Activity-Financing Contract No 4500004779
Summary Report

International Workshop on
Open Access and the Public Domain in Digital Data and Information for Science
10/11 March 2003, UNESCO
Jointly organized by UNESCO, ICSU, CODATA, the National Academies, US and ICSTI

Workshop on
Science in the Information Society
12 March 2003, UNESCO
Jointly organized by ICSU, CODATA and UNESCO

Content

1. Introduction

On the 10 and 11 March 2003, an *International Symposium on Open Access and the Public Domain in Digital Data and Information for Science* took place in UNESCO. It was jointly organized by UNESCO, ICSU, CODATA, The National Academies US and ICSTI. This two day meeting was funded by UNESCO, ICSU, CODATA, the John D. and Catherine T. Mac Arthur Foundation and the US National Weather Service.

On the 12 March, a special workshop was convened, bringing together scientific experts, managers and representatives from several inter-governmental agencies to try and identify the major issues for science in relation to the World Summit on the Information Society, Geneva 2003, Tunis 2005.

UNESCO contributed 25 000 US$ towards these meetings. The purpose of this report is to finalize compliance with Activity–Financing Contract No 4500004779 entered into between UNESCO and Committee on Data for Science and Technology, CODATA on 26 October 2002. That is:

To submit a full summary report of the meeting[1]

Recommendations and WSIS Action Plan[2]

Certified financial Statement showing the use of Funds of UNESCO[3]

It should be noted that the proceedings of the International Symposium are currently been edited and will be available in both electronic and book form in autumn 2003. The focus of this report is on how both of these meetings assisted the scientific community to define its input into the World Summit on the Information Society, Geneva 2003, Tunis 2005.

[1] According to the e-mail of John Rose, the deadline for receipt of this report is 31 July 2004.

[2] The recommendations of the Paris Workshop are referred to and incorporated into the UNESCO submission to WSIS on 31 May 2003. See website: http://www.itu.int/wsis/documents/listing

[3] The Financial Statement showing the use of funds from UNESCO, which is certified by the CODATA Treasurer can be found in Annex Four of this Report

2. Background to the International Symposium on Open Access and Public Domain in Digital Data and Information for Science[1]

Data and information produced by government-funded, public-interest science constitutes a global public good caught between two different trends. On the one hand, the Internet provides valuable new opportunities for overcoming geographic limitations and the promise of unprecedented open access to public information for research on a global basis. The synergistic aspects of the availability and access to such information result in a broad range of positive network externalities that increase exponentially with the addition of new Internet users. On the other hand, there are growing restrictions on the availability and use of public data and information arising from the privatization and commercialization of such sources. This countervailing trend undermines the traditional scientific cooperative and sharing ethos. It diminishes the public domain and open access to such global public goods and leads to a host of lost opportunity costs at both the national and international levels.

While there has been a great deal of focus on new commercial opportunities with digital information and on increased intellectual property rights, comparatively little attention has been devoted to the importance of maintaining open access to the source of upstream scientific-and other-data and information produced in the public domain for the benefit of all downstream users, or to the imperative to balance the public and the private interests. The question is, how to preserve and promote access to and sharing of such public scientific resources without unduly restricting new opportunities for commerce or the moral rights of authors? Or, conversely, how to promote commercial activities in the private sector without significantly compromising the availability of data and information in the public domain or through open access for global public good purposes?

The recent pressures on both public-domain and open-access information-scientific and otherwise-have resulted from a variety of legal, economic, and technological factors. New and revised laws have broadened, deepened, and lengthened the scope of intellectual property and neighboring rights in data and information, substantially redefining and limiting the public domain. National security concerns also are constraining the scope of government data and information that can be made publicly available. Economic pressures on both government and university producers of data and information similarly have narrowed the scope of such information placed in the public domain, with resulting access and use restrictions on resources that were previously openly available to researchers, educators, and others. Finally, advances in digital rights management technologies for enforcing proprietary rights in various information products are posing some of the greatest potential restrictions on the public domain and open access to data and information.

Nevertheless, some well-established mechanisms for preserving public domain or open access data and information-such as public archives and data centers, together with ever-increasing numbers of open Web sites-exist in the government, academic, and not-for-profit sectors. In addition, very innovative institutional and legal models for making available digital scientific data and information resources in the public domain or through open access provisions are now being developed by different groups in the scientific, library, and legal communities in many countries.

Various aspects of these issues have been addressed in some detail already in previous reports published by the National Academies and its National Research Council, including by the U.S. National Committee for CODATA. See, for example, ***The Digital Dilemma: Intellectual Property in the Information Age*** (CSTB, 2000); ***A Question of Balance: Private Rights and the Public Interest in Scientific and Technical Databases*** (CPSMA, 1999); ***Finding the Path: Issues of Access to Research Resources*** (CLS, 1999); and **Bits of Power: Issues in Global Access to Scientific Data** (USNC/CODATA, 1997). More specifically, the Office of International Scientific and

[1] This is taken from the background document to the Symposium prepared by Paul Uhlir

Technical Information Programs recently convened a "***Symposium on the Role of Scientific and Technical Data in the Public Domain"***

Activities focused on these issues also have recently been undertaken by several international organizations. For example, the ICSU-CODATA ad hoc Group on Data and Information was established in 1997. It focuses on the importance of full and open access to scientific data and information on a global basis. This group submitted a white paper on these issues to the World Intellectual Property Organization in 1997 and subsequently developed a set of guiding principles.[1]

In addition, ICSTI, working with CODATA and ICSU, has held two meetings on the important topic of preservation of digital content, more particularly on the topic of continuous availability of digitally produced materials. There are significant technical, administrative, and economic issues associated with the longer-term availability of scientific data and information and these constitute important elements in establishing policies in the area of open access.

ICSTI, with INSERM and INIST, organized an international meeting on 23-24 January 2003 on **Open Access to STI: State of the Art and Future Trends**[2] This meeting examined the consequences of recent organizational and technical developments on the wider availability of scientific information. It dealt with the issues from the point of view of authors, publishers, users-especially those in the developing world, and policy makers.

The Organization for Economic Co-operation and Development (OECD) has formed an "**OECD follow up group on issues of access to research data from public funding**,"[3]which recently has produced an interim report. This group has reported on the current practices concerning access to and sharing of research data and their underlying principles on the basis of case studies. It has also reported on the effects of selected current data sharing practices on the quality of research and the progress of science and it has suggested principles for making policy on data sharing within the relevant national and international policies and regulatory frameworks.

Objective of the meeting

The International Symposium sought to describe the role, value, and limits that the public domain and open access to digital data and information have in the context of international research. It identified and analyzed the various legal, economic, and technological pressures on the public domain in digital data and information, and their potential effects on international research and it reviewed the existing and proposed approaches for preserving and promoting the public domain and open access to S&T data and information on a global basis, with particular attention to the needs of developing countries.

[1] "A set of Principles for Science in the Internet Era" can be found in Annex One of this document
[2] http://www.inist.fr/openaccess/index_en.php
[3] http://dataaccess.ucsd.edu/

3. Summary of the International Symposium.

The symposium brought together some 140 leading experts and managers from both government and academic sectors who are involved in the creation, dissemination and use of data and information in public research.

The two-day symposium was divided into six sessions:[1]

- Legal, Economic, and Technological Framework for Open Access and Public Domain in Digital Data and Information for Science
- Data and Information in the Public Health Sector
- Data and Information in the Environmental Sector
- Basic Sciences and Higher Education
- Innovative Models for Public-Domain Production of and Open Access to S&T Data and Information
- Examples of New Initiatives in Developing Countries

Although the ICSU/CODATA Agenda for Action[2], as defined by the scientific community, was a direct product of the Workshop on *Science and the Information Society,* many of the presentations at the Symposium were directly or indirectly relevant and /or supported the Agenda for Action as defined. In other words the International Symposium helped the scientific community who participated at the Workshop to focus on those issues that clearly showed how important science and technology is in the information society.

Examples[3]

1. Dr. Chrisanthi Avgerou's presentation on "Information Technology and Data in the Context of Developing Countries" argued that the significance of both ICT (Information and Communication Technologies) and information resources is context-dependant, subject to interpretations and negotiations of human actors in their socio economic environment. She demonstrated the validity of this argument with the example of socio-economic indicators that are routinely constructed and published by development agencies and social science research centres, such as on "economic development," "human development," or "readiness for the information society." It was argued that mere access to such data does not empower developing countries' policy makers but what is also needed is a capacity to trace the underlying meaning of the indicators in relation to the models of development they stem from, thus to be able to judge their relevance in specific contexts and negotiate alternatives. However, most developing countries are weak in social and economic sciences and have little capacity to identify and negotiate with confidence models of development and courses of action that are meaningful and effective in their context. The assumed objectivity and universality of "data," in particular numerical data, exacerbates this weakness.
Agenda Action item defined in the workshop "Encourage initiatives to increase scientific literacy and awareness of how to interpret web-based scientific information"

Agenda Action item defined in the Workshop: "Promote sustainable capacity building and education initiatives to ensure that all countries can benefit from the new opportunities offered by information and communication technologies (ICTs) for the production and sharing of scientific information and data"

[1] The Agenda and Book of Abstracts of the Symposium can be found in Annex Two of this document

[2] The report on the Workshop and the background to the Agenda for Action can be found in sections five and six

[3] These examples are not exhaustive and serve for illustrative purposes only. Further examples taken from the Symposium can be found in the Report on the Workshop under section five of this document.

Agenda Action item defined in the Workshop "Encourage initiatives to increase scientific literacy and awareness of how to interpret web-based scientific information"

2. Academician Zgurovsky spoke about "Access to Scientific Information: Distance Education-The Ukraine and other CIS Countries Perspectives". He emphasized how the open information society in the Ukraine is connected with the development of the information medium in science and education. The system of distance education in the Ukraine includes the regional network of educational-information centers with adequate educational and information software for providing access to all students. The system of on-line libraries is a distributed informational infrastructure (electronic catalogues, databases, information enquiry systems of scientific and technical, university and public libraries are included in URAN network). The application of information technologies in education and science is connected with virtual laboratories, remote access to information resources, telematics in the field of economics and management, ecology, medicine, biology, research in the field of physics and mathematical modeling of complex processes, telemedicine, and other fields. His presentation also provided an example of application of telematics means and methods for solving the problem of ecological monitoring of Chernobyl Nuclear Power Plant, as well as the development of telemedical channel for diagnostics and treatment of those working at the Chernobyl Power Plant.

Agenda Action item defined in the Workshop: Ensure that all universities and research institutions have affordable and reliable high-speed Internet connections to support their critical role in information and knowledge production, education and training

Agenda Action item as defined in the Workshop: Support urgently needed research on the use of information technologies in key areas, such as geographical information systems and telemedicine and on the socio-economic value of public domain information and open access systems

3. Sal Muthayan and Florence Muinde, presented a paper on "Public Knowledge Project Open Journal System". The presentation was based on the activities of the Public Knowledge Project, developed at the University of British Columbia, Canada. It looked at the open access publishing Online Journal System (OJS) and how it can be applied to meet the needs of research capacity development in developing countries. The presentation reviewed the potential of new publishing technologies to develop research capacities in Kenyan universities through online publishing of research findings and sharing of information, based on research carried out in Kenya at Kenyatta University.

Agenda Action item defined in the Workshop: Promote sustainable capacity building and education initiatives to ensure that all countries can benefit from the new opportunities offered by information and communication technologies (ICTs) for the production and sharing of scientific information and data

Agenda Action item defined in the Workshop: Promote electronic publishing, differential pricing schemes and appropriate open source initiatives to make scientific information accessible on an equitable basis

4. Peter Weiss presented a paper on "Comparative Analysis of Data Access Policies in Meteorology" In his abstract he states that *"Many nations are embracing the concept of open and unrestricted access to public-sector information-particularly scientific, environmental, and statistical information of great public benefit. Federal information policy in the United States is based on the premise that government information is a valuable national resource and that the economic benefits to society are maximized when taxpayer funded information is made available inexpensively and as widely as possible. In other countries, particularly in Europe, publicly-funded government agencies treat their information holdings as a commodity to be used to generate revenue in the short-term. They assert monopoly control on certain categories of information in an attempt—usually*

unsuccessful—to recover the costs of its collection or creation. Such arrangements tend to preclude other entities from developing markets for the information or otherwise disseminating the information in the public interest" His paper provided a comparative analysis of these different data access policies and discuss some implications for developing countries.

5.Thomas DREIER, University of Karlsruhe, spoke about the overview of legal aspects in the European Union concerning access and use of digital data. In the European Union, the legal framework for access to and use of digital data and information for science is governed by a number of Directives (in particular, 96/9/EC on the legal protection of databases, 98/84/EC on conditional access, and 2001/29/EC on copyright in the information society). Copyright legislation strikes a balance between proprietary rights of those who create, and invest in, copyrightable subject matter, and access and use interests of those who create on the basis of pre-existing material. This balance is achieved by way of the idea expression dichotomy, by exceptions and limitations, and by limiting copyright protection in time, in order to create a powerful public domain.

However, modern reproduction and dissemination technologies call for an ever-increasing level of copyright protection. Moreover, due to convergence of copyrighted products and services, competition amongst producers of copyrighted materials is becoming stronger and stronger. Both tendencies create a danger of lock-in effects of both copyrighted material and material in the public domain. Finally, in a digital rights management scenario, technological protection measures can provide a powerful tool which may benefit rightholders, but it may likewise be detrimental the access needs of users and scientists in particular. The presentation sketched out this legal framework to discuss the issues raised and propose possible solutions.

Agenda Action item defined in the Workshop: Ensure that any legislation on database protection guarantees full and open access to data created with public funding. In addition, restrictions on proprietary data should be designed to maximize availability for academic research and teaching purposes

6.Jean-Luc Poncelet gave a presentation on "Health Information for Disaster Preparedness in Latin America" He spoke about how in Latin America, disaster vulnerability is high due to the significant risk of natural disasters, poverty, poor planning, and a weak institutional framework for disaster management. For example, Hurricane Mitch left 8,000 dead and 9,000 missing in Honduras and Nicaragua in 1998. In 2001, earthquakes in El Salvador left 1,000 dead and 650,000 homeless. Following these disasters, the National Library of Medicine (NLM) and the Pan American Health Organization (PAHO) developed a project to rebuild and improve the health information infrastructure in Honduras, Nicaragua, and El Salvador. In 2000, NLM supported the Foundation for the Coordination of Information Resources for Disaster Prevention (FundaCRID), a non-governmental organization that operates the Regional Disaster Information Center for Latin American and the Caribbean (CRID), to help these countries develop a system for collecting and disseminating health information related to disasters. This initiative has strengthened participating libraries and organizations in three areas: technological infrastructure (Internet connectivity and computer equipment); information Management (librarian training); and information product development (digital libraries and Web sites). Honduras, Nicaragua, and El Salvador have established Disaster Information Centers designed to enable health professionals, government agencies, and non-governmental organizations to access vital information that was previously unavailable. These organizations have acquired the knowledge and technological resources to promote the delivery of reliable information to health providers. The establishment of these centers should facilitate long-term improvement of disaster prevention activities. The NLM/PAHO/CRID collaboration is also a model for disseminating health information in underserved, disaster-prone environments, and for managing non-traditional literature regarding health aspects of disasters.

Agenda Action item defined in the Workshop: Support urgently needed research on the use of information technologies in key areas, such as geographical information systems and

telemedicine and on the socio-economic value of public domain information and open access systems

Agenda Action item defined in the Workshop: Promote interoperability principles and metadata standards to facilitate cooperation and effective use of collected information and data

Agenda Action item defined in the Workshop: Provide long-term support for the systematic collection, preservation and provision of essential digital data in all countries

7.Sarah Durrant, from the International Network for the Availability of Scientific Publications, INASP, spoke about how open access potentially presents a great many opportunities to creators and consumers of information within less developed countries (LDCs). Much has been written about the "knowledge gap" between the North and the South and whilst the Internet seemed to represent a new environment in which opportunities might be more equal, the ubiquity of the phrase "the digital divide" suggests that, although the medium is new, the same inequality and lack of opportunity persists. Importantly, the knowledge gap is not just confined to lack of access in the South to information generated in the North. Information produced in the South is in danger of remaining invisible to researchers, professionals and other information “consumers” in the North and in the South. So how can open access redress the inequalities surrounding access to and visibility, awareness and dissemination of information? What skills and knowledge are required to ensure that these opportunities are fully exploited? This presentation identified some of the challenges and the opportunities open access presents to LDCs and offers some examples of open access and related initiatives from Developing Countries, mentioning components from INASP's Programme for the Enhancement of Research Information (PERI).

Agenda Action item defined in the Workshop: Promote electronic publishing, differential pricing schemes and appropriate open source initiatives to make scientific information accessible on an equitable basis

8. Gilberto Camara from the Instituto Nacional de Pesquisas Espacias, Brazil addressed earth observation and GIS (geographical information systems) technology and showed how it was an excellent example of the use of advanced information technology for the improvement of mankind. In developing nations, these technologies have proven essential for the establishment of public policies in issues such as deforestation assessment, urban planning, agricultural production and environmental control. However, computer analysis of spatial data requires tools that are complex to develop and to use. To date, commercial companies in developed nations have produced most of these tools. Although these commercial systems have enabled major advances in the spatial analysis applications, there is scope for much improvement in the area.

A fundamental challenge for spatial analysis tools is the need to resolve the "knowledge gap" in the process of deriving information from images and digital maps. This knowledge gap has arisen because our capacity to build sophisticated data collection instruments (such as remote sensing, LIDAR, and GPS) is not matched by our means of producing information from these data sources.

Based on these needs, the paper indicated the benefits to the geographical information community would accrue from the use of open-source GIS tools. This co-operative software environment would allow researchers to share their results with the community, thus reducing the "time to market" from academia to society. As an example of such products, a group of R&D institutions in Brazil is currently developing TerraLib, an open-source GIS library that enables quick development of custom-built applications for spatial data analysis (the software is available at www.terralib.org). Projects such as TerraLib show that pursuing a "learning by doing" approach combined with substantial investment in local human resources is the key for successful deployment of advanced information technology in developing nations.

Agenda Action item defined in the Workshop: Recognize the important role for science in developing and implementing the new governance mechanisms that are necessary in the information society"

Agenda Action item defined in the Workshop: Provide long-term support for the systematic collection, preservation and provision of essential digital data in all countries

Agenda Action item as defined in the Workshop: Support urgently needed research on the use of information technologies in key areas, such as geographical information systems and telemedicine and on the socio-economic value of public domain information and open access systems

4. Follow up from the International Symposium

As stated in the introduction, the proceedings of the International Symposium are currently being edited and will be available in both electronic and book form in autumn 2004. They will also be available on the CODATA website on http://www.codata.org

CODATA will notify UNESCO as soon as they are available.

Since the meeting the following articles have been published on the International Symposium or have made reference to the Symposium in the context of the article:

- CODATA Newsletter N0 84

- Scidev.net "The Threat to Science as a Public Good"
  http://www.scidev.net/archives/editorial/comment56.html

- A World of Science
  "What Future for open science" Natural Sciences, UNESCO Quarterly Report
  (July-September 2003)

5. Background to the Workshop on Science in the information Society

The UN World Summit on the Information Society (WSIS) takes place in Geneva in December this year and in Tunis in 2005. The scientific community has a key role to play in the development of the Information Society for the benefit of society as a whole. In this development, there are both opportunities and challenges for the future of science itself. The WSIS, which will bring together stakeholders from all sectors of society (Governments, Business and Industry and Civil Society) is a unique opportunity to define the principles and specific actions that will dictate the future development of the Information Society. The international scientific community has a responsibility to ensure that it's voice is heard in defining these discussions. However in order to do this it is important that the scientific community consult with all stakeholders.

In order to commence this consultation process ICSU, CODATA , the Committee on Data for Science and Technology, and UNESCO organized a one day workshop in UNESCO on 12 March on "***Science and the Information Society".***

Preparatory steps leading to the Workshop[1]
It should be noted that in preparation for this Workshop, ICSU and CODATA organized an on-line discussion forum which was hosted on the ICSU web-site, Feb10-March 10, 2003 and the contributions to this forum provided an important in-put to the Workshop. **http://www.icsu.org/events/WSIS/workshop.html**.

An international Symposium on **"*Promoting Open Access and the Public Domain in Digital Data and Information for Science***" took place immediately prior to the workshop (10-11 March). The previous sections of this report focus on this meeting from the information society perspective. http://www.codata.org

The Workshop
On 12 March 2003, ICSU, CODATA and UNESCO organized a meeting in UNESCO of more than 60 invited experts-leading scientists and representatives of international organizations to consider the role of science in the information society.

The Workshop was organized around four themes and the participants were divided in four sessions

Scientific Information and Data as a Global Public Good:
Chair: Paul Uhlir Rapporteur: Lulu Makhubela

Scientific Data and Information for Decision Making and Better Governance
Chair: H Sun Rapporteur: D Dickson

Ensuring Universal Access to Scientific Knowledge Internationally, Including Overcoming the "Digital Divide"
Chair: Eric Sandewall Rapporteur: Barry Mahon

Using Scientific Data and Information to Improve all Levels of Education and Training
Chair: M Menon Rapporteur: Sally M. Johnstone

These themes were designed to be inclusive rather than exclusive and were chosen with the multi-stakeholder audience of the WSIS in mind.

Under each theme, the following key questions were addressed:

[1] The background documentation to the Workshop, including background to the themes and guidelines to rapporteurs can be found in Annex three.

1. What are the key principles that should govern the development of the information society?
2. What are the current and future opportunities and challenges in relation to this theme?
3. Are there good examples, both successes and failures, from the science community that illustrate 1 and 2?
4. What are the needs/actions required from both the science community itself and from other stakeholders.

The Workshop was opened by Sir Roger Elliot, ICSU, followed by presentations by Mr. A. Walid Khan, Assistant Director General for Communication and Information, UNESCO and Prof. S. Iwata, President of CODATA. The Workshop then divided into four parallel sessions. Each session addressing one theme as identified above.

Sir Roger Elliot, in his opening remarks, summed up the critical role of science in the information society. He stressed the need for scientific research, the need for scientists to have a full and open access to scientific information, and the need for improved scientific education and training, to increase public understanding of science in order to enable society to make more informed decisions. Sir Roger also emphasized the role of the scientists in the development of information and communication technologies (ICTs) which are the foundation of the information society. Without scientific research and development "there would be no information society to discuss". He expressed the hope that liberal IPR regimes would be developed to ensure the growth of science so that it could continue to play its vital role in the development of a "fair and truly international information society."

Theme I. Scientific Information and Data as a Global Public Good:

The Internet, World Wide Web, and data transfer and storage technologies have greatly accelerated collection, storage and dissemination of scientific data and information in the last decade. There have been, however, some significant developments, especially in the developed countries, as regards to ICTs, legislation on intellectual property rights, and methods for commercializing scientific information. These changes have put economic, legal and technological restrictions on full and open access to scientific information and data. They have created a tension between the traditional interest in a thriving public domain—in which publicly funded research data is openly and universally available—and the commercial interest in acquisition, ownership, licensing, and sale of scientific data and information.

Key Principles that came from this session:

1. The information produced from publicly-funded scientific research is a "public good" and an investment in the public interest.

2. Publicly-funded research data should be priced at no higher than marginal cost of dissemination and be freely available on the Internet to the greatest extent possible.

3. Scientific progress relies mainly on full and open access to public data and on the open disclosure of results in the scientific literature. Publicly funded research data should be openly available to the maximum extent possible in order to derive greatest possible social and economic value.

4. Intellectual property rights (IPRs) stimulate investment in the production and dissemination of scientific information in the private sector. The interest of rights holders, however, must be balanced with society's need for open exchange of ideas.

5. Although a market model may be appropriate for the dissemination of scientific literature, special provisions need to be made for providing access in developing countries. Open access journals provide the greatest access for all scientists to scientific literature.

Challenges and opportunities identified:

1. Opportunities for ensuring universal and equitable access to scientific data and information are threatened by excessive privatization and commercialization.

2. Extensive use of digital networks for the production and dissemination of scientific information should benefit all future users—both actual and potential.

3. Increasing protectionism of intellectual property regimes tends to reduce the availability of public domain data for scientific research.

4. Encouraging innovative and collaborative approaches to promote data access should have wide benefit but requires public support and investment.

Examples discussed:

The examples below represent solutions implemented to overcome the challenges described above, and if modified appropriately to address the local circumstances, they could serve as models for the future.

1) Open Access to Geographic Data in Namibia[1]

In January 1998, the Directorate of Environmental Affairs (DEA) under the Ministry of Environment and Tourism (MET) launched a national programme called "Information and Communication Services for Sustainable Development" (Infocom) in Namibia. The overall goal of Infocom was to promote sustainable development in Namibia, through developing an effective Environmental Information System (EIS) and communication mechanism to disseminate geographical information. EIS employed a network approach to strengthen and promote the state of data sharing, and access to spatial data. The Environmental Monitoring and Indicator Network (EMIN) was established in June 2001. EMIN showed that as Namibia progressively seeks to achieve sustainable development. EIS was shaped into defining appropriate pathways for engaging and communicating information to decision-makers and to the whole Namibian public at large.

EMIN houses the results of a national Atlas, regional profiles and mappings (with data on administrative and political boundaries, households, infrastructure, landscapes, land use, livestock, population, topography, vegetation and soils, climate and water resources, wildlife, literature and photographs). All data are made freely downloadable from the information portal. Upon request, the data are distributed on CDs to those who do not have access to the Internet. Hard copies of the publications are sent to all state libraries in the country. A national environmental metadata project documents all geographical data available in different institutions, making it easier to reach the data distributors of specific data sets.

2) Building research capacity and information sharing
The Ptolemy Project: Delivering Electronic Health Information in East Africa[2]

The Ptolemy project, a research partnership between the Office of International Surgery at the University of Toronto and members of the Association of Surgeons of East Africa (ASEA), combines the provision of access to high-quality electronic health information with a process to evaluate its impact for the participants. One hundred proxy server accounts at the University of Toronto Library were recently created for participants, most of who were members of the ASEA. Ptolemy has been shown to deliver useful, timely, and relevant content to surgeons in Africa, and it has made an immediate, positive impact on their clinical, teaching and research work. Ptolemy is a simple, low-cost, practical, and replicable model for bridging the digital divide in order to build clinical, teaching, and research capacity in East Africa.

---

[1] Based on a presentation by Emma Noongo and Nico Wellemse, Ministry of Environment and Tourism, Namibia at the International Symposium on Open Access and the Public Domain in Digital Data and Information for Science 10/11 March 2003.

[2] Based on a presentation by Massey Beveridge, University of Toronto, Canada at the International Symposium on Open Access and the Public Domain in Digital Data and Information for Science 10/11 March 2003.

3) Open Access publishing: Bioline International, and the Journal of Postgraduate Medicine - A Collaborative Model.[1]

Bioline International (BI) was set up in Canada, in 1993 as a result of increasing dissatisfaction among scientists about the way research publications, particularly those from developing countries, were (or were not) distributed. Managed by scientists, librarians, and information professionals on a not-for-profit basis, BI provides electronic publishing and distribution services for publishers of biomedical journals from developing countries who wish to increase the visibility, accessibility, as well as impact of their publications. The Journal of Postgraduate Medicine (JPGM), a quarterly publication from Seth G.S. Medical College, Mumbai, India, joined BI as an open access journal. The collaboration of BI and JPGM sets an example for the ways in which journals from developing country can benefit from low-cost shared technology and extend accessibility to their content.

These examples highlight the importance of adopting open standards and protocols in order to maximize interoperability between databases, provide an example of how to promote open access to and sharing of public scientific resources while considering new funding opportunities and the rights of authors, and illustrate the importance of institutional collaborations in the advancement of knowledge building and sharing on a truly global scale.

4) Weather Data – positive and negative examples:

Positive Policy Example:

Some 60 per cent of the world's population resides in regions affected by cyclical monsoons. The ability to predict the onset, duration, and severity of monsoons would greatly enhance agricultural management and flood preparation.

In order to develop reliable, predictive models for monsoons, scientists need access to historical atmospheric modeling data—most of which was originally collected by public meteorological services in North America and Europe—to compare with their own observational data.

The USA National Weather Service and National Oceanic and Atmospheric Administration openly provide such data, without any legal protection, and at dissemination cost only.

Negative Policy Example:

The EU-funded European Centre for Medium-Range Weather Forecasting (UK) treats its data as a commodity, charging for access on a cost-recovery basis—at prices that most researchers cannot afford.

By making it more difficult to integrate global data, such a commercialization policy hampers the international collaboration required to maximize the benefit of scientific data.
www.weather.gov/sp/Borders_report.pdf

This is an example of the economic pressures on public institutions to be self-sustaining and therefore model themselves after for-profit organizations. Even if the institutions survive economically, society would pay a price in the long run by stifling a global cooperation among scientists as well as the end users of such publicly-funded data.

[1] Based on a presentation by D.K. Sahu, JPM Managing Editor, India, and Leslie Chan, Bioline, Canada at the International Symposium on Open Access and the Public Domain in Digital Data and Information for Science 10/11 March 2003.

Recommendations based on the discussions in this particular session:

1. All governments should adopt policies to ensure that data produced from publicly-funded research remains openly available to the largest extent possible.

   Open availability of scientific data avoids unnecessary duplication of effort, maximizes the return on public investment, promotes verification of research results, and stimulates scientific progress. Scientific data produced with public funding should normally be made available at no more than the marginal cost of dissemination and with no restrictions on reuse.

2. Develop special programmes for scientific collaboration across the digital divide, thereby facilitating exchange of scientific information and knowledge.

   ICTs offer new and exciting opportunities for merging scientific knowledge and expertise from all countries to address issues of mutual concern and importance. Local, regional, and international scientific networks need to be strengthened.

3. Appropriate national policies should be developed to facilitate the exchange of scientific information.

   Equipment taxes, import duties and telecommunications pricing strategies can all have negative effects with regards to ensuring universal access to digital information. In many countries, special provisions have been made for research and education institutions; such approaches should be considered elsewhere. At the local community level, public-access stations can play an important role.

4. Promote different models of scientific information production and dissemination, including those particularly appropriate to developing countries.

   The Internet provides new opportunities for distributed, production validation and dissemination of scientific information, including open access journals, open data archives and other novel approaches. Robust, validated, and affordable software is needed to support wider adoption of these models.

5. Involve scientists, as major stakeholders in the information society, in the discussion and development of intellectual property rights and copyright legislation—at both the national and international level.

   Any new legislation should strike a careful balance between public and private interests, and the need to enhance science and education through full and open access to data, and the need to adequately protect authors' rights. Any restrictions on access to digital data should clearly indicate exemptions for research and teaching purposes.

5. Conduct more research on social and economic value of Public Domain information and open access regimes in science and other contexts.

   Although over the centuries society has benefited, socially and economically, from full and open access to scientific information, there has not been any study to quantify these benefits. Now that the Public Domain is under increasing pressure from commercial interests, and advocates of privatization of public services in the scientific field, it would be timely and important to study the economic and social value of maintaining and

strengthening the Pubic Domain. A quantitative economic argument would influence decision makers, and help them to make informed and objective decisions with regard to Public Domain, open access and privatization of scientific data.

Theme II. Scientific data and information for decision-making and better governance.

Scientific research, and the resulting scientific information and data, are the most reliable tools for identifying and analyzing objectively the problems faced by society and for finding appropriate and timely solutions to these problems. If used objectively and appropriately, scientific information, provides society with an important resource that supports good decision-making and policy development.

Information and Communication Technologies (ICTs) are transforming governance at many levels, in part by facilitating the involvement of more actors, whose effective interaction relies on full and open access to a knowledge infrastructure—*the public domain for science*—from which the whole of society should be able to benefit in an equitable way.

Effective interaction between the various stakeholders involved in, or affected by, policies formulated on the basis of scientific data requires total transparency in data collection and dissemination. The value of certainty and uncertainty, with respect to original scientific data, must be well understood by all parties to ensure the rational use of knowledge derived from this data. The media have an important and influential role to play in widely and responsibly disseminating scientific information.

Key Principles identified by this session:

1. Data created with the use of public funds should be recognized as a public resource and remain publicly accessible.

2. Standardization and quality assurance of scientific data and information are required for sound decision making.

3. Use of ICTs should ensure the open access and transparency essential for the effective use of data by decision makers.

Challenges and opportunities identified:

In order to ensure that ICTs effectively support good decision-making and governance, a number of major challenges must be overcome.

1. Many National governments, especially in developing countries, have not recognized the economic value of long term collection and monitoring of high quality scientific data.

   Governments need to invest resources at the national, regional and international levels to collect, monitor, and analyze high quality scientific data. The existence and access to such data will have a positive impact on health security, food security, economic infrastructure, and socio-economic development on a sustainable basis. This is particularly true with respect to scientific data pertaining to agriculture, climate change, infectious diseases and natural disasters.

2. Communication between scientists, decision makers, and civil society must be strengthened

   These three stakeholders have a lot to benefit from each other. Scientific research provides the decision makers with a resource to help them make decisions that lead to good policy making and governance. This in turn creates a better society for all. However the scientific community, in order to provide this resource, require the support of the decision makers. This support is not only from a financial perspective but also from training, education and legislative perspectives. To this end it is important that each stakeholder understand the

needs and requirements of each other and this can only be achieved by better communication.

3. The requirements of scientific independence and the needs of society must be balanced.

   On the one hand scientists need to be cognizant of and responsive to the immediate needs of the community they live in, and direct their efforts to solving immediate problems as prioritized by the community. On the other hand undue pressure should not be put on the scientific community to produce conclusions that "suit" political demands. Needs of the society and of the scientist should be recognized and balanced in order to foster independent scientific endeavor as well as to overcome challenges faced by society.

4. There is a need to ensure interoperability between established systems for data collection and dissemination and the new, ICT-based, methods.

   Accurate, efficient and timely flow of scientific information is necessary. This requires a networked system, which connects scientific information on national regional and international levels. Since the collection, dissemination and storage systems of developed and developing countries are at different levels of scientific sophistication using different hardware, software and types of medium, there is insufficient operability between networks. As a result even if there is sufficient data available to make scientific research and create applications, there is a discontinuity in information and data exchange.

5. There are difficulties in establishing working links and understanding between traditional and modern knowledge systems, which can be further exacerbated by the use of ICTs.

   Just as scientific information needs to flow from developed to developing countries, it also needs to flow in the other direction. Traditional knowledge and scientific data from developing countries need to be accessed in order to do research, and develop appropriate technological solutions to the problems of developing countries as well as to the global problems.

Examples discussed:

1) Regional cooperation and sharing of data for regional decision makers

A recent case study[1], on the use of scientific data in decision making related to sustainable development, in the Senegal River Basin (West Africa) illustrates the importance of collecting and integrating data from many different disciplines and sources. The livelihoods and health of many people in several countries depend on access to water from this region. Because the problems confronting management of this area are complex (e.g. endemic malaria), their resolution requires data from many sources and over variable timescales (e.g. rainfall estimates and infectivity rates).

Local and regional decision makers are confronted with a lack of baseline data, an inability to locate and share existing data, and a time lag between data acquisition and availability. This creates serious consequences for health and agriculture management. Wider use of ICTs would help establish a shared knowledge base founded on reliable data and improve access to, and dissemination of, relevant information from local and foreign data sources.
www.nap.edu.catalog/10546.html

[1] Senegal River Basin Study by U.S. National Committee for CODATA, Senegalese National CODATA Committee, and the National Research Council of the National Academies, USA, published by the National Academy Press in 2002.

2) Global Cooperation -- Mapping Public Health and Scientific Information Sharing

AIDS, Ebola, and SARS have shown how the entire world is affected by transmittable diseases, and need to find global solutions to these global problems. The recent emergence of Severe Acute Respiratory Syndrome (SARS) underlines the importance of ensuring that responsible authorities are adequately prepared to report accurately major public health risks. It also highlights the important role of the media in raising public awareness.

Maintaining careful and consistent disease surveillance across the globe is fundamental to ensuring that alert and response systems can be initiated and action taken at the first signs of an epidemic. Many countries still lack an effective, real-time disease surveillance system. As a result, epidemics of both emergent and known diseases can be hard to track and can have devastating effects.

By providing an interface between data and maps, geographic information systems (GIS) play a vital role in the detection of and response to health problems. HealthMap, interactive information and mapping system developed by the World Health Organization, strengthens data collection, management, and dissemination to support public health activities and decision-making. **www.who.int/emc/healthmap/HealthMap.pdf**

3) Communicating science to all stakeholders

Effective science communication plays a vital role in informing public opinion on the scientific issues that underlie decision-making, whether it is regarding new claims by a drug company or a government announcement on irrigation.

In many developing countries, the lack of communication infrastructure makes it particularly difficult for science journalists to respond quickly to scientific and health-related stories. In addition, they often lack access to the reliable background information and sources of informed opinion they need to report accurately and authoritatively.

The Science Development Network,[1] SciDev.net, provides a free-access source of online news and analysis about the role of science and technology in addressing the needs of developing countries. The Network also offers workshops and training sessions for journalists and public information officers, designed to build capacity in science and technology communication and create opportunities to share best practices. **www.scidev.net**

Recommendations based on discussions in this session:

1. Increase public investment in the collection and management of scientific data necessary to underpin sound decision-making.

   Governments should be made better aware of the importance of integrating scientific data from research into policy and decision-making. In the poorest countries, it is particularly important to prioritize essential data collection activities.

2. Ensure the long-term support for the collection of data and the maintenance of scientific databases.

[1] Based on the keynote address by David Dickson, Founder/Director of SciDev.net at the *International Symposium on Open Access and the Public Domain in Digital Data and Information for Science*, held on 10-11 March 2003 at UNESCO .

In many areas, particularly those relating to environmental change or public health, long-term monitoring is essential to produce a useful data set. Established data sets need to be maintained, up-dated and made available.

3. Ensure that the scientific data collected is of the highest quality.

   Data collection methods must comply with international standards if the data is to be used as a sound basis for informing national or international policy. Data collection and dissemination must be undertaken in total transparency to ensure its acceptance as a legitimate support to local, national and international decision-making.

4. Encourage closer involvement of the media as a bridge between scientists, decision-makers and the public.

   Converting and diffusing the knowledge derived from scientific data into relevant public action requires an intermediary that can be trusted. Efforts should be made to improve communication between scientists and journalists and other stakeholder groups, to ensure that each party understands the constraints of the other, and can better evaluate the relevance of the scientific knowledge to specific local situations.

5. Carry out research and development on new and more inclusive governance mechanisms at local, national and international levels for the information society.
   ICTs provide new opportunities to involve all stakeholders in policy formation and problem management, including people from the communities directly affected. The most effective and efficient strategies for participatory decision-making need to be identified and developed.

Theme III: Ensuring universal access to scientific knowledge internationally, including overcoming the "digital divide

Scientific research is an important factor underpinning the development of the information society. It leads to the generation of new technologies and to the production of data and information that, when combined with these technologies, can be of enormous benefit to society as a whole.

Scientific knowledge often has international applicability. Information and communication technologies (ICTs) have the capacity to increase accessibility to scientific knowledge internationally. Despite this potential, the knowledge divide appears to be widening. Increasing inequalities in access to ICTs reduce opportunities for individuals and institutions to use scientific knowledge that could help foster innovation, facilitate efficient decision making, and support education and training.

Adding to the problem of inequality, the present systems for the publication and dissemination of scientific information do not provide sufficient access to knowledge originating in many developing countries. This knowledge may be vital in addressing the problems of the developing countries as well as to find global solutions to global problems like transmittable diseases, climatic changes, natural disasters, etc., While scientific data and information from one country may or may not be specifically relevant to another country's needs, all countries must be able to develop and communicate their own knowledge so they can effectively cooperate in finding global solutions.

Inequalities in access to information and in the availability of relevant technologies lead to differences in productivity, creativity, innovation, and standards of living. If the United Nations' Millennium Development Goals—including the reduction of poverty—are to be realized, equitable access to scientific knowledge must be made a priority.

Key Principles identified that came from this session:

1. Universal and equitable access to scientific knowledge

2. Equal opportunities for all to create, disseminate, and use information

Challenges and opportunities identified:

In order to achieve universal access to scientific information, a number of major challenges must be overcome.

1. Access to scientific information, produced largely in developed countries, is prohibitively expensive for poorer countries.

   There should be mechanisms developed to offer publications and online scientific information to the researchers in developing countries either free or at substantially reduced costs.

2. Unequal opportunities exist internationally for the creation of, and access to, scientific information.

   Researchers in many developing countries do not have the resources to collect information and data, and to disseminate them to other researchers within their country or to the scientists in other countries. Many researchers find it difficult to publish their findings because their articles do not conform to the higher standards of the publications, principally in English, in the developed countries.

3. There is limited awareness of existing open access programmes for scientific information in educational and research institutions in many developing countries.

   Due to lack of availability of communications networks and access to Internet, many scientists and academicians are not aware of the open access programmes available to them.

4. Many developing countries lack the necessary technical infrastructure to benefit from recent ICT advances that would allow quicker and easier access to scientific knowledge.

   There is tremendous deficiency in the communication infrastructure -fibre optic networks, telephonic connections, computer hardware, etc., due to lack of institutional resources. As a result scientists are not able to take advantage of the scientific data that is vital for their research.

5. In some countries, the lack of incentives to perform scientific research, aggravated by the problems of accessing up-to-date scientific information, makes it difficult to retain skilled scientific researchers.

   Faced with lack of resources and sometimes the misplaced priorities of the decision makers, talented scientists get frustrated and look for opportunities in private industry or in public institutions in developed countries, where they have better facilities conducive to professional growth.

Examples discussed:

1) Developing global protocols

Expansion of the Internet and the development of author self-archiving (e-print) systems give researchers more control over the communication and distribution of their work. Many researchers now choose to share their results immediately by depositing papers or drafts into such digital repositories as well as—or even instead of—published academic journals.

But e-print archives can only realize their full potential if they are adopted by scientific communities in parallel with an agreement on interoperability protocols. The Open Archives Initiative was established to create a forum to discuss and develop common web protocols for e-print archives. It also promotes their global acceptance and accessibility across physical, organizational, and disciplinary boundaries. These protocols ensure that various e-print archives can interact, thereby making it possible to access any paper from any computer, as if all the material was held in one virtual public library. **www.openarchives.org**

2) Facilitating access through online scientific information
A growing number of initiatives aim to provide developing countries with low-cost access to online scientific information.

The Programme for the Enhancement of Research Information (PERI), operated by the International Network for the Availability of Scientific Publications (INASP), provides low-cost access to more than 8000 full-text online journals and databases. PERI's online services improve access to local research results, as well as locally facilitated training in Internet use and publishing skills for researchers, publishers, editors, and librarians. www.inasp.info/peri/

Through the Health InterNetwork Access to Research Initiative (HINARI), an initiative of the World Health Organization, accredited public institutions can take advantage of free or very low-cost access to more than 2000 leading biomedical journals. **www.healthinternetwork.org**

The electronic Journals Delivery Service (eJDS) Programme, run by the Third World Academy of Sciences and the Abdus Salam International Centre for Theoretical Physics, distributes scientific articles via e-mail to scientists in developing country institutions, where insufficient bandwidth makes it difficult to download material from the Internet. **www.ejds.org/**

3) Building capacity
African Journals OnLine (AJOL), managed by the International Network for the Availability of Scientific Publications, aims to promote the awareness and use of journals published in Africa and to strengthen the science sector of African academic publishing. It provides Internet access to the tables of contents of more than 50 journals published in Africa, backed by web links to electronic versions of articles (where available) and a delivery service for document photocopies.

INASP has also established a pilot project to help ten leading African journals develop online publishing capacity. By offering full-text, electronic delivery, these African journals will be better equipped to compete successfully with journals published in other parts of the world. The pilot project will evaluate whether electronic delivery increases journal use and sustainability.
www.inasp.info/ajol/

Recommendations based on discussions in this particular session:

1. Strengthen and enhance existing information and communications infrastructures to provide affordable and technically appropriate connectivity for all communities of scientific information users.

   Provision of adequate infrastructure is a prerequisite for ensuring universal access to scientific information. This should be a priority of the governments in developing countries.

2. Encourage human and institutional capacity building.

   Educational and research institutions and others familiar with ICT applications should work together to develop training facilities, including specialist training in open access approaches to information management. Both North-South and South-South networking are necessary in this regard.

3. Publicise and support programmes that promote equitable access to scientific information in developing countries. Better co-ordination between the various existing programmes should be encouraged to maximize their impact. More publicity and communication at a local level is necessary. The demand for affordable access to scientific information is far in excess of the capacity to deliver and effective programmes require additional financial support in order to fill this gap.

4. Improve bilateral transfer of scientific knowledge between developed and developing countries.

   Programmes to ensure that the results of scientific research in developing countries are submitted for publication in international science journals should be encouraged. The creation of new science publications, using low-cost electronic approaches, also needs to be promoted in developing regions.

5. Develop institutional repositories for the preservation and dissemination of the results of scientific endeavour**.** Scientists are increasingly publishing their results in open-access institutional archives, as well as in conventional literature. The development and use of institutional archives, including digital libraries and their related software, should be supported.

Theme IV: Using scientific data and information to improve all levels of education and training

Information and communication technologies (ICTs) are already having a tremendous impact on scientific education and training in many countries. Yet there is a risk that poorer countries, in particular, will be excluded from this development. ICTs offer unprecedented opportunities to support scientific education and training programmes that exploit and enhance global knowledge, yet can be tailored to local needs. However, it is important to note that not all education and training programmes require high-speed, two-way communication. In some cases, lower level technologies may be most appropriate.

An ever-increasing amount of science and technology information is freely available. Yet, without education and training on how to access and utilize it efficiently and effectively, the potential benefits for society as a whole will not be realized.

The dialogue between researchers and the potential end-users of scientific information—be they government ministers or local farmers—must be improved. When producing scientific information, researchers need to consider the dissemination and benefit to the end-users.

Key principles that came from this session:

1. Scientific knowledge derived from data and information is vitally important for all levels of education and training.

2. Learning to infer the implications of data is vital to the public understanding of science.

3. Education should include an appreciation of the importance of data quality.

4. ICT educational tools should take into account the world's linguistic and cultural diversity.

Challenges and opportunities identified:

There are a number of opportunities and threats to the use of scientific information and tools for training and education.

1. ICT tools can decrease the costs of disseminating knowledge, but they require that people have a higher level of information literacy.

2. New frameworks for quality assurance of ICT education need to be established.

3. The use of ICT tools could lead to the excessive commercialization of education.

4. In some countries and institutions, there is a lack of foresight and willingness to invest in ICT-based education.

Examples discussed:

1) Bringing data into the classroom

School children in Europe and Africa are using real-time data in their classrooms to follow migration patterns of black storks between their respective continents.

An international programe, launched in 1998, brings together scientists, naturalists, and schools in a joint effort to study the habits and behaviors of these protected birds. The storks are tagged with radio markers and their signals are picked up by the ARGOS satellite-based data location and collection system—a system dedicated to monitoring and protecting the environment.

Children can use the recorded data, accessed via Internet, to calculate flight speeds and compare performances of individual birds. This information is also integrated into a wider ranging study of the environmental factors influencing the storks' migration patterns. **www.explorado.org/solon-new/**

2) Opening up education

A growing number of ICT-based initiatives provide opportunities for individuals and higher education institutions to access valuable educational material.

The Massachusetts Institute of Technology's OpenCourseWare initiative plans to make approximately 2000 MIT courses and related teaching material freely available for use by faculties and students around the world. **http://ocw.mit.edu**

CERN, the European Laboratory for Particle Physics, is piloting a web-based project to archive a selection of its lectures. It aims to implement an electronic archival system for slide-based presentations as a tool for collaborative communication and learning.

UNESCO is leading the Avicenna Virtual Campus project, which promotes best use of ICT-assisted Open Distance Learning (ODL) through a network of 11 e-learning centres around the Mediterranean basin. In collaboration with some of the EU's leading Open Universities and ODL providers, the project will establish local infrastructure and transfer best practices between participating universities. **http://avicenna.unesco.org/**

3) Safeguarding indigenous knowledge

A project in the Philippines is combining ICT-based data and indigenous knowledge to create 'community maps' of forests and other areas that are environmentally at risk due to economic development.

Scientists from the Environmental Science for Social Change Centre, based at the Manila Observatory, are working closely with members of the local community to create a detailed map of the area. The project combines indigenous knowledge, which provides information about the current ecosystem, and data from satellite-based Geographic Information Systems (GIS), to ensure that the map is spatially accurate. The resulting community map shows how land is currently being used and models various plans for the future. These maps help the community and government resource management professionals develop a sustainable approach for future land use—one that respects both local needs and cultural values

4) Virtual Libraries for scientific information[1]

World Federation of Engineering organizations (WFEO) is now working with UNESCO to establish Virtual Environment and Sustainable Systems Engineering Library (VESSEL) Network to provide scientific and technical information to developing countries at the high school, technical college and university levels.

[1] Based on comments by Mr. W. J. Rourke, Special Advisor to President, World Federation of Engineering Organizations (WFEO), in the Online Discussion Forum held by ICSU from February 8 through March 7, 2003.

5) Transferring scientific knowledge to the general public:

Knowledge Management Division of South Africa Medical Research Council (MRC) is developing a Research Translation Unit to guide the use of various modalities of transfer of scientific knowledge to the general public, and to evaluate the impact of health research.

Recommendations based on discussions in this particular session:

1. Support further research into ITC-supported learning.

   Science educators must understand how the use of ICTs relates to the learning capabilities of children. They should also recognize the importance of imparting how scientific knowledge is produced and how it differs from other types of information. Both students and the general public should be taught how to discriminate between scientific information of variable quality, particularly in regards to information available on the Internet.

2. Encourage service-learning—or community service as a mode of learning—in science classes to promote public understanding of science and knowledge transfer.

   Use of the scientific method and 'hands-on' data collection should be an integral part of science lessons in schools whenever possible. ICTs should support such activities to give children the opportunity to integrate the use of digital data in their early learning experiences.

3. Use ICTs to share educational resources through open courseware that is freely available online to researchers, teachers, and students.

   Open distance learning, as well as global virtual libraries and laboratories, can be used to support scientific research and education worldwide. Educational ICT materials must be archived to ensure that best practices are safeguarded and that resources are available over long periods of time.

4. Promote mechanisms for integrating traditional knowledge into modern information societies.

   Creating a bilateral flow of education and learning between local communities and scientific researchers is vitally important. ICTs can provide new opportunities for information and knowledge exchange between communities, but they must be supported by appropriate capacity building and skills training.

5. Recognize the value of research published in electronic format and of service-learning efforts in higher education and research institutions.

   Researchers need to see that their efforts to share data and knowledge with the widest possible public will be positively encouraged and recognized by their peers.

6. Follow up from the Workshop

Immediately following the Workshop, the Chairperson and Rapporteur of each thematic group met to develop the issues that were discussed in each session and to define the most important recommendations that should be included in a "short-versioned" Agenda for Action that could be included in the WSIS. They related nine key recommendations are as follows:

Agenda for Action

1 Ensure that all universities and research institutions have affordable and reliable high-speed Internet connections to support their critical role in information and knowledge production, education and training.

2. Promote sustainable capacity building and education initiatives to ensure that all countries can benefit from the new opportunities offered by information and communication technologies (ICTs) for the production and sharing of scientific information and data.

3. Ensure that any legislation on database protection guarantees full and open access to data created with public funding. In addition, restriction on proprietary data should be designed to maximize availability for academic research and teaching purposes.

4. Promote interoperability principles and metadata standards to facilitate cooperation and effective use of collected information and data.

5. Provide long-term support for the systematic collection, preservation and provision of essential digital data in all countries.

6. Promote electronic publishing, differential pricing schemes and appropriate open source initiatives to make scientific information accessible on an equitable basis.

7. Encourage initiatives to increase scientific literacy and awareness of how to interpret web based scientific information.

8. Support urgently needed research on the use of information technologies in key areas, such as geographical information systems and telemedicine, and on the socio-economic value of public domain information and open access systems.

9. Recognize the important role for science in developing and implementing the new governance mechanisms that are necessary in the information society.

Endorsements

The Agenda for Action has been circulated to the ICSU and CODATA members for review and comment. To date the following scientific organizations have formally endorsed this Agenda.

The Royal Society, UK
The Royal Society of New Zealand
The Science Council of Japan
The Chinese Association for Science and Technology, CAST
The Scientific and Technical Research Council, Turkey
National Research Council, Thailand
Consiglio Nazionale delle Ricerche, Italy

Academy of Sciences of Moldova
IUPAB International Union for Pure and Applied Biophysics
IMU International Mathematical Union
IUPAP International Union of Pure and Applied Physics
IUPsyS International Union of Psychological Science
IURSI International Union of Radio Science
IUPESM International Union for Physical and Engineering sciences in Medicine
IUHPS/DHS International Union of the History and Philosophy of Science
ISPRS - International Society for Photogrammetry and Remote Sensing
IUPAC International Union of Pure and Applied Chemistry
IUPAB International Union for Pure and Applied Biophysics
WDC Panel on World Data Centres
COSPAR - Committee on Space Research
IGBP International Geosphere-Biosphere Programme

The scientific members have also been encouraged to bring the Agenda for Action to the attention of the delegates within their respective countries, who will attend the governmental session of WSIS.

The Agenda for Action has also been incorporated into the official joint submission by ICSU, ICTP, TWAS and UNESCO to WSIS on 31 May 2003. Much of it was also incorporated into the formal submission from UNESCO for the same deadline.

Acknowledgement of thanks

CODATA would like to thank UNESCO for its financial support towards both meetings and in particular to John Rose and Annick Ongouya from the Information Society Division.

We would also like to thank Carthage Smith, Hervé Barioulet, Paul Uhlir, Subhash Kuvelker, Julie Esanu, Malene Munkebo and Valerie Theberge, for their guidance and assistance which directly contributed to the success of these events