmes similar to those found at ICTP, for example the Institute of Theoretical Physics in Santa Barbara (USA) and the Newton Institute in Cambridge (UK).

Yet ICTP is unique in its mandate, which involves not merely serving the global scientific community but also paying particular attention to the needs and concerns of scientists from the developing world. ICTP must attract and retain the best scientific talent that it possibly can and, at the same time, promote and support world-class science in the developing world. Excellence is at the heart of what the Centre does and that is what I intend to support during my tenure in

*Katepalli R.  
Sreenivasan*

Trieste. I should also emphasize that the centre's excellence is in no small measure due to the work of its dedicated staff.

### ICTP operates under a tripartite agreement between the Italian government, UNESCO and IAEA. How do you view the relationship with each?

ICTP's relationship with the Italian government and the Italian scientific community is very good. I have met a few government officials, including the Italian ambassador to UNESCO, Francesco Caruso, and they have expressed nothing but praise for the Centre's work. Their interest, I think, is driven by two overall concerns. Firstly, they want to be proud of the Centre and its contributions to science, especially in the developing world. Secondly, I think they would like ICTP to become better known among the Italian citizenry. That is something I intend to work on. The Italian government has been generous in its support of ICTP and it is quite reasonable for them to expect that the public knows as much as possible about the Centre.

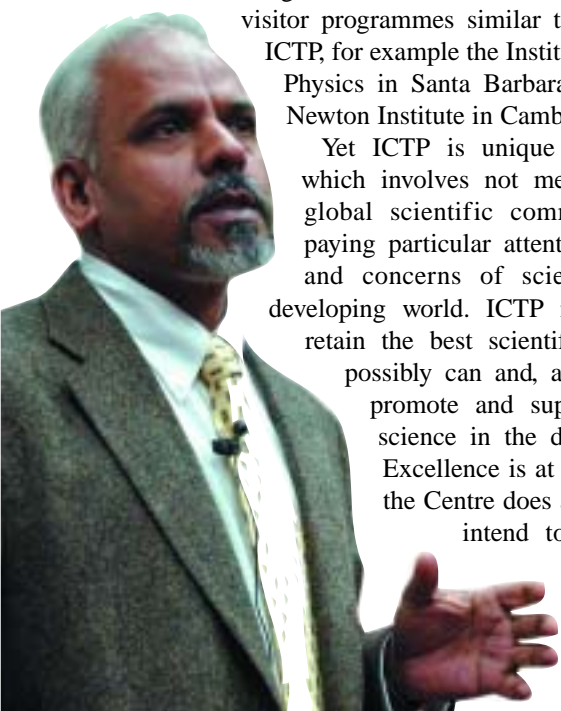
ICTP has good working relationships with Trieste's other scientific organizations, often sharing their resources and expertise in ways that make the entire system stronger than any of its individual components. I support that.

ICTP's relationship with IAEA is strong and I think the increased number of joint activities now taking place have added value and strength to this partnership. IAEA understands the need for academic freedom within ICTP.

As for UNESCO, there is enormous potential to tap in terms of the avenue it provides to its member states. I fully intend to capitalize on this advantage. Conversely, I think UNESCO can tap ICTP's scientific expertise to its advantage in a number of ways. There's a great deal of common ground worth exploring and, if cultivated properly, this could serve the goals of both bodies well. In early discussions with UNESCO, we have agreed to work closely on several activities.

### Could you explain the broad focus of your research and how you plan to pursue it in Trieste?

Broadly speaking, my area of research involves the understanding of a wide range of non-linear and



non-equilibrium problems, with a focus on turbulent flows. I was the founding chairman of the American Physical Society's Topical Group on Statistical and Non-linear Physics. There are people at ICTP and next door at the International School for Advanced Studies in condensed matter physics and other fields and I see myself developing close ties with them. There are also people in Rome, in particular, but also in Milan and Padua, who have conducted world-class research in these areas and I intend to interact with them.

On an international level, I have worked in India, Australia, the USA and elsewhere, forging close collaboration with a broad range of people within my field. Here, too, I plan to maintain my contacts. As a result, my research at the Centre will not only be connected to ICTP but also to scientific communities in Italy, Europe and the rest of the world. This approach conforms to the spirit of international science, which is not confined to one neighbourhood but welcomed in many places around the world.

**What, specifically, has your research on turbulence entailed?**

My research includes turbulence in the atmosphere, oceans, aerodynamics, blood vessels and even home-heating systems. The major challenges facing those studying turbulence is to understand how properties vary as a control parameter is increased and to relate these aspects to the governing equations.

One specific problem my colleagues and I have been working on recently is thermal convection: studies of the motion of fluid to better understand how thermal energy is transported from one part of a system to another, say, from the centre to the edge of the sun; or from the centre to the surface of the earth; or, more simply, from the bottom to the top of a heated pot of water. Typically, the experiments consist of a container with fluid (helium at a few degrees Kelvin) that is heated on the bottom. The fluid on the bottom of the container expands and becomes lighter, causing it to rise to the top. Meanwhile, the fluid at the higher levels of the container, which is colder and denser, tends to sink to the bottom. This creates a continuous motion representing a form of turbulence.

The description makes the process sound deceptively simple but it is not. For example, small changes in boundary conditions can lead to dramatic changes in behaviour that are far from easy to understand.

**The challenges that ICTP faces today differ vastly from those it faced at its inception in 1964. How should ICTP respond to these?**

If you read some of the speeches that ICTP's founding director, Abdus Salam, gave during the 1960s and 1970s, you come across passages praising the Soviet Union's

scientific enterprise and suggesting that other nations, particularly developing nations, carefully examine those efforts for guidance in designing their own scientific enterprises. Salam, of course, was not the only person expressing this opinion. The same argument today would carry less weight. You simply cannot talk about science organizations in the same political and social context in which they were debated 30 or 40 years ago. Nevertheless, when ICTP was launched, the Cold War was in full tilt and the Centre served as a forum where fruitful East–West exchanges took place.

Now the scientific community faces challenges that sometimes have a similar ring: most notably, the inability of scientific communities to interact because of political and diplomatic circumstances beyond their control. For example, scientists working in universities and government research laboratories in the USA would like to interact with scientists from Iran at conferences and other events. But such interaction has proven difficult because of the severed diplomatic relations between the two nations. There is no reason why ICTP could not serve as a bridge between the scientific communities in these two nations in much the same way that it served as a bridge between East and West during the Cold War. ICTP's function must be first and foremost to do and develop good physics but in the process it can serve as a facilitator promoting mutual understanding among nations, especially those that are isolated from, and suspicious of, one another. ICTP, after all, is part of the larger world and simply cannot ignore what divides and endangers humanity.

When ICTP was created, the state of science throughout the developing world was not advanced. Today the situation is different. Some countries like the Republic of Korea have done very well. China and India, for example, have a few scientific institutions that rank among the best in the world. Yet, the quality of basic science in these same countries is still far from uniform and has actually declined in some instances. Other countries have done worse. As a result, today there is no single strategy for promoting science in the South and ICTP has to devise different innovative policies for different countries. Whether we should target some countries and work more diligently with them may be something to consider. I am not sure this is the best way to proceed but it is unrealistic to think that one can elevate every country to a high level of scientific excellence in a short time. We must understand the needs of different countries and devise different strategies. If history is any guide, the Centre can make a tremendous difference and I look forward to being part of this effort.

Interview by Daniel Schaffer<sup>11</sup>

<sup>11</sup> The full interview will appear in *ICTP Newsletter* N°103: [www.ictp.trieste.it](http://www.ictp.trieste.it)



# Journey to the **highest lake in the world**

Lake Titicaca is a region of mystery and legend. Originally inhabited by the now-extinct Urus, it has been dominated successively by Aymara warlords, Quechuas of the Inca empire and Spanish conquerors. In the 16th century, the advanced Tiahuanacu civilization spread out from its banks to inhabit the entire Andean region before mysteriously disappearing.

Today, Lake Titicaca is inhabited by the Aymara and Quechua peoples. Despite four centuries of Spanish colonization, their lifestyle has changed little; it still revolves around agriculture, their only source of wealth.

Lake Titicaca straddles the border of Bolivia and Peru; it is perched in the highest plateaux, or Altiplano, of the Andes mountain range. The largest lake in Latin America, Titicaca is also the highest navigable lake in the world and, according to Inca beliefs, the Sacred Lake, origin of human life. It is also the only example of joint sharing of a lake in the Americas.

Lake Titicaca is the largest of the four major river basins which make up the Titicaca basin system, the others being Desaguadero River, Lake Poopó and Coipasa Salt Lake. The three-tiered Titicaca basin system consists of a mountain ridge with altitudes of over 4200 m, slopes of 4000–4200 m and the Altiplano of 3657–4000 m where we find Lake Titicaca, the most densely populated part of the system. The system's two million inhabitants are divided evenly between Bolivia and Peru.

Of the five major rivers running into the lake, four run through Peruvian territory. Ramis River to the north is the largest of these, representing 26% of the tributary basin.

In the basin, summers are usually wet and winters dry. The climate is that of a high mountain region with a tropical hydrological regime. Rainfall varies from as little as 200 mm to 1400 mm a year, with maximum rainfall at the centre of the lake. Logically, the zone around Lake Titicaca is humid; as you move towards Coipasa Salt Lake, formed by the evaporation of overflow from Lake Poopó, the basin becomes increasingly arid.

At such a high altitude, there is a lack of vegetation and water but no lack of sunlight. Despite the very strong solar radiation in the basin, the air temperature varies greatly, from a low of  $-10^{\circ}\text{C}$  to a high of  $23^{\circ}\text{C}$  depending on latitude, longitude, altitude and proximity to the lake.



*Pre-Columbian terraced agriculture lakeside for the production of potatoes and quinoa*

Lake Titicaca is home to over 60 varieties of birds, including the Titicaca flightless gube. Some 18 varieties of native fish species have been identified and as many amphibians. Perhaps the most famous of these is the giant Titicaca frog discovered by the French oceanographer Jacques Cousteau in the 1960s. Measuring 30–45 cm in length, it can weigh up to 5 kg. The frog is found only on the bottom of the lake and is completely blind.

## **Grinding poverty chases away the young**

Poverty is the most critical social problem in the Titicaca Basin system. It forces families to devote all their energy to survival and pushes the rural population, especially the young, to migrate to cities where they swell already crowded slums. There is 22% adult illiteracy, although this varies according to area and is higher for women.

A Bolivian born today can expect to live 62 years, compared to 68 years in Peru (and less in the basin system). Health problems stem from the endemic poverty and, by extension, from poor nutrition and lack of clean water and sanitation. As many as 71% of children suffer from chronic

**THE TITICACA BASIN SYSTEM**

**Basin area**

Lake Titicaca.....	56,300 km <sup>2</sup>
Desaguadero River.....	29,800 km <sup>2</sup>
Lake Poopó.....	24,800 km <sup>2</sup>
Coipasa Salt Lake.....	33,000 km <sup>2</sup>
<b>Total area.....</b>	<b>143,900 km<sup>2</sup></b>

**Lake Titicaca**

Average area.....	8,400 km <sup>2</sup>
Average height.....	3810 m
Average depth.....	45 m
Average volume.....	930 km <sup>3</sup>
Maximum length.....	176 km
Maximum width.....	70 km
Maximum depth.....	283 m

**Desaguadero River**

Length.....	398 km
Average flow.....	70 m <sup>3</sup> /sec
Average gradient.....	45 cm/km

**Lake Poopó**

Average area.....	3191 km <sup>2</sup>
Average height.....	3686 m

**Coipasa Salt Lake**

Average area.....	2225 km <sup>2</sup>
Average height.....	3657 m

Source: Binational Autonomous Authority of Lake Titicaca, 2002



Source: AFD/EC, 2002. Prepared for World Water Assessment Programme

*At 14° South latitude, the Andes range divides into eastern and western ridges. These harbour a closed system of rivers which all flow into Lake Titicaca*

malnutrition in Peru and 84% in Bolivia and there is 14% child mortality. Some health problems are compounded by ancient traditions; resistance to child vaccination for example has been overcome only by legal enforcement.

**A fragile environment**

The environment surrounding the lake is fragile, subject to flooding (around Lake Titicaca), drought (in the central and southern parts) and, increasingly, to pollution.

Groundwater is scarce and aquifers recharge slowly because of the dry conditions. The water of Lake Titicaca and its tributaries is normally saline with salinity increasing downstream and reaching a peak in the aptly named Coipasa Salt Lake, where evaporation is high and rainfall only 200 mm/year.

Mining occupies only 3–4% of the basin population. It consumes little water but has contaminated the southern part of the system with heavy metals. Mercury and arsenic concentrations of 0.4 ppm for example have been found in mackerel captured in Puno Bay. Puno Bay is also contaminated by wastewater from the sewers of Puno City in Peru, which has led to eutrophication (i.e. plant decomposition). The high incidence of gastrointestinal diseases can be attributed to the deficient disposal of

wastewater from the cities of Juliaca (Peru) and Copacabana (Bolivia), as well as to the agricultural activities and animal husbandry around the lake.

Water is used essentially for basic needs and for agricultural irrigation. Increasing access to the water supply alone will not improve local living conditions. Unhealthy drinking water and sewage systems also need to be modernized and access to sanitation throughout the basin needs to be raised to well over the current 17.2% of the population. As much as 80% of water for drinking and sanitation returns to the system as sewage.

**WATER USE IN AGRICULTURE**  
(in basin system)

Use of system's water for agriculture.....	48%
Shared water for agriculture.....	90%
Irrigated land as percentage of total productive land.....	0,43%
Water used for irrigation which returns to system.....	25%
<i>(ie not lost through evaporation or transpiration)</i>	

Source: Binational Autonomous Authority of Lake Titicaca, 2002





Photo: C. Fernandez-Jauregui

Members of an Aymara women's co-operative packing produce. Women play a major role in the basin communities



Photo: C. Fernandez-Jauregui

Members of an Aymara men's co-operative in a greenhouse covered by a plastic roof. The holes in the mud walls serve to ventilate the 'hot house'

**Widespread subsistence agriculture**

Agriculture occupies 73% of active Bolivians, compared to 59% of Peruvians. In the basin system, yields are generally low because of limited use of sown seeds, fertilizers and machinery, coupled with the ravages of drought, floods and frost. Only 34% of the land is arable and most of the soils have organic matter and nitrogen deficiencies.

The Aymaras and Quechuas use ancestral crop-breeding technologies that are remarkably efficient; they have developed over the centuries, for example, 50 varieties of potato and the high-protein quinoa bean. Minimizing risk matters more to them than maximizing production.

Land fragmentation and a complex traditional property system which superimposes communal property over individual holdings makes only small-scale subsistence agriculture possible. This has repercussions for the sharing of Lake Titicaca, both at the macro (both countries) and micro (basin system) levels.

**A Master Plan for joint ownership**

In the mid-1950s, the Bolivian and Peruvian governments agreed to examine the possibility of a binational management system of Lake Titicaca. The Binational Autonomous



Photo: C. Fernandez-Jauregui

An Aymara women's co-operative plants trees to reforest the upper part of the basin and thereby control flooding

WATER FOR BASIC NEEDS (in basin system)		
	Bolivia	Peru
Access to clean drinking water (%)	24	19
Access to sewage system (%)	13	20
Daily water consumption (in litres)	30	50

Source: Binational Autonomous Authority of Lake Titicaca, 2002

Authority of Lake Titicaca was created in four stages: an evaluation of resources, design of a legal framework, identification of a management model and implementation of a Master Plan. The Plan included a development strategy for irrigation and drainage, a strategy for water regulation of the system, an environmental survey and analysis, and a conservation plan.

Since the Binational Authority was created in 1993, information on water resources in the basin system that had previously been scattered among different institutions in Bolivia and Peru has been consolidated. The data in the Master Plan have also since been systematized and standardized by both countries.

The joint ownership model put in place by the Binational Authority applies to the entire Titicaca basin system; it ensures integrated management of the water system involving risk management, assigning value to water, water resource sharing, good governance, a firm knowledge base and sound policies.

In 2001, the first dam was completed close to the international bridge over the Desaguadero River. Although its primary purpose is to prevent flooding, or at least protect the surrounding 6,000–10,000 hectares from floods, the dam also offers protection to the vast fish populations and aquatic vegetation. In addition, the dam provides Peru with 50,000 hectares of secure irrigation and Bolivia with a further 15,000 hectares.

### Recipes for alleviating poverty

Poverty undermines every effort to prioritize solutions to Lake Titicaca's problems. One way of alleviating poverty would be to invest more in public health services. Another could be to increase the irrigated surface area of the basin. Productivity loss through lack of irrigation helps to perpetrate poverty. Developing the irrigation potential would require a more detailed evaluation of water reserves and development of extensive natural gas reserves to provide cheap energy to power the scheme. One possible means of implementing more efficient agricultural technologies would be to pass legislation promoting co-operatives to manage farms of a more adequate size.

The challenge facing the Binational Autonomous Authority today is to provide an enabling environment in which culturally sensitive development and resource-sharing may flourish.

*Based on the case study of Lake Titicaca  
published in the World Water Development Report (2003)  
Water for People, Water for Life.*

## The pastoralists of **Wadi**



The arid lands of the world cover one-third of the Earth's surface, fall within territories of over 110 national governments and are home to some 700 million people. Wadi Allaqi Biosphere Reserve in southern Egypt is one of these.

The main headache for the populations of hyper-arid, arid or semi-arid areas is the scarcity of freshwater. The nomadic populations in Wadi Allaqi live in an area where rainfall occurs only once every few years. Only a deep knowledge of the local ecosystem and the nomad's sustainable utilization of resources, particularly pasture, help them to survive. They know the names of all 130 plant species growing in the surrounding desert and use almost all of them in their daily lives, including for food and medicine, animal fodder, domestic artefacts and for charcoal and firewood.

### Surviving in a hostile environment

Most arid lands are, at best, only suited to pastoral livestock keeping. The traditional system was, and still is in some areas, essentially nomadic or transhumant, with seasonal movement of flocks in search of water and grazing. Pastoralists and nomads represent the main population of the vast desert areas, arid grasslands and steppes. Nomadic populations have not only survived in but also helped maintain the natural habitats on which they depend by both regenerating and



# Allaqi



Wadi Allaqi Biosphere Reserve. 'Wadi' is an Arabic word meaning the bed or valley of a temporal stream in regions of southwestern Asia and northern Africa that is usually dry, except during the rainy season when it often forms an oasis

A woman investigates a flooded plain in the downstream part of Wadi Allaqi. The water stored in Lake Nasser, formed by the Aswan High Dam, has brought new opportunities to the Bedouins, enabling them for example to cultivate plots on the shores of the lake. The plains remain flooded for 3–6 months

LAND USE IN ARID REGIONS	
Nomadic pastoralism .....	41%
Ranching .....	25%
Rain-fed agriculture (on the margins of the desert) .....	12%
Hunting, fishing, gathering .....	3%
Irrigated agriculture .....	2%
Practically unused .....	16%

Source: Clarke, J. and Noin, D. (1998) Population and Environment in Arid Regions, p.5. UNESCO Publishing and Parthenon Publishing Group.

exploiting renewable natural resources. The astonishing capacity of this system is that it enables human survival in very hostile environments.

The pastoralists living in Wadi Allaqi adjust to highly seasonal rains falling unpredictably over different areas by keeping mobile to take advantage of changes in availability of pasture. In traditional society, there is substantial mutual support through sharing (or giving) of grazing land, animals or their products. In a severe drought, nomads migrate further into grazing land of other tribes or even into other countries.

For example, in 1986 many Sudanese nomads and their livestock were seen in the Eastern Desert deeply inside Egyptian land.

The pastoralists also conserve fodder by postponing the use of dry-season pasture for as long as possible. They diversify their holding with grazing and browsing species (sheep, goats and camels), and even manage to optimize milk production and ensure rapid herb recovery after a bad year by maintaining a ratio of males and females in their livestock.

### Dryland development a low priority

Dryland development has been a low political priority in recent decades because the people affected have little political influence. For political reasons, pastoralists have been both pulled and pushed towards sedentarization to control the movement of nomads across national borders. However, even though a sedentary lifestyle would offer pastoralists the chance to secure land tenure and improve social services, this may not be the best remedy in the long term to the problem of dryland neglect. By settling, they would be unable to use the dryland pasture sustainably. Sedentarization leads to concentrated grazing on the more easily accessible lands and to cultivation of marginal lands. This results in land degradation under the impact of severe overgrazing, destruction of natural vegetation and soil erosion.

12. Upton, M. 1995. Integrated management Report. in Sustainable Range-Dependent Small Ruminant Production Systems in the Near East Region. FAO Near East Regional Office, Cairo



*Pastoralists making coffee in the upstream part of Wadi Allaqi near the Sudanese border*

The introduction of modern technology has been responsible for much of the degradation and desertification of rangelands in many Near Eastern regions, according to Upton<sup>12</sup>. The use of vehicles to carry animals, feed and water through the rangelands has made pasture easily accessible and increased the number of animals, resulting in overgrazing. Vehicle tracks have not only damaged vegetation but also destroyed the seed bank, which is only source of plant propagation in desert pasture. On top of that, they have caused soil erosion. Uncontrolled drilling of wells has also led to larger herds and again, overgrazing. Moreover, lowering underground water can limit the water supply of the deeply rooted trees and shrubs which are the main source of fodder in the driest season.



*A Bedouin woman shows a researcher (second from left) how to make bread (using flour bought from a passing caravan)*

### The ecotechnie approach to sustainable development

Wadi Allaqi was incorporated into UNESCO's World Network of Biosphere Reserves in 1993. Like all Biosphere Reserves, it is divided into zones to accommodate different forms of land use. There are two core areas which are strictly protected. They are surrounded by a buffer zone where conservation is emphasized but where people also live and work and the whole is encircled by a transition area promoting sustainable development. In this way, the Biosphere Reserve brings together different actors whose interests may not seem compatible at first sight.

The UNESCO-Cousteau Ecotechnie Chair manages a research station in Wadi Allaqi. The station runs an interdisciplinary programme linking education, ecology, economics, social sciences and technology within the ecotechnie approach.

The Chair was established at the South Valley University's Unit of Environmental Studies and Development (UESD) in Aswan (Egypt) in November 1997, in recognition of its outstanding contribution to the field of multidisciplinary research and applied studies towards the sustainable development and protection of natural resources in Egypt as a whole and in Wadi Allaqi Biosphere Reserve in particular. On 13 November 2002, it was one of 17 UNESCO Chairs singled out for an award at the three-day UNITWIN World Forum organized by UNESCO<sup>13</sup>.

Ecotechnie adheres to the UNCED<sup>14</sup> definition of sustainable development, namely that of 'the management and development of natural resources within the ethical constraints that relate to responsibilities of the present

13. See A World of Science, Vol.1, No. 2, p. 9

14. United Nations Conference on Environment and Development (Rio, Brazil, 1992)

15. Draz, O. (1981) An International Programme for Range Management and Sheep Feeding for the Near East and North African Countries. FAO. Rome



*The nomadic tribes return periodically to their wooden dwellings*





© South Valley University

*Small plots cultivated by Bedouins. These crops serve as animal fodder*



© South Valley University

*Children minding goats in the downstream part of Wadi Allaqi*

generation towards future generations'. In arid lands, the hema system is an example of the kind of environmental ethics which are inherent to sustainable development. This traditional form of communal tenure was developed in the Arab Heartland. Certain areas belonging to Bedouin tribes were declared as hema, meaning protected and off-limits. Access to these areas was restricted by inter-tribal agreements or by force. According to Draz<sup>15</sup>, 'the Arabian hema is probably the world's oldest effective range conservation system'. It still operates today in a limited form.

### **Working hand in hand with the local people**

The interdisciplinary team working from the UESD provides Wadi Allaqi with logistic support. It also involves the local populations in all stages of the design, planning and implementation of dryland development in buffer and transitional zones, a precondition for successful management of any Biosphere Reserve.

One of the activities in which local people participate is the collecting and sharing of information. For example, the Bedouins' indigenous knowledge of plant uses combined with advanced technology, including the different irrigation methods for cultivation of desert plants, provided the basis for the establishment of a demonstration farm of economically important indigenous plants.

For any activities undertaken in this area, local people are informally consulted; when asked what plants they would like to see cultivated in the buffer and transition zone, for example, they opted for medicinal and fodder plants.

If decisions as to which indigenous plants should be cultivated and where are made in consultation, the local people alone decide when and where to take their livestock for grazing. The Biosphere Reserve managers don't attempt to exert any influence, even if it is a core area, as long as there is no overgrazing.

*A Bisharin tribesman helps researchers to converse with members of his tribe who do not speak Arabic*

Local people also act as guides for tours of remote areas of the biosphere reserve and work as rangers, on experimental plots, at the Conservation Centre and at the Field Station.

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The UNESCO–Cousteau Ecotechnie Chair at South Valley University co-ordinates the Arab Region Ecotechnie Network (AREN) linking itself and the Universities of Bahrain, Jordan, Mohamed V (Morocco), Khartoum (Sudan), Damascus (Syria) and Sana'a (Yemen).

Irina Springuel and Ahmed Belal

*For further information, contact the UNESCO–Cousteau Ecotechnie Chair: [irina44@yahoo.com](mailto:irina44@yahoo.com)*

*Read also about eco-tourism in Wadi Allaqi: [www.unesco.org/mab/qualityEconomies/WadiAllaqi.pdf](http://www.unesco.org/mab/qualityEconomies/WadiAllaqi.pdf)*



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## Diary

### 7-11 April

**The use of ICTs in reporting on the science of HIV/AIDS**, workshop for women communicators, University of Makerere, Kampala (Uganda): s.hughes@unesco.org; www.scidev.net

### 7-16 April

**Empowerment of Women with Traditional Knowledge for Sustainable Utilization of Local Biological Resources**, regional training workshop organized by UNESCO New Delhi with National Botanical Research Institute, Lucknow (India): s.mehn@unesco.org

### 9-11 April

**1<sup>st</sup> International Conference on Climate Change and Tourism**, organized in Djerba (Tunisia) by WTO with UNESCO-IOC, IPCC, UNEP, WMO, UNFCCC, UNCCD: www.worldtourism.org/sustainable/climate/brochure.htm

### 23-24 April

**IDRC/UNESCO Review of Science, Technology and Innovation Systems**,

UNESCO Paris, Room 14; contact: f.osotimehin@unesco.org

### 25 April

**International Consultation on UNESCO S&T Policy Programme**, UNESCO Paris: f.osotimehin@unesco.org

### 27 April - 10 May

**Sea Level Data Analysis, GLOSS training workshop**, Kuala Lumpur (Malaysia) IOC: t.aarup@unesco.org

### 5-24 May

**WMO Congress**, Geneva (Switzerland); IOC and WMO are co-operating on Global Ocean and Global Climate Observing Systems and Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology: c.summerhayes@unesco.org

### 15 May

**Deadline for applications for Kalinga Prize** (see p. 9) and other UNESCO science prizes, for info: y.nur@unesco.org

### 17-18 May

**Basic Sciences and emerging pathogenic factors**, meeting organized by UNESCO and European Academy of

Arts, Sciences and Humanities (EAASH) at Polish Academy (Paris), to establish network associating UNESCO, EAASH, WHO, FAO and Office international des epizooties: l.hoareau@unesco.org

### 30 May

**Deadline for new biosphere reserve nominations from MAB National Committees**: www.unesco.org/mab/

### 4-6 June

**IOCARIBE-GOOS Steering Committee** at TOS Americas Meeting/Oceanology International, New Orleans (USA): c.summerhayes@unesco.org

### 5 June

**IGOS Partnership meeting** UNESCO Paris, co-chaired by NOAA and UNESCO: r.missotten@unesco.org www.igospartners.org

### 24 Jun - 4 July

**IOC Assembly**, UNESCO, Paris: ioc@unesco.org

### 30 June

**Distance training for Avicenna centre staff**, organized by CNED (France), see p. 8.

## New Releases

### UN World Water Development Report: Water for People, Water for Life

*Published by UNESCO and Berghahn Books on behalf of 23 United Nations agencies comprising the World Water Assessment Programme hosted by UNESCO. English only until 2004, 700 pp, US\$49.95*

First in triennial series; covers various water resource challenges around the world and is based on the highly specific real-world conditions of pilot case studies (see pp. 2-6 and 13). Purchase from www.unesco.org/publishing

*An Executive Summary is available in Arabic, Chinese, English, French, Russian and Spanish, as well as Bahasa Malay, Japanese and German. View at www.unesco.org/water/wwap or request a copy from: MERIC, Cairo: order@mericonline.com; MDC, Kuala Lumpur: mdcpp@mdcpp.com.my; Peking University Press: zpup@pup.pku.edu.cn; (English and French) UNESCO Publishing: c.laje@unesco.org; UNO-Verlag, Bonn: fischer@uno-verlag.de; Hara Shobou, Tokyo: naru@harashobo.co.jp; VES MIR, Moscow, Komarova@vesmirbooks.ru; Mundi-Prensa, Madrid, pedidos@mundiprensa.es*

### Traditional Ecological Knowledge for Managing Biosphere Reserves in South and Central Asia

*UNESCO, Oxford and IBH Publishing Co. Pvt. Ltd, India; English only, 536 pp.: s.mehn@unesco.org*

### Managing conflicts over resources and values: continental coasts

*Results of a UNESCO workshop in Maputo, Mozambique, November 2001. CSI paper 12, English only, 86 pp: csi@unesco.org*

### Computer-based Training in Physics (CD-ROM)

*Covers topics in mechanics, optics and semiconductors for undergraduate physics students. English only. Developed by UNESCO New Delhi in collaboration with Jawaharlal Nehru University. Educational institutions may request a free copy from Messers Jayakumar and Alam: newdelhi@unesco.org*

### Managing Trans-Boundary Nature Reserves: Case Studies on Sunderbans Mangrove Ecosystems in Bangladesh and India

*English only, occasional papers: s.mehn@unesco.org*

*For sales publications: www.unesco.org/publishing  
UNESCO science portal: www.unesco.org/science*

## Governing Bodies

### UNESCO's Executive Board will be in session from 31 March to 16 April

In his report to the Board under agenda item 3.1.2, the Director-General will be describing progress in implementing the International Year of Freshwater. He will also be reporting on the ad hoc committee of experts on an international basic sciences programme, which convened recently on the Board's recommendation.

The Director-General's report will embrace follow-up to a number of science-related events, including the World Conference on Science (1999), World Summit on Sustainable Development (2002) and International Seminar on Forward-looking Approaches and Innovative Strategies to Promote the Development of Africa in the 21<sup>st</sup> Century and in Support of NEPAD (2001).

In the area of bioethics, the Director-General will be reporting on the Round Table of Ministers of Science on Bioethics (2001) and on measures taken to evaluate the impact of the Universal Declaration on the Human Genome and Human Rights adopted in 1997.

Moreover, under item 3.1.1 of the agenda, the Director-General will be reporting on the preparation of an international declaration on human genetic data (document 166 EX/11).