



United Nations Educational,
Scientific and Cultural Organization

Poverty and reefs
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Natural Sciences
Quarterly Newsletter

Vol. 1, No. 5

October–December 2003

A World of **SCIENCE**

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EDITORIAL

Talk is cheap

Far from the headlines, Israeli and Palestinian scientists have spent the past four years discussing how to improve the lot of Palestinian children. With the only teaching aid in most schools a blackboard, Palestinian teachers are ill-equipped to help their pupils demystify science. This state of affairs would sadden any scientist. It has spurred this group to act.

Realizing it would be financially unfeasible to equip every Palestinian school with a laboratory, the Al Quds University in East Jerusalem and Bloomfield Science Museum in West Jerusalem imagined an Interactive Science Centre hosted by the former institution and supported by the latter. The centre would enrich the Palestinian science programme by giving children the opportunity to observe natural phenomena and conduct experiments of their own and, at the same time, encourage a vocation for science. The centre could showcase Palestinian research and industry and, by opening its doors to the general public, would foster science popularization.

The project quickly captured the imagination of other partners, including the Andrea and Charles Bronfman Philanthropies (ACBP) in Israel, the Hebrew University of Jerusalem and the University Federico II in Naples (Italy). All took part in a meeting organized by UNESCO, the European Collaborative for Science, Industry and Technology Exhibitions and the *Città della Scienza* in Naples last June to carry the project forward. Now the partners are about to take a travelling science exhibition on the road to build public awareness and raise funds to complement those already donated to the centre by the ACBP, European Union and Napolitan Region.

Talk is cheap. We can talk about the virtues of peace until we are hoarse; it doesn't cost anything and it makes us feel good. But that is not peace-building. Peace-building means translating words into deeds.

SESAME is a word. But it is above all a deed. Or rather, a succession of deeds: there are the scientists from within and beyond the Middle East who have spent the past six years drumming up support for a research centre of international standing for the Middle East by the name of SESAME; there is UNESCO, which has acted as mentor; and Germany, donor of the 'centrepiece', a synchrotron light source; there is Jordan, which has agreed to host the SESAME centre, currently under construction; and there are Bahrain, Egypt, Iran, Israel, Jordan, Pakistan, the Palestinian Authority, Turkey and the United Arab Emirates who have all agreed to share the centre. Deeds, not words.

World Science Day for Peace and Development comes around again on 10 November. It will be an occasion for all of us to ask what we, as scientists, can do to make a difference.

W. Erdelen
Assistant Director-General for Natural Sciences

The water crisis: how has it come to this?

Arguably the strongest message to emerge from the International Year of Freshwater is that the global water crisis will reach unprecedented levels in the years ahead if nothing is done to rectify the current 'inertia at the leadership level'.

This is the sobering prediction of the *World Water Development Report – Water for People, Water for Life* published by UNESCO this year on behalf of 23 United Nations agencies. The report predicts 'growing per capita scarcity of water in many parts of the developing world' because of population growth, pollution and expected climate change.

Water supplies are falling while the demand per capita is dramatically growing at an unsustainable rate. Over the next 20 years, the average supply of water is expected to drop worldwide by one-third,' notes UNESCO Director-General Koichiro Matsuura. 'No region will be spared from the impact of this crisis which touches every facet of life, from the health of children to the ability of nations to secure food for their citizens'.

So, how has it come to this? Simply because, despite widely available evidence of the crisis, political commitment to reverse these trends has been lacking. A string of international conferences over the past 25 years has focused on a great variety of water issues including ways to provide the basic water supply and sanitation services required in the years to come. Several targets have been set to improve



Above: Boats stranded in what used to be a deep-water port in south-west Kazakhstan. The Aral Sea has shrunk to about half its original size and what remains is heavily polluted, an ecological disaster

Opposite page: Cultivating plants in the desert

water management but 'hardly any', says the report, 'have been met. Inertia at leadership level and a world population not fully aware of the scale of the problem means we fail to take the needed timely corrective actions'.

Many countries and territories already in crisis

The report ranks over 180 countries and territories in terms of the amount of renewable water resources available per capita, meaning all of the water circulating on the surface, in the soil or deeper underground (see table for both ends of the scale).

By the middle of this century, at worst seven billion people in 60 countries will be faced with water scarcity and at best 2 billion in 48 countries, depending on factors like population growth and policy-making. Climate change will account for an estimated 20% of this increase in global water scarcity. Humid areas will probably see more rain, whereas precipitation is expected to decrease and become more erratic in many drought-prone regions and even some tropical and sub-tropical regions. Water quality too will worsen with rising pollution levels and water temperatures.

The water crisis 'is set to worsen despite continuing debate over the very existence of such a crisis'. One litre of wastewater pollutes about eight litres of freshwater. There is an estimated 12,000 km³ of polluted water worldwide, which is more than the total amount contained in the world's ten largest river basins at any given moment. If pollution keeps pace with population growth, the world will effectively lose 18,000 km³ of freshwater by 2050 – almost nine times the total amount countries currently use each year for irrigation, which is by far the largest consumer of the resource. Irrigation currently accounts for 70% of all water withdrawals worldwide.

Using treated wastewater could ease the water crisis. Farmers already use this resource for about 10% of irrigated land in developing countries and could use more (see *Tips for improving water availability*).

In terms of water quality, the poor continue to be the worst affected, 'with 50% of the population in developing countries exposed to polluted water sources.' Asian rivers are the most polluted in the world, with three times as many bacteria from human waste as the global average. Moreover, these rivers contain 20 times more lead than those of industrialized countries.

'The future of many parts of the world looks bleak,' says the report, in reference to projected population growth

which will continue to be a driving factor in the water crisis. Per capita water supplies decreased by a third between 1970 and 1990, according to the report. Even though birth rates are slowing down, the world's population should still reach about 9.3 billion by 2050.

'Water consumption has almost doubled in the last 50 years. Meanwhile, water quality continues to worsen [...]. Every day, 6000 people, mostly children under the age of five, die from diarrhoeal diseases,' says the report. 'These statistics illustrate the enormity of the problems facing the world with respect to its water resources and the startling disparities that exist in its utilization.'

'Globally, the challenge lies in raising the political will to implement water-related commitments. Water professionals need a better understanding of the broader social, economic and political context, while politicians need to be better informed about water resource issues. Otherwise, water will continue to be an area for political rhetoric and lofty promises instead of sorely needed actions.'

Health and economics

The overriding problem of the 21st century is that of water quality and management. 'More than 2.2 million people die each year from diseases related to contaminated drinking water and poor sanitation. Water vector-borne diseases also take a heavy toll: about one million people die from malaria each year and more than 200 million suffer from schistosomiasis. Yet these terrible losses, with the waste and suffering they represent, are preventable.'

The international community pledged through the UN Millennium Development Goals (2000) and at the World Summit on Sustainable Development (Johannesburg, 2002) to halve the proportion of people without access to safe drinking water and basic sanitation by 2015. To achieve these targets, an additional 1.5 billion people will require improved access to water supply (by 2015). This means providing services for another 100 million people each year (274,000/day) from 2000 to 2015.

'The challenge for sanitation is more daunting. An additional 1.9 billion people will need improved access, which means another 125 million each year (or 342,000/day) from 2000 to 2015. The report explains that cultural factors further complicate the logistic and financial difficulties in providing adequate sanitation.'

The two extremes in terms of water availability

The 20 water-richest countries and territories* (in m ³ per person per year)	
French Guiana	812,121
Iceland	609,319
Guyana	316,689
Suriname	292,566
Congo	275,679
Papua New Guinea	166,563
Gabon	133,333
Solomon Islands	100,000
Canada	94,353
New Zealand	86,554
Norway	85,478
Belize	82,102
Liberia	79,643
Peru	74,756
Bolivia	74,743
Laos	63,184
Paraguay	61,135
Chile	60,614
Equatorial Guinea	56,893
Panama	51,814

The 20 water-poorest countries and territories (in m ³ per person per year)	
Kuwait	10
Gaza Strip	52
United Arab Emirates	58
Bahamas	66
Qatar	94
Maldives	103
Libyan Arab Jamahiriya	113
Saudi Arabia	118
Malta	129
Singapore	149
Jordan	179
Bahrain	181
Yemen	223
Israel	276
Barbados	307
Oman	388
Djibouti	475
Algeria	478
Tunisia	482
Burundi	566

* Excluding Greenland (10,767,857 m³) and Alaska (1,563,168 m³)

Were current levels of investment to be maintained, all regions in the world could reach or come close to both goals, with the exception of sub-Saharan Africa. But 'in absolute terms, the investment needs of Asia outstrip those of Africa, Latin America and the Caribbean combined.' It is estimated that the first interventions would cost about US\$ 12.6 billion.

Questions remain as to the source of this investment. 'Financing the Millennium Development Goals will probably be one of the most important challenges that the international community will have to face over the next 15 years'. The report outlines debates over water pricing and privatization.

© Yann Arthus-Bertrand/UNESCO



World Water Development Report – Water for People, Water for Life (2003)

Tips for improving water availability

Did you know that you can bolster nature's capacity for replenishing groundwater simply by letting water seep through a river bank? Or by injecting water underground through boreholes? These are two examples of tried and true methods which have demonstrated their sustainability over time.

The water injection method is currently used in major cities like Berlin (Germany) where two-thirds of drinking water is bank-infiltrated. And the same process utilized in Berlin with state-of-the-art monitoring¹ is commonly used in rural India and southern Africa. In these parts, hand-dug pits and dams are used to collect floodwater or seasonal river flow and store it safely from evaporation in the form of groundwater which can later be pumped for use. These simple, low-cost structures can ease water scarcity in arid areas of developing countries through the storage of infrequent excess water.

Soil acts as a natural filter of particles in water, breaking down impurities like pharmaceuticals. In addition to being purified during its passage through the soil, water also leaches beneficial nutrients, thereby improving its quality. Aquifers even have the capacity to inactivate harmful micro-organisms like viruses, a prowess which is the object of intensive research. Thanks to the natural biological, chemical and physical processes occurring underground, treated reclaimed wastewater can be used safely for mostly non-potable purposes, a great asset for arid zones in particular where water is scarce.

Within a project launched with its partners in 2002, the UNESCO-IHP has published a brochure on how to replenish groundwater, entitled *Managing Aquifer Recharge*: <http://unesdoc.unesco.org/images/0012/001278/127843e.pdf>

You will find details of methods employed specifically in the drier regions of the world in a booklet UNESCO is currently preparing with the International Association of Hydrogeologists on *Wise Strategies for Recharge Enhancement in Arid and Semi-arid Areas*. The booklet will be available as of 2004 at: www.unesco.org/water

1. www.kompetenz-wasser.de

'Although it is considered essential to involve the private sector in water resource management, it should be seen as a financial catalyst – not so much as a precondition – for project development [...]. Control of the assets and the resource should remain in the hands of the government and users.'

Any privatization or water-pricing scheme must include mechanisms to protect the poor. 'A disturbing fact is that poor people with the most limited access to water supply have to pay significantly more for water.' In Delhi (India), for example, vendors charge the poor US\$ 4.89 per m³, whereas families with piped connections pay just US\$ 0.01, according to a survey published in the report. In Vientiane

(Lao PDR), vendors charge US\$ 14.68 per m³, compared to municipal tariffs of US\$ 0.11.

Hunger unlikely to be halved before 2030...

About 25,000 people die every day from hunger. An estimated 815 million people suffer from malnutrition: 777 million in developing countries, 27 million in countries in transition and 11 million in industrialized countries. The absolute number of malnourished people is dropping at a much slower rate, despite the fact that 'food production is satisfying the market demand at historically low prices'.

The international community has pledged through the Millennium Development Goals to halve the proportion of people suffering from hunger by 2015. However, by factoring in a distinction between rain-fed and irrigated crops (a distinction not made in previous estimates), the report is able to present more precise projections concerning the water required to feed the world today and in the future: it concludes that the target may not be achieved before 2030. According to these new calculations, another 45 million ha will be irrigated by 2030 in 93 developing countries, where most of the population growth will take place. About 60% of all land that could be irrigated will be in use. This will require a 14% increase in irrigation water.

Of the 170 countries and territories surveyed, 20 are already using more than 40% of their renewable water resources for irrigation, 'a threshold used to flag the level at which countries are forced to make difficult choices between their agricultural and urban water supply sectors'. Most of these are Arab states. Another 16 countries use more than 20%, 'which can indicate impending water scarcity. By 2030, South Asia will have reached the 40% level on average and the Near East and North Africa not less than 58%.'

By contrast, sub-Saharan Africa, Latin America and East Asia are likely to remain far below the critical threshold. These regions will see the bulk of agricultural expansion in the next 30 years.

Pastures and crops take up 37% of the Earth's land area. Irrigation is extremely inefficient – close to 60% of the water used is wasted. This will only improve by an estimated total of 4%. Moreover, About 10% of the world's irrigated lands have been damaged by waterlogging and salinization because of poor drainage and irrigation practices. There is a tremendous need to improve the financing of better technology and to promote better management practices.

...even though food security is growing

On a more positive note, food security is improving globally. Per capita food consumption in developing countries rose from 2,054 kcal per day in 1965 to 2,681 kcal per day in 1998.

Average grain yields doubled between 1962 and 1996, from 1.4 to 2.8 tons/ha/crop. This means that less than half the amount of arable land is now required to grow the same amount of grain. 'By 2030, it is expected that 80% of the increase in crop production will come from higher yields, increased multiple cropping and shorter fallow periods.'

'Towards 2050, the world could enjoy access to food for all,' notes the report. 'The fact that 815 million are presently ravaged by chronic undernourishment is not due to a lack of capacity to produce the required food but to global and national social, economic and political contexts that permit, and sometimes cause, unacceptable levels of poverty to perpetuate.'

We are nonchalantly destroying ecosystems

By 2025, it is predicted that water withdrawal will increase by 50% in developing countries and by 18% in developed countries.

The report describes a vicious circle unleashed by growing water demand. By depleting and polluting rivers, lakes and wetlands, we are destroying ecosystems which play an essential role in filtering and assuring freshwater resources. In the USA, 40% of water bodies assessed in 1998 were not deemed fit for recreational use due to nutrient, metal and agricultural pollution. Furthermore only five out of 55 rivers in Europe are considered pristine, according to the report and, in Asia, all rivers running through cities are badly polluted. Some 60% of the world's 227 largest rivers are severely fragmented by dams, diversions and canals leading to the degradation of ecosystems.

Turning to the animal life of inland waters, the report claims that 24% of mammals and 12% of birds are threatened with extinction. Only about 10% of the world's fish species, the majority from inland waters, have been studied in detail, yet one-third are at risk. Up to 80 known fish species have become extinct since the late 19th century.

When cities become life-threatening

'When infrastructure and services are lacking, urban areas lacking water infrastructure are among the world's most life threatening environments'. According to a survey of 116 cities, urban areas in Africa are the worst served, with only 18% of households connected to sewers, followed by Asia where the connection rate is just over 40%.

'The poor of these cities are the first victims of sanitation-related disease, flooding and even a rising rate of water-borne disease like malaria, which is now among the main causes of illness and death in many urban areas'. In South Asia, for example, the *Anopheles stephensi* mosquito has actually adapted its breeding habits around the ubiquitous rooftop water storage tanks.

'From a public health perspective, it is better to provide a whole city's population with safe supplies to taps within 50 m of their home than to provide only the richest 20% of households with water piped to their home.'

The report outlines several reasons as to why cities and towns should take priority over rural areas when choices must be made. Firstly, the unit costs of the required infrastructure are lower because urban areas provide significant economies of scale and proximity. Secondly, many cities have a more prosperous economic base than rural areas, providing greater possibilities for raising revenues for water provision. Thirdly, 'urban areas concentrate not only people and enterprises but also their wastes.'

Industrial countries produce 80% of hazardous wastes

Today, industry accounts for 22% of total water use in the world: 59% in high-income countries and 8% in low-income countries. The report predicts that this average will reach 24% by 2025 when industry will be using an estimated 1,170 km³/year of water. Every year, 300–500 million tons of heavy metals, solvents, toxic sludge and other wastes accumulate in water resources from industry. More than 80% of the world's hazardous waste is produced in the USA and other industrial countries.

The pros and cons of tapping the hydropower potential

Hydropower is the most important and widely used renewable source of energy, providing about 19% of total electricity production. Industrialized countries are exploiting about 70% of their electricity potential, compared to 15% in developing countries. Canada is the largest producer, followed by the USA and Brazil. Untapped hydro-resources are still abundant in Latin America, India and China.

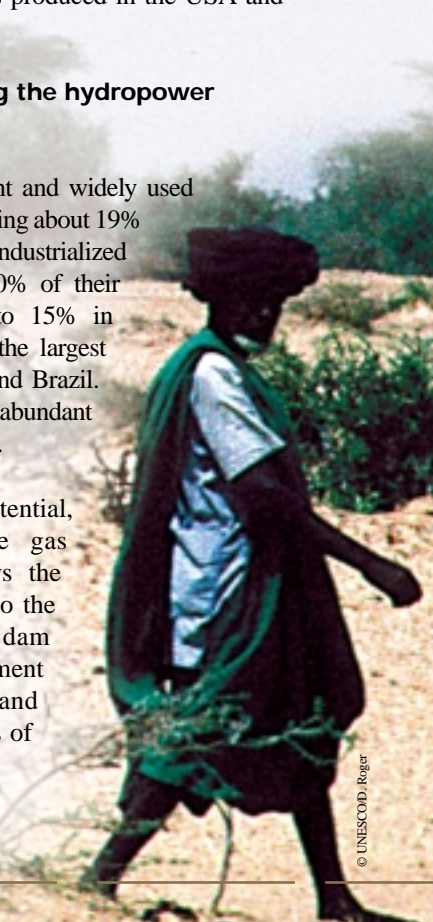
'By developing half of this potential, we could reduce greenhouse gas emissions by about 13%,' says the report. However, it also points to the many negative impacts of dam construction, including displacement of local populations and environmental damage (like loss of biodiversity and wetlands).

Amy Otchet²



In Haiti, a woman bathes her daughter in their courtyard

© UNICEF/N. Toussaint



© UNESCO/Roger

'We are more determined than ever' to help Iraq

UNESCO's Director-General Koïchiro Matsuura has condemned the terrorist bombing of the UN Headquarters in Baghdad on 20 August, in which UN Special Envoy Sergio Vieira de Mello and 21 others died and at least another hundred were injured, as an outrage committed not only against the United Nations but also against the people of Iraq. UNESCO's commitment to help the Iraqi people rebuild their lives and reconstruct their country remains undiminished. 'Indeed, we are more determined than ever to ensure that the victims of yesterday's terrible violence have not died in vain', Mr Matsuura said the day after the tragedy.

UNESCO's 11 international and 25 national staff in Baghdad were unharmed in the attack. Although all of its international staff have since been temporarily evacuated from Baghdad to the north of Iraq or to the Organization's Amman office in Jordan, UNESCO still expects to be able to complete the revision, printing and distribution of five million textbooks in science and mathematics in time for the start of the new school year. The US\$ 10 million textbook programme is being supported by, and undertaken in co-operation with, the US Agency for International Development (USAID) and other partners, including Iraq's Minister of Education, Iraqi educators, textbook specialists, private companies and UN sister agencies.

Through its national staff on the ground, UNESCO is working with the Ministry of Education in Iraq to get the education system functioning again. UNESCO has provided basic materials for the end-of-year examinations to allow children to complete the 2002–2003 school year and is currently equipping educational institutions throughout the country using an additional US\$ 60 million allocated it from the UN Oil for Food programme last June.

UNESCO's *Situation Analysis of Education in Iraq*³ (2003) reveals that Iraq's education system before 1990 was considered by education experts to be one of the best in the Arab region. Education was free, enrolment and literacy rates were high. However, the 1990–1991 Gulf War and subsequent economic sanctions led to the rapid deterioration of the education sector, with a critical shortage of teaching and learning materials, mounting rates of repetition and dropout and a loss of qualified teachers due to poor remuneration and brain drain.

Before the war broke out in March, UNESCO had more than 20 international and 100 national staff working

2. UNESCO Bureau of Public Information

3. <http://unesdoc.unesco.org/images/0013/001308/130838e.pdf>

primarily in northern but also in southern Iraq. The Oil for Food Programme established in 1995 permitted a considerable improvement in facilities and school supplies in northern Iraq, where UNESCO and UNICEF were given responsibility for education. However, in the central and southern regions where the Iraqi government was directly responsible for implementation, programme delivery was slower. Even before the recent conflict, an estimated 24% of children aged 6–11 from the centre and south were out of school.

As a starting point for boosting higher education and scientific research, UNESCO's Division of Science Analysis and Policies is currently approaching academic institutions in the USA and elsewhere, as well as the Abdus Salam International Centre for Theoretical Physics, to propose a consultation between these institutions and the Iraqi Ministry of Higher Education, Iraqi universities and research institutes.

As soon as the security situation allows, it is hoped to open a UNESCO office in Baghdad.

A tailor-made science education programme for Timor-Leste

UNESCO is launching a science education programme in October which has been tailored to the unique situation of the world's youngest country, one of the ten poorest on Earth.

The programme will cover community science education, staff training, the equipping of science laboratories and curriculum development. 'At present', explains Stephen Hill, Director of UNESCO's Jakarta Office, 'we are still identifying participating schools and communities. Over a dozen will be chosen in and around the capital, Dili'.



Children in the schoolyard in the town of Baguia, central Timor-Leste

© Photo Jacques Zahles

The science education programme has been designed to help the government attain its paramount goals of poverty reduction and sustainable development by creating a strong base of scientists, technologists and engineers to assist in building the nation and ensuring the optimal use of natural resources.

There is some urgency. At present, tertiary enrolment in the fields of science and technology is extremely low; moreover, science students are presented with only two options: courses which prepare for secondary school science teaching or agricultural courses. The country has a single public university, the National University of Timor-Leste in Dili; although as many as 18 private institutions have sprung up in Dili recently, these are all very small and none have obtained government accreditation.

The science education programme represents a three-pronged national strategy to foster community awareness of the importance of science education for health, food production and sustainable development; guide government decision-making on key policy issues; and strengthen formal education. Widening the country's narrow education base in science and technology will be a central concern.

The proposed educational methods are innovative and interactive, with the different 'modules' able to be undertaken independently of one another. One module is the 'mentoring' programme involving university students as peer tutors for secondary students. This module is being funded through Japanese Funds-in-Trust to the tune of US\$ 254,000. University students will be trained in how to



© Annette Pipe



Children at the Interactive Science Exhibition in Dili, in July 2003

use interactive science models and equipment featuring displays which demonstrate basic principles of physics, chemistry and biology. Once trained, the university students will work with pupils at schools in small communities.

Hill attended the country's first Interactive Science Exhibition, organized by the government from 4 to 8 July in collaboration with UNESCO and Questacon (National Science and Technology Centre) in Canberra, Australia. Among the educational science shows Questacon show-cased using its own interactive exhibits were demonstrations of how thunder-claps are produced and how oxygen is depleted in water polluted with organic waste.

The pilot exhibition heralded the launch of the Community Science Park which is to be a focal point of UNESCO's science education programme. The public will be able to visit the centre to learn about science and the environment in an entertaining setting. The centre will also serve as a resource for formal science education.

While existing funding is adequate to get the programme off the ground, an additional US\$ 200,000 will be necessary to secure use of interactive science models and displays over the coming two years.

Timor-Leste became the 189th Member State of UNESCO on 5 June. UNESCO's involvement in the country dates back to the late 1990s.

For further information: Jakarta@unesco.org

Education in Timor-Leste	
Population	780,000
Literate population over age of 15*	43%
7-12 year olds enrolled in primary school	73%
13-15 year olds enrolled in junior secondary school	25%
16-18 year olds enrolled in senior secondary school	17%
Adults enrolled in tertiary education	4%

* 37% of rural and 82% of urban populations are literate
Source: UNDP (2002) *Ukun Rasik A'an, the Way Ahead: East Timor Human Development Report*. UNDP, Dili.

Asian teens top performance rating for science and maths

Pupils in Japan, Hong Kong-China and the Republic of Korea lead in mathematics and science, according to a survey of 15-year-olds in 43 countries. By contrast, pupils in several Latin American countries lag seriously behind, even after taking lower national income levels into account.

These are some of the conclusions of a report published in July jointly by the Organisation of Economic Co-operation and Development (OECD) and UNESCO, *Literacy Skills for the World of Tomorrow*, based on data gathered in the context of the OECD's Programme for

International Student Assessment (PISA). PISA administers tests and background questionnaires to between 4,500 and 10,000 pupils in each participating country.

The report compares and analyses data collected in 2002 from 15 mainly middle-income countries and economies (Albania, Argentina, Brazil, Bulgaria, Chile, Hong Kong-China, Indonesia, Israel, Latvia, Liechtenstein, FYR Macedonia, Peru, Romania, Russian Federation and Thailand) with data collected in 2000 from 28 of the 30 member countries of the OECD⁴.

Analysing gender differences, PISA found that boys tend to score better than girls overall in mathematics, except in Albania. There are fewer differences between the genders in scientific literacy, however.

The survey confirms the importance of parental education – and particularly the level of educational attainment of pupils' mothers – in children's learning outcomes. In all countries, pupils whose mothers have completed upper secondary education achieve higher scores in reading, mathematics and scientific literacy than pupils whose mothers have not done so. The difference is most marked in FYR Macedonia, Bulgaria, Argentina and Albania and least evident in the Asian economies.

Sue Williams²

For further information: www.unesco.org/education

Stepping up exploration of inner space

On 3 August, the world's first Earth Observation Summit established an ad hoc Working Group to prepare a 10-year implementation plan for an international, sustained Earth observation system.

The plan is to be developed in association with representatives of more than 30 countries and some 20 international bodies which include the Integrated Global Observing Strategy (IGOS) and UNESCO. The move reflects a deepening awareness that we can no longer afford to neglect the exploration of 'inner space' – the land, atmosphere and oceans that make up our planet.

4. OECD Member States: European Union plus Australia, Canada, Czech Rep., Hungary, Iceland, Japan, Korea (Rep. of), Mexico, New Zealand, Norway, Poland, Slovak Rep., Switzerland, Turkey, USA

Earth observation is nothing new. Satellite and *in situ* (on land and at sea) observations have provided some excellent results over the past 25 years, particularly in the areas of improved weather forecasting, El Niño predictions, earthquake and volcanic eruption precursors and ecological assessments. But the exploration of inner space has long been eclipsed by governments preoccupied by more tangible environmental concerns linked to freshwater availability and quality, deforestation, dwindling biodiversity and other problem areas.

Now, however, we have reached the point where socio-economic development is beginning to interfere with the natural processes that sustain life on Earth. The Kyoto Protocol (1997) implementing the United Nations Framework Convention on Climate Change is just one of several recent agreements which have spawned a new awareness of the risks we are running.

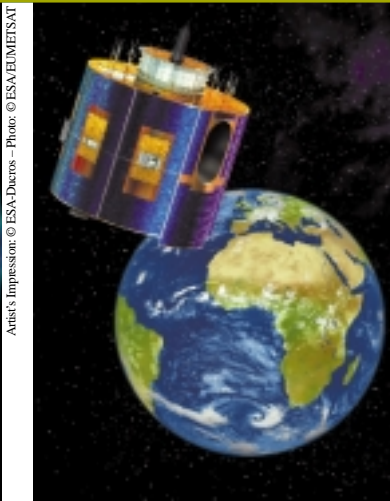
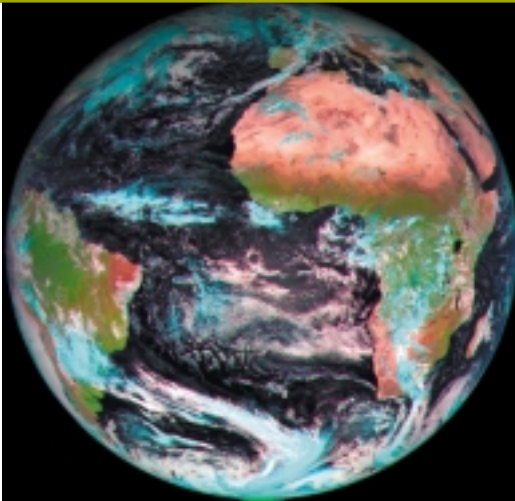
The land, atmosphere and oceans are three interlocking parts of the same Earth system. If we are to pierce the secrets of this complex system, we shall need to approach it in an integrated fashion. This will entail associating not only governments and international agencies but also private interests. The private sector is already making a regular, if discrete, contribution: a great many ships carry current meters, for example, and the greatest source of air pressure observations are airline jets.

Governments first acknowledged the urgency of the situation at the World Summit on Sustainable Development last year. References to the need for an integrated global Earth observation system emerged in the *Plan of Action* adopted in Johannesburg and the topic was again picked up at the G8 meeting in France in June this year. Sensing that the time was ripe for an Earth Observation Summit, the USA took the initiative of hosting the event at the Department of State in Washington DC from 31 July to 3 August.

The Earth Observation Summit recognized that ground observations needed to be much more widespread and better co-ordinated. Take the example of the 1100 observation stations located on land and on boats. These release balloons twice a day to take readings of the atmosphere. The number of stations is largely insufficient but increasing the number of observation posts will have a cost: even maintaining the current

Some 860 Argo floats like the one on the left are currently deployed in the world's oceans. Parked at a depth of 2000 m, the floats measure temperature and salinity by ascending to the surface in a 10-day cycle. The data they provide are made readily available on the Internet (www.jcommops.org) through the Operational Centre of the Joint UNESCO-IOC/WMO Commission of Oceanography and Marine Meteorology and are used for ocean climate variability studies. Deployed by participating nations, the floats have a lifespan of 3–4 years. They are part of the Global Ocean Observing System (GOOS) led by the UNESCO-IOC and its partners





Far left: This image was taken on 29 November 2002 by the new weather satellite, *Meteosat Second Generation (MSG-1)*, which provides crucial information for short and medium-range forecasts. The acquired information includes visible images of weather systems during the day, cloud temperature at night, surface temperature, water vapour, trace gas concentrations and dust particles in the atmosphere. The original images are coloured for ease of interpretation by the user: here, blue depicts cold and pink warmer temperatures

Left: An artist's impression of *MSG-1*

number costs more than US\$ 250 million annually for the balloons alone, a cost borne by a large number of countries within a longstanding UN treaty.

On a scientific and technical level, we already have many of the ingredients for an integrated Earth observation system. But without national and international political commitment, the system cannot be viable. This is because, to be effective, spatial and ground observations have to be comprehensive and uninterrupted. Observations *in situ* or from aircraft and satellite networks need to be exchanged by countries in a full and open manner with minimum delay and at a reasonable cost. Similarly, there has to be a guarantee of continuous monitoring. This is currently not the case. Research satellites, for example, which provide radar observations of the Earth, have a limited life-span. Should one of these satellites 'die', there is presently no back-up satellite foreseen.

Everyone agrees that it would both be too expensive for every country to build its own satellite network and needlessly duplicate efforts. 'This makes it all the more important for the plan to pay sufficient attention to the equitable sharing of data between countries', notes Walter Erdelen, Assistant Director-General for Natural Sciences at UNESCO. 'My organization wants to place emphasis on this to ensure that all countries are in a position to contribute to improving information for sustainable development. UNESCO', he adds, 'will be ensuring that the plan includes provisions for improving the capacity of countries to interpret data and integrate spatial and ground observations'.

For further information: www.earthobservationsummit.org

Satellites to the rescue of **world heritage**

UNESCO and the European Space Agency (ESA) are to encourage the use of Earth observation satellites to monitor more than 730 cultural and natural World Heritage sites, including national parks in Africa that are home to endangered mountain gorillas.

The agreement was signed on 18 June at the Paris Air Show in Le Bourget (France) by UNESCO's Director-General and ESA Director-General Antonio Rodotà. It officially launches the Open Initiative partnership between UNESCO and ESA, which aims to bring all international space agencies on board to assist developing countries in monitoring their World Heritage sites.

Civilian Earth observation satellites can now distinguish details as small as 60 cm wide. This makes them ideal tools for monitoring cultural sites and for mapping changes in land use, even in remote areas.

In April this year, ESA provided significant funding and technical know-how for a joint project with UNESCO called BeGo (Built Environment for Gorilla). This project involves the production of a series of maps of national parks in inaccessible mountain areas (up to 5000 m) in Uganda, Rwanda and the Democratic Republic of Congo (DRC) that are home to the mountain gorilla.



Loss of forest habitat, both to make way for human settlement and to provide fuel, poses the biggest threat to the remaining 600 or so mountain gorillas in central east Africa

The Virunga National Park (DRC) and Bwindi Impenetrable National Park (Uganda) are already World Heritage sites, while the Parc National des Volcans (Rwanda) and Mgahinga Gorilla National Park (Uganda) are candidate sites. The project will compare satellite image archives to assess changes in gorilla habitats in World Heritage sites since 1992. The Government of Belgium is also providing expertise and financial support for these conservation activities in sites in DRC.

Peter Coles²

For further information: www.unesco.org/mab

AIDS fight takes Africa's First Ladies to Venice

A group of Africa's First Ladies was in Venice (Italy) on 1 September for a meeting on 'AIDS in Africa and the threat of new emerging viruses' at the Palazzo Labia and to attend a scientific information conference given by Professor Luc Montagnier. Members of African Synergies, a movement they launched in November 2002 to link the different initiatives fighting AIDS on the continent and mobilize resources at the international level, the First Ladies were in Venice during the international film festival at the invitation of the Italian government and the Veneto region.

The meeting was held within the Families First Africa project which focuses on the problem of mother-child transmission of the HIV virus. Some 800,000 African babies are infected by the virus every year. The Families First Africa project was set up at the end of 2002 by UNESCO and the World Foundation for AIDS Research and Prevention presided by Professor Montagnier. The Foundation has been supported by UNESCO within a co-operation agreement since 1993.

Families First Africa is an integral part of the AIDS Research and Prevention in Africa project, which received a US\$ 2 million



The First Lady of Guinea, Henriette Conte, seen here at the gala with Italian actress Gina Lollobrigida and the President of the Veneto Region, Giancarlo Galan, was in Venice to mobilize support for the "Families First Africa" project, which is developing a vaccine for the newborn babies of HIV-positive mothers

grant from the Italian government in 2002. Professors Montagnier, Robert Gallo of the Institute of Human Virology at the University of Maryland (USA) and Vittorio Collizzi of the Tor Vergata University in Rome are trying to develop a vaccine for the newborn babies of HIV-positive mothers. Africa's First Ladies were the guests of honour at a gala evening on 1 September at the Palazzo Pisani Moretta which raised over € 20,000 in cash donations, as well as generous pledges from numerous film and business personalities, towards a UNESCO solidarity fund for the fight against HIV/AIDS.

For further information: relint@regione.veneto.it or v.nunez-valladares@unesco.org, or: www.unesco.org/science/bes

'First-timers' among new Biosphere Reserves

Among the 15 new sites in 10 countries added to UNESCO's World Network of Biosphere Reserves in July are the first members of the network in Slovenia and Yemen.

Socotra Archipelago Biosphere Reserve in Yemen is an archipelago located at the crossroads of the Red Sea and the Indian Ocean. The site is internationally renowned for its remarkable plant diversity and for its cultural richness, with the area's 40,000 inhabitants speaking the unique Soqotri language.

Julian Alps Biosphere Reserve in Slovenia encompasses the Triglav National Park as a core area. Managed through a co-operative agreement with the three neighbouring municipalities, it focuses on developing high-quality ecotourism based on local products.

The new biosphere reserves and extensions were approved by the Bureau of the International Co-ordinating Council of UNESCO's Man and the Biosphere (MAB) Programme at its meeting on 8–11 July at UNESCO Headquarters. This brings the total number of sites within the World Network of Biosphere Reserves to 440 in 97 countries.

At its July meeting, the MAB Bureau also selected the winners of this year's Sultan Qaboos Prize for the Environment. The US\$ 20,000 prize goes jointly to the Centre for Ecology (Centro de Ecología) in Venezuela and to the Norwegian biodiversity specialist Peter Johan Schei, who was nominated by UNEP.

The MAB Bureau also acts as the jury for the MAB Young Scientists Awards. These go this year to Brián Germán Ferrero, Fabio Alberto Kalesnik, Natalia Politi (all from Argentina), Paulo Pagliosa Alves (Brazil), Paulette Taita (Burkina Faso), Alice C. Bett (Kenya), Kassim N'Tji Doumbia (Mali), Guillermo Crespo-Pichardo (Mexico), Nay Win Oo (Myanmar), Adrian Ionascu (Romania) and Minh Phuong Tran (Vietnam).

For further information: www.unesco.org/mab

Rita Colwell

Art is I; science is we

On 1 October, the USA returns to UNESCO after an absence of nearly twenty years. The event is all the more significant in that the USA contributes more than one-third of the world effort in research and development.

Dr Rita Colwell is Director of the US National Science Foundation. A microbiologist of international reputation, she has spearheaded the NSF's programme in science education from the kindergarten to post-graduate levels and directed the NSF's science investment priorities since taking office in 1998.

Here, Dr Colwell gives her views on the impact the US return is likely to have on UNESCO's science programme.

Why did the US scientific community remain active in UNESCO after the US withdrawal in 1984?

Let me begin by saying, on behalf of the US scientific community, that we are enthusiastic about the official US return to UNESCO and look forward to active participation with our colleagues from around the world.

The continual participation of individual US scientists in UNESCO activities over the US hiatus period speaks a great deal about the nature of scientific activity and of individual interest in UNESCO's mission. Science has always been an intellectual endeavor that builds bridges with colleagues of like interest. Even before the advent of the Internet, members of the science and engineering community connected and shared ideas and information across borders and cultures. In so doing, they influenced each other's thinking and built an ever more comprehensive body of knowledge. This collegial activity is an outgrowth of the very nature of science. French physiologist Claude Bernard said, 'Art is I; science is we.' I don't think many members of the science community would dispute that characterization. This collegiality was deeply ingrained in our psyches long before the advent of global institutions and organizations that brought scientists together to address both intellectual and societal problems. It seems logical that individual US scientists would continue to do what comes naturally; in this case, remaining engaged in UNESCO activities.

Over the past twenty years, US scientists have continued to participate in a broad range of UNESCO's core research programmes. This has been accomplished through international scientific unions and through US government support.

During the roughly twenty-year absence of the USA from UNESCO, US researchers have remained active in

the Intergovernmental Oceanographic Commission (IOC), International Hydrological Programme (IHP), International Geological Correlation Programme (IGCP) and, since its inception in 2000, in the World Water Assessment Programme.

Other areas of ongoing collaboration between UNESCO and the US scientific community include earthquake research, conflict prevention involving coastal resources, centres for cosmic ray observatories, the SESAME synchrotron project, hydrology education, mineral and energy research, and environmental engineering.

It is easy to discern from this list that US scientists value UNESCO programmes and expertise and have participated on a continual basis.

Rita Colwell



UNESCO is a leader in international science and has been uniquely successful, both as a bridge between scientists in developed and developing countries and as a connection for young scientists worldwide. These links contribute to a more balanced globalization of science so necessary in the modern world.

I have always been a staunch supporter of UNESCO's science programmes. I was involved in setting up the MIRCEN programme, which supports the establishment of centres in developing regions of the world with the objective of conducting integrated programmes for the preservation and use of microbial resources. As the former Chair of UNESCO's Biotechnology Action Council, I am also a strong advocate of UNESCO's BETCEN Programme, an important network of biotechnology education and training centres.

What do you see as the US role in promoting science through a multilateral forum like UNESCO?

Over the last several decades, we have seen an enormous acceleration in the pace of science. This is partly due to the development of a whole new generation of tools that allow scientists to process multitudinous data with lightning speed, probe problems that were heretofore 'unaddressable', bridge the boundaries between disciplines and grasp an understanding of large systems such as the oceans, climate change, galaxies and ecosystems such as deserts and rain forests.

In fact, our accumulated knowledge in science over the centuries has brought us to the enviable threshold of being able to probe deeper to develop emerging fields such as nanoscience and engineering, and genomics, and at the same time to address problems that are global in scope.

Many of the changes in science, such as interdisciplinary approaches to problems, are occurring successfully in UNESCO programmes. We hope that the US return to UNESCO can contribute to, and benefit from, the melding of ideas, models and experimental platforms from many disciplines. Every endeavor is enriched by a diversity of perspectives and cultures. These opportunities abound in UNESCO partnerships and projects.

Advanced technologies and communication have also helped to highlight the problems that all nations have in common. A partial list includes infectious disease and public health, child mortality, science and mathematics education, environmental degradation and water usage. In the age of globalization, our common problems can bring us together to find solutions.

The USA returns to UNESCO with a willingness not only to offer its co-operation and expertise, but also in the

recognition that we have much to learn from others. The results of research – from the interaction of oceans and atmosphere to the human genome – are applicable to everyone. They are international activities, human activities. No science today can thrive in isolation; today's science is increasingly an endeavour of communication and collaboration – especially international collaboration.

Within the framework of UNESCO, science is a tool to improve the human condition and the dignity of the world's citizens. Science and engineering are universal tools, with their ability to transcend national borders and cultural divides.

In the USA, we are eager to encourage our younger generation of scientists and engineers to develop closer bonds through research and education with colleagues throughout the world. The UNESCO framework is an ideal setting in which to advance this goal and we look forward to pursuing it with Member States.

What spectrum of programmes do you envision the USA might pursue as a Member State of UNESCO?

Naturally, we would want to continue areas of historical involvement such as the IOC, IHP and IGCP, as well as the MIRCEN programme. We also have interests in a variety of other programmes. In the area of education, we share a broad concern with other nations about the state of science education for young people in a global society that is increasingly rooted in science and technology.

The social and human sciences have assumed a growing prominence as we examine the impact of technologies on families, communities, and cultures. Recent advances in genomics and nanotechnology could augur developments with broad societal influence and it is important to explore these issues in tandem with the progress of the science.

In the last two decades, we have seen the emergence of whole new fields of science as well as startling discoveries in established disciplines. The potential for improving human health and life expectancy, agricultural yield, environmental preservation, education, nutrition and our understanding of the universe is vast and exciting. The USA looks forward to sharing these scientific journeys with UNESCO's Members and creating new initiatives that will continue to increase our knowledge and improve the human condition.

*The US Department of State has created a website on the theme of US Priorities in UNESCO:
<http://usinfo.state.gov/products/pubs/unesco/priority.htm>*

'Africanizing' tropical forest management

On 5 January 2004, a new generation of students will be enrolling at the Regional Post-graduate Training School on Integrated Management of Tropical Forests and Lands (ERAIFT) in Kinshasa (Democratic Republic of Congo, DRC).

This will be the third intake of a school which is training a new generation of African specialists and decision-makers to apply the ecosystem approach⁵ *in situ* to forest management in Africa. The aim is to 'africanize' forest management by training local specialists to take over from their expatriate counterparts.

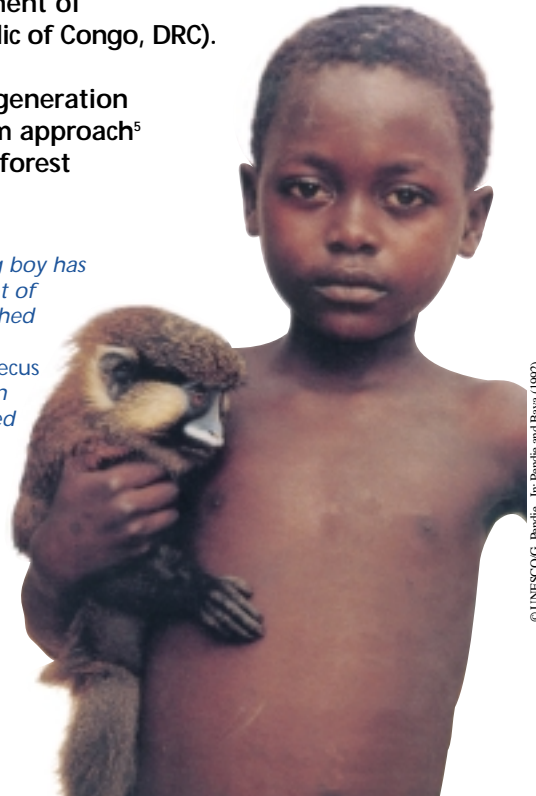
Tropical forest management is an increasingly complex affair. Managers have to be able to juggle forest-based subsistence activities such as farming, hunting, fishing and gathering of firewood or non-timber forest products, with encroaching urbanization and demographic growth and, last but not least, the increasing involvement of tropical forest areas in the global economy with governments reliant on the extraction of natural resources to generate badly needed revenue.

The philosophy behind the school is simple: Africa's development must lie with Africans themselves. Africa is rich in natural resources but these are being depleted by multinational companies driven by their own interests. Africans need to reappropriate their resources and follow their own path to development, a path strewn with their cultural and human values.

The central mission of the school is to promote good environmental governance for the benefit of the population, which is essentially rural. The 18-month course includes a two-month stay in a village buried deep in the forest so that students can see first-hand the problems with which villagers – and the environment – are confronted and involve the local community in finding solutions to these.

The first intake of students in 1999 spent two months working with local groups in six villages of the district of Mbanza-Ngungu situated 150 km from Kinshasa. The aim was two-fold: to improve the living conditions of the local population and, in parallel, provide income-generating activities. By the end of the field work, the area's health centres had been linked up to the local electricity grid and a socio-cultural centre had been rehabilitated and fully

This young boy has made a pet of a Moustached Monkey (Cercopithecus cephus), an endangered species found in Luki Biosphere Reserve



© UNESCO, Penje and Boyi (1992)
La réserve de biosphère de Luki; patrimoine floristique et faunique en péril, UNESCO, Paris

equipped with sewing machines and a delivery room for midwives to use. The local soils had been fertilized and the villagers had been introduced to more efficient techniques for raising poultry and other small farm animals.

In 2001, the students of the second intake focused on the theme of freshwater and ecosystems. In collaboration with the National Institute of Agricultural Research (*Institut national de recherche agronomique*), students worked with the local population to replant trees, establish tree nurseries and rehabilitate fish-farming ponds.

By adopting an endogenous, people-centred approach, ERAIFT seeks to break the vicious circle whereby poverty

5. *i.e. systemic or holistic approach*





© UNESCO. Pendje. In: Pendje and Baya (1992)
La réserve de biosphère de Luki: patrimoine, foresterie et faune en péril. UNESCO, Paris

Hunting in Luki Biosphere Reserve is widespread, despite being forbidden by law. A small forest animal like this one, Genetta servalina, nets the hunter 10–20 times the monthly wage of an agricultural worker. An estimated 11,000 animals were being exported dead (as fresh or smoked meat) or alive from the Reserve to towns annually in 1992. As a result, game are becoming rare and some species are threatened with extinction

leads to environmental degradation which, in turn, exacerbates poverty.

The 2004 intake of students will spend two months in Luki Biosphere Reserve, one of three biosphere reserves in the DRC. The school has set itself an ambitious agenda for Luki over the next few years; students will focus on reducing diarrhoeal diseases and combating tropical illnesses (malaria, bilharziosis, etc.), on lessening maternal and infant mortality, and on improving nutrition and hygiene through a safe water supply system and other means. They also aim to increase agricultural productivity and develop a healthy respect for nature among the population, as well as a more rational use of natural resources.

‘In addition, we are going to generate solar electricity in six villages in Luki using photovoltaic panels and we plan to build solar water-heaters’, explains Michel Maldague, Honorary Director of ERAIFT. ‘In parallel, we shall be teaching people how to produce biomass. By burning animal and plant wastes, you produce methane, an inflammable gas that can be used either for heating or lighting. Even the leftovers in the *digesteur* do not go to waste. They can be used for agriculture, animal husbandry and fish-farming’.

Why the Democratic Republic of Congo?

The choice of the DRC as host country for this regional training centre was governed by ecological factors. Some 47% of all African tropical forest is located in DRC, the largest of Sub-Saharan Africa’s nation states.

The country houses the world’s second-largest block of remaining tropical forest. Only the Amazon forest represents a larger tropical forest area. The tropical forest

areas – which cover 60% of the total land area in DRC – constitute invaluable ecological, cultural, social and economic wealth, not only for the people who live in and near them but also for the entire world population because they play a crucial role in global climate dynamics.

The diversity of Congolese ecosystems provides very useful scientific laboratories for training and research. Deforestation has progressed less rapidly than in other Congo Basin countries, such as Cameroon, Central African Republic, Congo, Equatorial Guinea or Gabon.

As commercial logging is one of the primary threats to tropical forests (along with demographic growth, urbanization and agricultural expansion), the relative isolation of the DRC’s forest blocks has helped to preserve them.

UNESCO’s determination to create ERAIFT at the University of Kinshasa despite the politically unstable climate in Central Africa has been appreciated by the region.

How does ERAIFT work?

ERAIFT is above all a post-graduate training institution. It is accredited to award both a Master’s Degree and PhD.

Admission criteria are selective. In addition to the requisite tertiary diplomas, applicants must have acquired three years of professional experience. In cases where there is only partial equivalence, the commission of admission may impose a complementary programme.

ERAIFT being a regional school, it serves the needs of French, Portuguese and Spanish-speaking countries of Sub-Saharan Africa. For logistic reasons, students are expected to have a good working knowledge of English but English-speaking students who can follow courses in French are highly appreciated.

There is a quota of 30 students for each post-graduate diploma course and five PhD places. The courses of the 16 university chairs are given by untenured professors recruited from various universities in Africa (e.g. Universities of Benin, Cameroon, Congo, Guinea, Maroc, Nigeria), Europe (e.g. the Belgian Universities of Gembloux and Tervueren, and the Université libre de Bruxelles, as well as the University of Besançon (France), and North America (Laval University in Québec, Canada).

UNESCO has set up an International Steering Committee (ISC) and an Academic Advisory Committee. The latter is made up of ten specialists nominated in their personal capacity who guide the School’s development. Donors become members of ISC. ERAIFT functions on the basis of the dual principles of transparency and excellence in research.



Some of the 36 men and 5 women graduates of the Master's programme for 2000 and 2002, during the award ceremony on 3 June 2002

The first class graduated in 2000 and the second two years later. It is hoped that, once the level of funding allows, the school will be able to accept an annual, as opposed to biennial, intake of students.

Modern techniques for an interdisciplinary education

Students learn an interdisciplinary, systemic and participatory approach to tropical forest management. They are taught to process complex information from different fields such as ecology, economics, social sciences and modern environmental monitoring technologies.

A key technology for ecosystem monitoring is that of remote sensing. As its name suggests, remote sensing encompasses different techniques for collecting images of an object, or other forms of data, by taking measurements at a distance (e.g. from an aircraft, spacecraft or ship), which are then processed and analysed. North-South and South-South co-operation is being put in place for the transfer of remote sensing technology to the school.

For example, ERAIFT is in touch with a UNESCO network launched a couple of years ago to apply remote sensing to sustainable development of ecosystems and freshwater in Africa. The participating countries are Benin, Botswana, Côte d'Ivoire, Equatorial Guinea, Guinea, Mozambique, Niger, Senegal and South Africa.

The network includes several regional associated institutions, such as the African Association of Remote Sensing for Environment, Regional Centre for Mapping of Resources for Development for East Africa (Kenya), West Africa Regional Centre for Training in Aerospace Surveys (Nigeria), African Centre for Meteorological Application for Development (Niger) and Federal University of Technology of Minna (Nigeria). Partnerships have also been formed with the Brazilian Space Agency, Indian

Space Research Organization, European Space Agency, and with other European and UN bodies.

As part of a field training course run by the UNESCO Chairs in remote sensing and digital mapping, students have prepared a vegetation map of the forest province of Bandundu in the DRC. The study was supported by the Central African Regional Program for the Environment run by USAID.

In April 2003, the government of Belgium decided to finance the further development of the ERAIFT laboratory for remote sensing and geographical information system (GIS) mapping to the tune of US\$ 340,000 over the coming two years. This joint project between UNESCO's World Heritage Centre and Division of Ecological Sciences will considerably enhance the laboratory's capacity to monitor UNESCO's biosphere reserves and world heritage sites.

Increasingly, as the school develops, experience from individual biosphere reserves in the region is being woven into the training programme, in terms of both course work and practical field training. ERAIFT is also training biosphere reserve site managers to use the Internet and GIS.

Powerful computers and related equipment have been bought with the assistance of Bowie State University (USA) and UNDP funding.

The school considers networking to be vital for driving rapid change. It is stimulating a regional network of academic exchanges between centres engaged in activities related to its own. Similarly, the school 'networks' its own graduates, many of whom have since taken up posts in the government and university sectors, or with NGOs and international bodies.

On the origins of ERAIFT

The seeds of ERAIFT were sown at a regional seminar organized in March 1991 to reinforce scientific co-operation for African tropical forest management. The 150 experts attending the meeting in what was then known as



Known affectionately to students as 'ERAIFT Castle', the school building dominates the valley with a breathtaking view of Kinshasa and the Congo River in the distance

Zaire recommended that a regional institution for training tropical forest management specialists be created. UNESCO, which had organized the meeting with the Agency for Cultural and Technical Cooperation and with the collaboration of the host government, set about preparing a feasibility study.

ERAIFT became operational on 10 April 1999. Run by UNESCO's Man and the Biosphere (MAB) programme, ERAIFT is supported by Cameroon, Côte d'Ivoire, DRC, Gabon, Guinea, Madagascar, Mauritania and Chad. The European Commission is contributing € 1,180,000 within the framework of its tropical forests programme in developing countries. For its part, Belgium is contributing US\$ 337,000 for the period 2002–2005 independently of the laboratory project.

In December 2001, the African and Malgache Higher Education Council (CAMES) decided to recognize the equivalence of the 18-month (three semester) post-graduate ERAIFT degree.

Where to from here?

In 2004, ERAIFT plans to emphasize cultural factors which influence natural resource management. These cultural factors are of major importance because the inhabitants of tropical forests have adapted valuable ethno-ecological strategies over millennia. Rational tropical forest management can benefit significantly from integrating these ethno-ecological strategies, as well as local indigenous knowledge.

Co-operation is currently being fostered between ERAIFT and Columbia University (USA) within UNESCO's joint International Programme on Biosphere and Society (CUBES), which is seeking to build capacity in developing countries by connecting communities.

More than 20 countries currently send students to ERAIFT. It is intended to diversify further their number.

MAB plans to strengthen ERAIFT and use it as a model for the development of other regional training facilities for forests, tropical lands and other ecological systems, including arid lands and wetlands. To this end, links will be established with universities and academic centres in Africa, Europe, in North America, Latin America and South-east Asia, in order to develop further North–South and South–South partnerships.

Sami Mankoto Ma Mbaelele⁶

Download an admission form from:
www.unesco.org/mab or contact: s.mankoto@unesco.org

6. UNESCO Programme Specialist and ERAIFT Project Officer

Poverty and reefs

While most people tend to agree that coral reefs need to be protected, the complex relationship between people and reefs – and the value of reefs to the coastal poor – is only just beginning to be understood. Consequently, although much attention has been paid to coral reef conservation, efforts have sometimes excluded the local population.

There is a growing recognition that coral reef conservation cannot meet its objectives without better consideration of poverty issues and the sustainable livelihoods of the poor reef-dependent communities.

A report published in September by UNESCO's Intergovernmental Oceanographic Commission (IOC), the UK's Department For International Development (DFID) and IMM Ltd, a UK-based research and development group, takes us a step closer to understanding the relationship between poor coastal communities and coral reef environments.

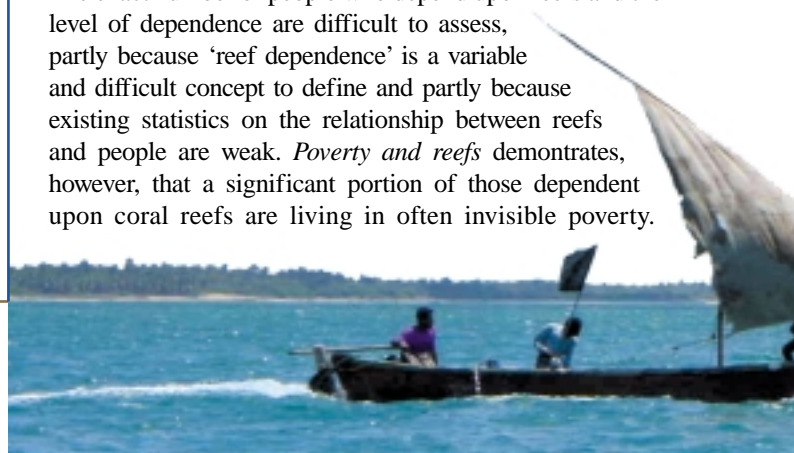
Poverty and Reefs is the outcome of the DFID-funded Reef Livelihoods Assessment project implemented by IMM Ltd to guide DFID's future policy on reefs and poverty reduction among vulnerable coastal communities; it is hoped, however, that the findings will also contribute more widely to global policy development.

The report combines a global review of existing literature on coral reefs and poverty with case studies from three reef locations in South Asia and one in East Africa. Field assessments were carried out by local groups applying a new participatory livelihood assessment methodology. Research in South Asia was undertaken in co-operation with partners of the regional node of the Global Coral Reef Monitoring Network in South Asia (GCRMN South Asia), established by institutions in India, Maldives and Sri Lanka with financial and technical support from DFID and the UNESCO-IOC.

These studies shed new light on just how much the coastal poor depend on coral reefs for survival and the diversity of livelihoods they sustain.

The invisible poverty of the reef-dependent

The exact number of people who depend upon reefs and their level of dependence are difficult to assess, partly because 'reef dependence' is a variable and difficult concept to define and partly because existing statistics on the relationship between reefs and people are weak. *Poverty and reefs* demonstrates, however, that a significant portion of those dependent upon coral reefs are living in often invisible poverty.





© Emma Whittingham, IMM Ltd

*Gulf of Mannar, India. Top: cleaning the crab nets
Bottom: Small-scale fishing craft in protected lagoon*

The reef-dependent poor tend to fall into the gaps between different coastal development activities. Marginalized more often than not, they find themselves with no formal rights to coastal resources and at times are even perceived as obstacles to conservation or development.

A wide diversity of stakeholders depends upon coral reefs: direct users, whose livelihood involves direct extraction, processing and sale of reef resources and benefits, including distant markets and tourism; and indirect users, whose homes and land are sheltered by the reef from wave action, or those who use the near-shore reef and coastal environment as a dumping ground for waste or, in wider society, those who value the reef's existence but who may never use it directly.

The dependence of these groups may vary from full-time or part-time to those who only occasionally depend upon reefs. Some may rely on reef resources only in certain seasons of the year, when the reef serves as a critical keystone resource. For others, the reef provides a vital safety net which enables them to overcome extreme hardship or sporadic crises. One man on Agatti Island off the Lakshadweep Reef (west coast of India) explains how his family has always relied on natural resources for survival. He recalls a famine when he was a young boy. Although he belongs to the caste whose profession it is to climb coconut trees for tree owners, when the yield from the coconuts dropped during the famine to the point where there was no money to buy food, his father was able to catch *Karatty* (or Trigger fish) from the reef to ensure their survival.

Vital livelihoods for poor communities

The diverse benefits that flow from reefs to the coastal poor may not score highly from an economic perspective but, in terms of livelihood, they are vital. Reefs provide seasonally stable sources of food and status. The physical structure of the reef dictates a communal approach to many activities and the traditional linkages between reef resources and the spirit world mean that reefs can be socially and spiritually unifying. Reefs also protect coastal villages from storms and wave action. Similarly, they provide shelter to lagoons and other

productive areas, such as seagrasses and mangroves, which in turn provide habitats for other resources that may be sources of food and income.

The diversity of reef products supports multiple opportunities for direct exploitation by people with many different skills; while the structural and biological diversity of coral reefs limits large-scale industrial production. By favouring small-scale production, reefs preserve opportunities for those with smaller financial or physical resources. The 'common pool' nature of many reef resources allows easy entry for those who have been displaced from other sectors, especially in times of emergency. Since, in some situations, a reef can maintain large populations above the breadline, reef-dependent communities often appear less badly off than some of their land-based neighbours.

Unlike many fisheries, from which women are excluded, reefs offer women opportunities to collect aquatic resources on foot. This empowers women in the household. Moreover, the diverse reef-based livelihoods strategies employed collectively by men and women spread the household risk. One woman on Agatti Island has been a cowrie (a type of mollusc) collector since she was a child. Now aged 47, she has become somewhat of an expert. She pokes out cowries from the reef platform and mud flats using sharp sticks and



Source of map: UNEP/WCMC/ICRAN

Coral reefs in South Asia (in yellow). Red circles indicate GCRMN South Asia's monitoring demonstration sites. This regional network of coral reef stakeholders involves local communities, government agencies, NGOs, universities and the private sector. It operates from Colombo, assisted by DFID and the UNESCO-IOC. In 1997–2002, it co-ordinated 26 training workshops and consultations in India, the Maldives and Sri Lanka, enabling the partners to collect key information for coral reef management planning and policy-making. This information includes environmental and socio-economic data on reef status and reef-user practices. A regional information system has been developed to inform local and national policy-making and reef management planning

© Emma Whittingham, IMM Ltd



© Venkataraman, Zoological Survey of India

Precious protein (Parrot fish) for sale at a local market, India. As a result of reef degradation and concern for biodiversity conservation, increasing legislation has emerged to control and restrict resource use, prohibiting extraction of many reef products. These changes have disproportionately affected the poorer households who typically have no viable alternative to reef use to fall back on

iron hooks. Convinced that the cowrie quantities are cyclic, she only collects them during the fair season, thereby enabling the stocks to replenish during the monsoon season.

Reef-based livelihoods under threat

Coral reef ecosystems are extremely sensitive to physical damage and disturbance. Around 60% of coral reefs are threatened by human activity, a figure as high as 80% in South-east Asia.⁷ To make matters worse, this damage is being compounded by acute disturbance events such as hurricanes, and longer-term effects of climate change such as coral bleaching, disease outbreaks, rising sea levels and other environmental degradation.

The ability of reefs to provide income and food security is steadily being eroded, as is their role as a buffer against seasonal and periodic hardships. With many reefs already degraded and most of the remainder under threat, the benefits

Fish market, Nagapatnam, Palk Bay, east coast of India

available to poor coastal communities are in decline, or being lost or distorted irreversibly. At the same time, many poor stakeholders have become increasingly dependent on reef benefits, as growing coastal populations and coastal development overwhelm and degrade many alternative resources. Increasingly dependent on a declining resource, the livelihoods of poor reef-dwellers are vulnerable. Simultaneously, their access to the reef is often limited by coastal tourism developments, external markets and well-meaning but misguided efforts to halt reef decline. In extreme cases, livelihoods have become criminalized, increasing the burdens of risk and transaction costs on the poor, who typically have few alternatives.

Some of the harm done to reefs is caused by the very same people who depend upon the reef for their survival, such as those who resort to destructive fishing practices (e.g. dynamite fishing, damaging fishing gear or chemicals) and coral mining. However, more damage is being caused by external forces beyond the control of the reef-dependent communities. These include marine pollution, overfishing, extensive tourism and construction. This degradation is predicted to increase in the near-future as a result of climate



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Women gleaning the reefs for molluscs and other reef organisms on the Lakshadweep Reefs, a group of small coral atolls off the west coast of India. The local community has co-existed with the reef for hundreds of years



© Venkataraman, Zoological Survey of India



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Coral rubble and reef shells used in house construction

change and other trends, such as population growth and coastal development.⁸

If we are serious about meeting development targets

There is an urgent need for guidance and support to coral reef practitioners, managers, and agencies to address poverty and reef-related issues more effectively. Unless this happens, the implications for international development targets are serious both in terms of people sliding back into poverty and a growing loss of reef-based environmental resources.

Within the global policy framework, there must be a shift in focus from reef conservation alone to the sustainable and equitable use of reef ecosystems with poverty reduction as a more central theme rather than a means to an end.

There is also a need for more capacity-building in approaches to coastal community development and poverty reduction, incorporating a better understanding of the nature of reef-dependent poverty.

The *Poverty and Reefs* study has shown that a wealth of information exists but has not yet been brought together to provide a cohesive body of knowledge that can inform policy. The reef-dependent poor have much to teach us about the way they live with, use and manage their reefs. Armed with this knowledge, we shall be in a better position to begin developing new approaches to sustainable livelihoods, livelihood enhancement, poverty reduction and reef management.

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7. Bryant et al. (1998) Reefs at risk: a map-based indicator of potential threats to the world's coral reefs. *World Resources Institute*, 56 pp.

8. Hughes et al. (2003) *Climate change, human impacts and the resilience of coral reefs* (Science, 301)

9. IMM Ltd

10. UNESCO-IOC, GCRMN South Asia project co-ordinator

Governing Bodies

Coming to grips with the knowledge society

One of the highlights of this year's General Conference (Paris, 29 September – 18 October) will be a two-day roundtable entitled 'Towards knowledge societies', involving Ministers in charge of ICTs and information society issues; the roundtable will begin on Thursday, 9 October, at 3:00 pm.

Participants will discuss, among other issues, the scientific challenges posed by the knowledge society: the impact of scientific research on knowledge production, access to scientific knowledge in the information society and the distribution of this knowledge, science education and training in the knowledge society and, last but not least, science and governance.

There will also be an exhibition on 'Building knowledge societies' for the duration of the General Conference.

Budget increase anticipated

Every two years, all Member States meet at UNESCO Headquarters to approve the Organization's programme and budget for the coming biennium. Two new Member States, Timor Leste and the USA (see pp. 6 and 11), will be participating in this year's 32nd General Conference, bringing the number of UNESCO's Member States to 190.

The USA's departure from UNESCO in 1984 amputated 25% of the Organization's budget (a contribution henceforward lowered to 22%.) Repeated zero nominal growth budgets resulting from this have severely handicapped the Organization's ability to act over the years.

Buoyed by the announced return of the USA, the Director-General threw his weight behind the most optimistic of three scenarii prepared for 2004–2005, that of a real growth budget of US\$ 610 million, or an increase of US\$ 34 million over the previous biennium. This scenario was 'predicated on the assumption that the return of the USA should signify something special for UNESCO'. The Executive Board has followed the Director-General's reasoning, recommending that the real growth scenario go forward to the General Conference.

Some of the additional funds have already been earmarked: education for all (US\$ 10 million), coping with global change, freshwater, the oceans and bioethics (US\$ 5 million), safeguarding cultural diversity (US\$ 7.5 million), strengthening UNESCO's contribution to NEPAD (US\$ 1 million) and enhancing programme delivery, monitoring and evaluation (US\$ 4 million).

Two landmark decisions expected

Two landmarks of this General Conference are likely to be: the adoption of the proposed International Programme for the Basic Sciences (see the interview in *A World of Science*, vol. 1, n° 1, for details); and the adoption of the draft *International Declaration on Human Genetic Data*.

Diary

1 October

Space education. Information session for delegates., UNESCO HQ, Room IV, 3:30 pm: y.berenguer@unesco.org
www.unesco.org/science/earthsciences/sep.htm

1 October

Technological innovation and intellectual property in the context of NEPAD: what strategy for Africa? Ministerial roundtable. UNESCO and African Regional Centre for Technology, Rabat (Morocco): rabat@unesco.org; f.osotimehin@unesco.org

13-15 October

NEPAD Ministerial Conference on S&T for Development. Preparatory workshop. Organized by UNESCO Nairobi with African Union and NEPAD Secretariat: Nairobi@unesco.org

21-22 October

Planned European Research Council. 3rd meeting, organized by ELSF, FEBS, EMBO, EMBL with Euroscience. Dublin (Ireland): www.elsf.org

3-7 November

African Ministerial Conference on S&T for Development at NEPAD Secretariat, Pretoria (South Africa), with African Union and UNESCO:

f.osotimehin@unesco.org;
Paul.Vitta@unesco.unon.org

8-10 November

World Science Forum, under joint patronage of President of Hungary and President of European Commission, intl patrons UNESCO Director-General and ICSU President. Budapest (Hungary): d.malpede@unesco.org
www.sciforum.hu/programme.html

10 November

World Science Day for Peace and Development: d.malpede@unesco.org
UNESCO's international science prizes will be awarded in Budapest: y.nur@unesco.org

12-14 November

Global Conference on Oceans, Coasts, and Islands, Mobilizing for implementation of commitments made at World Summit on Sustainable Development 2002. Organized at UNESCO HQ by Global Forum on Oceans, Coasts and Islands: www.globaloceans.org/globalconferenc e/index.html

26-28 November

Great Apes Survival Project (GRASP) preparatory meeting for Intergovernmental Meeting on Great Apes/GRASP in 2004. Room XI, UNESCO HQ: s.mankoto@unesco.org; www.unep.org/grasp

1 December

Biosphere reserves as sustainable development laboratories for NEPAD, roundtable organized by UNESCO-MAB: www.unesco.org/mab

1-3 December

Development of technical entrepreneurship and innovation programmes in higher institutions in Africa. Regional workshop organized by UNESCO at Lagos Business School (Nigeria): f.osotimehi@unesco.org

8-9 December

The Role of Science in the Information Society. Side event of World Summit on the Information Society, organized by UNESCO, CERN, TWAS, ICSU. Hosted by CERN, Geneva (Switzerland): http://rsis.web.cern.ch/rsis; rsis@cern.ch

8-12 December

World Summit on the Information Society, 1st round, Geneva (Switzerland), organized by ITU in co-operation with other UN agencies, including UNESCO: www.unesco.org/wsis

8-13 December

Pan-African Implementation and Partnership Conference on Water Addis Ababa (Ethiopia). Co-organized by UNESCO (in Nairobi): e.naah@unesco.org
http://unesco-nairobi.unon.org

New Releases

Poverty and reefs

By E. Whittingham, E., J. Campbell and P. Townsley. DFID-IMM-IOC/UNESCO. Vol 1: Global Overview, Vol. 2: Case Studies. 260 pp. Printed by UNESCO (see p. 16) (ref:IOC/UNESCO/INF-1188). English only. Request a free copy from: IOCMailService@unesco.org

Management of University-Industry-Science Partnerships (UNISPAR)

A case study of the Indian Institute of Technology, Madras English only, 72 pp. Tells the success story of the IIT in Madras, highlighting its significant contribution to technology development and transfer. Compiled within UNESCO's UNISPAR programme. Request a free copy from: newdelhi@unesco.org; or consult at: www.unesco.org/science/new_releases.html

The changing ocean

Its effects on climate and living resources

By Bruno Voituriez. IOC Ocean Forum Series, no. 4. Exists in French and English. ISBN: 92-3-103877-X

SESAME

12-page full colour brochure printed by UNESCO on the project for a **Synchrotron light for Experimental Science and Applications in the Middle East (SESAME)**. Construction of the research centre, which has been placed under the auspices of UNESCO, began at Al-Balqa' Applied University in Jordan in July 2003. Request a free print copy from c.formosa-gauci@unesco.org or go to: www.sesame.org.jo

World water portal

Before going global, a prototype water portal for the Americas has been developed by the World Water Assessment Programme and partners to test ways of sharing information among local, national and regional water organizations: www.waterportal-americas.org

Barbados + 10 portal

Enables partners to contribute to comprehensive review of *Programme of Action* on small island developing states, adopted in Barbados in 1994, and follow preparations for Barbados +10 conference in mid-2004: http://portal.unesco.org/islandsbplus10.

...for Children

Rashid the recycler

Guide to recycling for youngsters prepared by UNESCO Doha and printed by Ministry of Education of Qatar. Features cartoon character of Rashid. Teacher training courses, a quiz, photo contest and an environment prize are to be associated with the book. A Pan-arab version of the 2nd volume is planned: doha@unesco.org

Tell me about the oceans

By Patricia Chairopoulos, illustrated by Pascale Collange, UNESCO Publishing/Nouvelle Arche de Noé Publishing, ISBN 92-3-103872-9 (€ 4,57), exists in English, French and Spanish, 48 pp. For 8-12 year olds. Do you know that... is the password to an adventure which first began 4 billion years ago. Oceans of the origin of life, mysterious oceans, dangerous oceans, life-sustaining oceans. Knowing this vast, watery world better will help us take better care of it.