[1]The Digital Divide: your role in bridging the gap in aquatic library services for the disconnected

Meryl J. Williams and Choo Poh-Sze, ICLARM – The World Fish Center, PO Box 500, GPO, 10670 Penang, Malaysia

ABSTRACT

In the mid-1990s information and communications technology (ICT) boomed, enabling rapid and worldwide dissemination of information to those with access. However, the rapid transfer of information benefits the developed nations more than the developing ones, giving rise to concerns of a digital divide. Aquatic library and information services are just as subject to the digital divide as other endeavours, and perhaps more so since, in the developing world, aquatic resources sectors, such as fisheries, are often economic activities of the marginal poor and receive little attention.

Bridging the digital divide in aquatic library services requires solutions that are complex and multifaceted. Above all, many poor developing nations have different national priorities such as the provision of health programs, housing, peace and basic education in the 3Rs – all of which must be attended to before hooking up to the Internet.

Coincident with the digital divide is the avalanche of information that swamps the connected. Solutions to organizing information and knowledge management appear to create win-win possibilities – what helps make the information mountains more accessible to the connected can also help the disconnected. The above approaches with nodes, focal points and international reference centers could mean that anyone is just one step away from access. IAMSLIC members have a dual obligation – to help potential users make the step and, when it is made, to make sure that the step was worthwhile and the data, information and knowledge so desired is ready in a useable form.

Keywords: Digital divide; aquatic library services; bridging the gap; solutions

---

[1] Paper presented in the 28th IAMSLIC Conference, 5-11 October 2002, Mazatlan, Mexico

Introduction

The boom in information and communications technology (ICT) has brought vast benefits to mankind- to the rich as well as the poor. For the developed nations, the ability to access the Internet has made the lives of people more convenient in terms of information retrieval, in the performance of their daily chores such as shopping for necessities, payment of bills as well as banking and other business transaction, and in recreation and access to culture. ICT benefits the poor by removing social, economic and geographical isolation, by increasing access to information and education, and by enabling poor people to participate in more of the decisions that affect their lives (The Human Development Report 2001). The Report provided examples and showed how ICT gave poor people political empowerment in the Philippines and Honduras. In Honduras, it enabled a fishermen's organization to send a video on illegal mangrove felling to Congress. ICT has created jobs in Costa Rica, India and South Africa, and provided health networks in Gambia and Nepal.

Some development agencies, however, fear that the ICT fad may detract donors, and may drain resources and support for traditional development goals. Others fear that the more developed nations, which can utilize the technology more effectively than the developing nations, may lead to further marginalization of the poor.

Over the last couple of years, there is active discussion on the digital divide where the development of ICT is believed to have widened further the opportunity gap between the haves and the have-nots. There is a real risk that the interest of poor people and poor countries are being left on the sidelines, and governance of the Internet needs to be widened to bring in the needs and concerns of developing countries (UNDP 1999).

The digital divide is not a new problem- whenever new technologies were introduced, disparity arose between those who could afford the technology and those who could not, and technology transfer programmes, too, have existed for many decades (Bridges.org report: http://www.bridges.org/spanning/chpt4.html- downloaded on 6 July 2002). James (1999- quoted from Bridges.org) noted the similarities between the current ICT age and the Green Revolution, and urged that we learn from past mistakes and draw on successes in our quest to bridge the digital divide.

Bridging the digital divide requires a clear understanding of the issues and the objectives, before solutions can be considered. In the library information services, even before the digital age, disparity existed between the rich and the poor nations in their ability to procure books, journals and other documents. The ICT era has merely aggravated this situation.

The digital age is definitely here to stay. A study carried out at the School for Information Systems in the University of California showed that growth of digital information is the fastest compared to all other forms; most of the information are created by individuals, amounting to a total of 740,000 terabytes in a year (thousand billion bytes) versus a mere 285 terabytes from published information (Anon 2000). ICT innovations, which are more effectively used by the richer nations, are continuously rolled out due to the rapid advancement of the digital frontier.

The divide is of varying 'widths' across the developing world but nowhere does it seem to be narrowing, even though many developing nations have given prominence to ICT development. To find solutions to bridging the gap would therefore require specification of the level of technology one hopes to bridge. Statistics on the availability of digital infrastructures, availability of computer hardware and software, availability of ICT specialists and information on users of digital technology for information retrieval, would provide a better perspective on the 'width' of the gap, and would help provide solutions on how to bridge, or at least narrow this divide.

In library information services, the most important need would be to ensure that those in the developing nations are able to gain access to information quickly, even though they may lag behind in the latest ICT development. The mountains of digital information need to be organized and managed for ease of retrieval subsequent to knowledge conversion. It is critical that professionals in the library information services reexamine their roles to ensure that the services they provide are able to meet the challenges posed by the digital age, and to ensure that they still play a relevant and effective role in information dissemination and knowledge enhancement.

Development of ICT

The invention of the electronic computer in 1939 marked the beginning of the electronic age. This invention was surrounded with controversy, with two parties (John Atanasoff, and Mauchly and Eckert) laying claims to the honour. This dispute was finally settled decades later in the United States Supreme Court, which recognised Atanasoff as the inventor (http://www.thehistorychannel.com/timeline/main.html). The electronic computer did not yet herald the boom in information technology; it took a few more decades and several other milestone events (see http://www.thehistorychannel.com/timeline/main.html), such as the invention of the transistor (thus ushering in the age of modern electronics), the development of computer memory in 1948, the invention of the email in 1972, and the invention of World Wide Web in 1990 at the European Organisation for Nuclear Research (CERN) in Geneva, to initiate the digital information boom. The announcement by CERN that it would not charge fees for the use of the Web, helped to shape its future as an open and free communication area.

Further advances, which spur the world towards the age of information technology, include the development in 1993 of Adobe Acrobat, software designed to distribute identical copies of electronic documents. In 1993 Stephen King published a short story collection "Nightmares and Dreamscapes" on the Internet. In 1994 search engines - Netscapes and Yahoo- were launched. In 1997 Microsoft purchased WebTV Networks, which has developed technology that enables users to read emails and surf the Web on their television sets.

The Internet has been described as the biggest library in the world with 24-hour access; the number of Web pages doubles every 100 days, with the number of Web-hosting computers doubling every seven months (Chowdhury 2000). A total of eight billion Web pages is projected by 2004, but current search engines track only about 20 to 25% of the existing information (Peizer 2000). Aquatic library and information services are perhaps subjected more to the digital divide than other endeavours since, in the developing world, aquatic resources sectors, such as fisheries, with few exceptions, are often economic activities of the marginal poor and receive little attention.

Digital Divide: definition and causes

The term digital divide often has different connotations to different people. Its definition takes on a range of comparisons from: better access to computers by the rich compared to the poor, and better computer knowledge among the young compared to the old, or the urban from the rural. It has also been noted that women face more restrictions than men in the use of ICT (Chamberlain 2002). These differences may exist between or within countries.

The divide may also refer to the more effective use of ICT by developed countries compared to those in the developing countries, and to a greater number of trained ICT specialists in the developed countries compared to those from the developing countries. Since English is used in almost 80% of websites, there may also be a divide between those proficient in the English language and those who are not.

The divide has been attributed to numerous reasons. It is inevitable that rich nations are often the first to benefit when new technologies are introduced, due mainly to the fact that they have better access to financial and trained human resources. Poorer nations, because of their commitment to other more urgent priorities such as the provision of better health care, housing, peace and basic education in the 3Rs, may not be able to allocate resources for ICT development. Moreover, as reported in the Human Development Report 2001, technology tends to favour high-income consumers rather than the needs of those with little purchasing power. Hence, development of low-cost computers and low-literacy touch-screens for the poor lags behind efforts devoted to the development of faster and more sophisticated computers, which have a ready demand from the rich. One other development which promises to narrow the divide is the Voice Portal, which may enable people without computers or Internet access obtain information from the Web, using just the telephone and their own voice, but it will be many years before they are widely used (Geer 2001).

Internet access

Internet use has grown exponentially from 16 million users in 1995 to more than 400 million in 2000, and is expected to reach 1 billion in 2005 (quoted from The Human Development Report 2001). Of the estimated 429 million people online globally, 41% are in North America, 27% in Europe, the Middle East and Africa, 20% in Asia Pacific and 4% in South America (Nymia 2002).

The ability to own computers is not merely an issue between countries; disparity exists within countries as well. For example, in the United Sates of America, Whites are more likely to have access to the Internet from home than Blacks or Hispanics have from any location, and regardless of income level, Americans living in rural areas are lagging behind in Internet access (NTIA 1999).

One of the greatest constraints to Internet access in poor developing countries is the cost of purchasing the hardware. In Bangladesh, for example, a computer costs more than eight years of income of an average earner, compared to one month's wage of an average American (UNDP 1999).

General Solutions to Digital Divide

Solutions to the digital divide require actions from various agencies and stakeholders, and the commitments of the governments as well as regional collaborative efforts and partnerships. In the 56 General Assembly of the United Nations held in June 2002 (see website: http://www.un.org/News/Press/docs/2002/GA 10031.doc.htm), participants recognized that the key causes are not simply technological but include also economic and social issues; bridging the divide would require concerns such as purpose, mindset, governance, leadership and vision. Participants also urged governments to recognize ICT as a necessity, not a luxury in government budgets, and equitable rules should be established to ensure that developing countries are not marginalized. The ICT era brings with it a world economy that is increasingly dependent on digital-based information; consequently the social well-being and economy of societies, communities and people are dependent on the successful mastery and utilization of ICT.

More research should be directed towards technology, which is more user-friendly and affordable to the illiterate and the poor, and not just to cater for market demand. Swaminathan (2001) noted, "if the market is the sole determinant of research investment decisions, orphans will remain orphans and economic and technological divides will grow". Ventura (2001) observed that there is as yet no well-publicized award of the status of the Nobel Prize to recognize scientific work that directly improves the quality of life of the poor and underprivileged; such an award may spur interest in research towards poverty alleviation. The availability of funding to carry out need-based and public good research is critical to hasten the bridging of the digital divide. Funds should be allocated to researchers, and recognition given to those who had contributed to research, which contribute to human development (UNDP 1999).

Libraries must also recognize that they play a central role in providing solutions to the digital divide. Their time-honored role as information providers may need to adapt to the

increasingly important forms of digital information, and there is a need to devise strategies for their effective and equitable dissemination.

Roles of aquatic library services in information acquisition and dissemination

Library services play a central role in transforming information into knowledge, and the latter into wisdom (Ventura 1997- quoted from Chowdhury 2000). Access to information is essential to all sectors of society, and is a pre-requisite for research and development. Aquatic information services, which provide specialized services tailored towards aquatic and fisheries sciences should understand fully the need of the users. Lourduswami (1996) noted that information management "is all about getting the right information, in the right form, to the right person, at the right time, in the right place to arrive at the right decision" and all information services should address the following issues:

- Need: what the user ought to have
- Want: what the user would like to have
- Demand: what the user asks for
- Use: what the user actually uses

Lourduswami (1996) recommended that when planning an aquatic resources library, the information systems design phase has to be preceded by an information audit to establish clearly the present and future requirements of those using the services.

In the digital age, the traditional roles played by the library, as an institution to preserve and disseminate knowledge, have not changed essentially, but with the avalanche of information especially from the digital sector, it has become a challenge to manage all these information - to determine what is needed and useful for the users, and how to handle and integrate the various forms of information (published, unpublished, printed and digital) pose big challengers to any library service. Lise Bissonnette, administrative head of the Grande Bibliothéque du Québec ă Montréal noted that "libraries have always tried to bring order to the chaos of knowledge, and with the explosion of information, this chaos has never been greater" (Lawrence 2000).

There are, however, positive aspects associated with the age of computers and ICT. The Web allows the linking and networking of libraries much more easily than before and it is possible for every library in the world to be linked up, provided funds are not a constraint. Eleanore Rodger (quoted from Lawrence 2000) believed that the Web complements rather than competes with public libraries. That digital information may replace paper texts is perhaps an unfounded fear. Lawrence (2000) noted that Canada, which is one of the most connected countries in the world is also well endowed with books- 275 million in its libraries.

Roles of aquatic library information services in bridging the digital divide

The digital divide is of great concern to information service providers, especially those from developed countries with democratic governments, because it touches on issues and policies which threaten traditional democratic ideals and library concerns and

interests, including freedom of speech, intellectual freedom and equity; in this regard the digital divide has forced on new roles for libraries and librarians in the 21st century (Shirley 2000).

The Governing Board of International Federation of Library Association and Institutions (IFLA), in its 75th anniversary Meeting in Glasgow, Scotland on 24 August 2002 approved the following declaration (Anon 2002):

- The IFLA supports the development of library information services worldwide, and ensures these services respect equity, the general quality of life for all people and the natural environment;
- Library and information services provide access to information, ideas and works of imagination in various formats, supporting personal development of all age groups and active participation in society and decision-making process;
- Library and information services provide essential support for lifelong learning, independent decision-making and cultural development for all;
- Library and information services contribute to the development and maintenance of intellectual freedom and help safeguard basic democratic values and universal civil rights. They respect the identity, independent choice, decision-making and privacy of their users without discrimination;
- To this end, library and information services acquire, preserve and make available to all users without discrimination the widest variety of materials, reflecting the plurality and cultural diversity of society and the richness of our environments;
- Library and information services are helping to tackle information inequality demonstrated in the growing information gap and the digital divide. Through their network of services, information on research and innovation is made available to advance sustainable development and the welfare of peoples worldwide.

Governments should therefore ensure sufficient financial and technical support for libraries to ensure that information service providers are updated on ICT, and include them as key collaborators in seeking solutions to bridge the digital divide. Strategies for bridging or narrowing the divide include the following:

National focal points and networking

In an unequal world, it may not be realistic to ensure that all institutions in all poor developing countries are linked to the Internet and able to afford the services. It is more logical to identify national focal points with good Internet access for information retrieval and dissemination, which are linked to international reference centers such as ICLARM. Requests for information from the less equipped institutions could then be directed to the national focal point through the more conventional means, such as through the post, telephone call or facsimile message. These focal points can also build up their collection of digital documents and CD-ROMs.

The Denver Public Library in the United States of America, has a well acknowledged collection of Western History, including 600,000 digital photographs which can be accessed on the Web; other libraries with digital collections include the Library of Congress in Washington, the Bibliothéque nationale de France Paris and the Leninka in Russia (Lawrence 2000).

Specialization and creation of focal points occurs throughout the library and information world. Networking of these national focal points through the Internet would permit quicker transmission of messages for interlibrary loans, and would be able to make available many more documents to the users. Steps have already been taken by Fathom.com to connect six major libraries in the world, including the British Library and the Smithsonian Institute (Lawrence 2000).

Information dissemination and the question of quality

The role of libraries- to provide copies of documents, whether hard or digital, needs to be retained or enhanced, even during the ICT age, when huge amount of information can be downloaded from the Internet. A survey carried out on African Internet usage showed that Web resources are still under-utilized (information from Mike Jensen: mikej@sn.apc.org) and in three of the poorest countries in Southeast Asia, namely Laos, Cambodia and Vietnam, even when Internet access in the countries is good, usage is low, due mainly to the high cost of usage (information from Jean Collins: jean.collins@fao.org). Countries that have deregulated their telecom services usually have lower connectivity costs. Unlike Nepal, Laos, Cambodia and Vietnam had not and connectivity costs stay high relative to wages (Ghahremani 2001).

A user survey carried out by EIARD-InfoSys in 2000 showed that journals are still the most popular means by which researchers sourced information, followed by the Internet, while CD-ROMs are rarely used (Dreyer 2000).   The survey also indicated that some researchers are skeptical about data quality sourced from the Internet. Peizer (2000) similarly noted that although a lot of information is available on the Internet, trusted sources are still needed to filter and interpret it, to turn it into knowledge. A need for quality control of data and classification of digital information is obviously needed to boost user confidence.

The Programme for the Enhancement of Research Information (PERI), which helps provide access to quality information for the academic and research communities, has received positive responses from many African countries, for example Ghana. Martey (2002) noted that PERI has helped the academic librarians regain their lost image in the academic community, since they can now deliver, to the users, up-to-date databases and thousands of electronic full-text journals in various subject areas, while previously, all too often, they were only able to offer titles of outdated books and journals in their possession. Under the PERI initiative, documents required by the users are then sourced from the British Library and other services.

Other information retrieval services include the Consultative Group on International Agricultural Research (CGIAR) Infofinder and the Selective Fisheries Information Services (SFIS) provided by ICLARM. The former provides a list of documents available electronically, and in most cases, the full document. SFIS reaches out primarily to developing countries, whose users comprise more than 80% of the requests received, and supplies material to meet users request.

Training, provider of database and Internet access

With the advent of ICT, apart from information dissemination, many information service providers are moving towards providing practical training in Internet usage to enable

users to make better use of ICT to access information, and some even offer free access to expensive databases (Lawrence 2000). Online information or software on aquatic sciences such as FishBase and ReefBase developed by ICLARM and partners are available free through the Internet or through free CD-ROMs, and have helped the disadvantaged gain access to knowledge, which otherwise are beyond their financial means. FishBase, which provides information on more than 26, 870 species of fish with over 26,505 selected references, receives an average of 4 million hits every month, and has received 85 citations, including 3 in Nature and 2 in Science. Although currently more than 80% of the hits are from developed nations, strategies are now being developed to increase its use in developing countries. Since its launch on the Internet on 2 April 2002, up to 2 August 2002, ReefBase has recorded 1,244,501 hits, with many of its users from developing countries, downloading information ranging from coral bleaching to GIS data, to global reef status reports and to more than 2000 photographs.

Our experiences with FishBase and ReefBase show that structured knowledgebases are proving to be very powerful and are popular with users. Multi-disciplinary linkages found in FishBase and ReefBase are immensely useful to specialists who are seeking information from other disciplines. For example, a social scientist, familiar with only the common names of fish may easily obtain the scientific names from FishBase, and similarly a specialist in taxonomy will also be able to source the common names of the fish in several countries and languages from FishBase. A layperson can also upgrade his or her knowledge on fish taxonomy through an ichthyology course available on-line through the FishBase information system. The repository of information in ReefBase is like a computerized encyclopedia, which makes it very convenient for specialist from one field to check on information in another field. A meteorologist interested in global warming, for example, can access information on related issues, such as coral bleaching, can download maps on affected areas and seek information on its seriousness throughout the world from just one web site. Geo-referencing of events and information in scientific papers and databases, including social science outputs, therefore enable scientists the opportunity to collate all information by location.

Libraries can also double up as telecentres or community access centres, and provide internet access for those that are disconnected, at minimal charge or at subsidized rates. Donor support, the goodwill of publishers to reduce the cost of online access to journals, books and patents could help students, teachers, researchers and policy makers gain knowledge and information through the Internet (Keese 2001). In India, the MS Swaminathan Research Foundation has set up rural information centres with Internet access where fishermen can download information on rich fishing grounds, and where the assetless from different villages can exchange information through the Internet on farming techniques, microcredit management, including business and education opportunities (The Human Development Report 2001). In Veerinpattinam, India, fishermen were able to access weather reports relayed from a nearby village where four full-time staff download information from a US Navy website, translate the messages into Tamil, and send it to villages, which also have access to computers (Le Page 2002).

Information organization and knowledge management

Although hard copies of library documents are generally well catalogued permitting easy retrieval, it is not the case with digital documents. The phenomenal increase in the number of digital documents requires more effective solutions to the organization of information and knowledge management. Welty 1998 (quoted from Horrocks et al.

2002) viewed the World Wide Web as a massive and unstructured digital library. A study led by Peter Lyman and Hal Varian (quoted from Anon. 2000) noted that we are drowning in too much information. In the United States of America, although more information is being produced, there is no indication that more is consumed. The study showed that the total time American households spent reading, watching television or listening to music increased only slightly from 3,324 hours in 1992 to 3,380 hours in 2000.

Clearly, the mountains of electronic information must be better organized and managed, so as to be better accessible. If digital information is more structured, there will be less time wasted in going through the enormous amount of literature while searching for the relevant. Michael Hart, founder of Project Gutenberg, suggested that "the greatest value created by computers would not be computing, but would be the storage, retrieval, and searching of what was stored in our libraries" (http://promo.net/pg/history.html).

In the age of information overload, web information would greatly benefit from some structure and explicit semantics to improve the system of information retrieval and recall (Horrocks et al. 2002). They noted that the entirely human-based system of subject classification in digital libraries would create a backlog and would become a hindrance. Research on the classification and retrieval of card catalogue information for digital documents is of the greatest priority.

Digitizing electronic documents

Aquatic library services can digitize documents (produced by their researchers), which are currently available as hard copies, so that they can be made available via the Internet. ICLARM is in the process of digitizing its publications, so that they can be accessed electronically. Presently, all publications by ICLARM in the year 2001 and 2002 are available electronically through the Internet. Other initiatives, albeit not in aquatic sciences, have made available books that are not under copyright and have entered the Public Domain, available to the public at no cost. Such projects include Project Gutenberg (http://promo.net/pg/history.html), Alex Catalogue of Electronic Texts (http://www.infomotions.com/alex/about.shtml) and The Online Books Page (http://onlinebooks.library.upenn.edu/aboutolbp.html).

The Internet provides a more efficient and cheaper means of information dissemination, once the electronic hardware is in place. The cost of sending one megabyte of digital data per second over a given distance has fallen by a factor of 100 over the last 20 years (Chowdhury 2000). Sending documents through the Internet is cheaper than other means: emailing a 40-page document from Chile to Kenya costs less than US10 cents, faxing costs about $10, and sending by courier $50 (The Human Development Report 2001).

Bridging the Digital Divide and Gender

Although various reports (Chamberlain 2002; Hafkin and Odame 2002) have highlighted the gender issue in the digital divide, the problem of women being disadvantaged is not peculiar only in ICT development, but also in many other fields. Williams et al. (2001) and Williams et al. (2002) highlighted various gender issues in the fisheries sector in Asia and globally in two women in fisheries symposiums held in conjunction with the Fifth and Sixth Asian Fisheries Forum.

In planning their strategies to provide information access to all, information service providers must be aware of some of the social and cultural problems faced by women, especially those from developing countries. Hafkin and Odame (2002) highlighted seemingly trivial but important issues, such as the opening hours of telecentres. Women normally have multiple roles to fulfill, and the opening hours of telecentres must also cater for their convenience to allow them to use the facilities provided. Information service providers must remember that ICT skills are not gender neutral, and when planning for skill-upgrading should ensure gender-balance participation (Engelhard 2002).

Conclusion

In the ICT age, the roles of information service providers are more demanding than ever before. They not only need to re-examine their strategies and roles, but also in some cases, may need retraining, so that they are more effective in bridging the digital divide that exists between information users in the developed and developing nations. Resource persons from the aquatic library services may have an even more daunting task, since the aquatic resource sector is often associated with economic activities of the marginalized poor, and financial allocations for aquatic library services upgrading may be scarce and given low priority. Dedication and labour of love are qualities that make a difference in the technology transfer process in bridging the digital divide.

Although the ICT boom has seemingly widened the gap between the haves and the have-nots, it has also brought many benefits to information dissemination. The link from developed to developing world is now possible via focal points and permits quick information retrieval. Programmes like PERI, CGIAR Infofinder and SFIS are able to reach out to many users in developing countries. In the age of information overload, web users will further benefit if digital information is well organized and reliable, and if the system of information retrieval and recall is improved.

References

Anon. 2002. Statement on Libraries and Sustainable Development. Background Paper No. 8. United Nations World Summit on Sustainable Development, Johannesburg, South Africa, 26 August to 4 September 2002. Submitted by the International Federation of Library Associations and Institutions.

Anon. 2000. Quantifying information: Byte counters. p.154. *The Economist*. October 21st 2000.

Bridges.org 2002. Spanning the international digital divide. http://www.bridges.org/spanning/html

Chamberlain, L. 2002. Gender review of ICT projects. Digital Divide Network. (http://www.digitaldividenetwork.org/content/stories/index.cfm?key=247).

Chowdhury, N. 2000. Information and communications technologies and IFPRI's mandate: a conceptual framework. Washnington, D. C. International Food Policy Research Institute. 37p. (ICT discussion paper, No. 1).

Dreyer, H. 2000. EIARD-InfoSys User Study: Executive Summary. (Memeo). 4p.

Engelhard, R. 2002. Observatory on ICT Gender and Agriculture in the Information Society Report on the preparatory e-consultation. Paper presented in the fifth annual consultative expert meeting of CTA's ICT observatory meeting on gender and agriculture in the information society. 11-13 September 2002.

Geer, S. 2001. *Pocket Internet* (Third Edition). The Economist in Association with Profile Books Ltd.

Ghahremani, Y. 2001. Heroes of the digital divide. *Asiaweek*. 29 June 2001.

Hafkin, N. J. and Odame, H. H. 2002. Gender, ICTs and Agriculture. Paper presented in the fifth annual consultative expert meeting of CTA's ICT observatory meeting on gender and agriculture in the information society. 11-13 September 2002.

Horrocks, I., McGuinness, D. L. and Welty, C. 2002. Digital libraries and web-based information systems. (http://www.cs.vassar.edu/faculty/welty/papers/dlhb-14.pdf).

James, J. 1999. *Globalization, Information Technology and Development*. London, Great Britain, Macmillan Press Ltd.

Keese, P. 2001. Even 'free access' is still beyond the means of most scholars in Africa. *Nature*, Vol.410, April 2001.

Lawrence, G. 2000. Boldly bookish. p.75-82. *EnRoute*, September 2000.

Le Page, M. 2002. Village-Life.Com. p. 44-45. *New Scientist*. 4 May 2002. Vol. 174 No. 2341.

Lourduswami, G. 1996. How important are information services? *Bay of Bengal News*. Vol II No. 2. March 1996.

Martey, A. K. 2002. PERI in Ghana. p. 3-4. *INASP Newsletter* February 2002.

NTIA. 1999. Falling through the Net: Defining the Digital Divide- U.S. Department of Commerce, National Telecommunications and Information Administration. (http://www.ntia.doc.gov/ntiahome/fttn99/execsummary.html)

Nymia. 2002. The digital divide bridged by Linux. (http://www.advogato.org/article/411.html)

Peizer, J. 2000. Bridging the digital divide: first you need the bridge. (http://www.mediachannel.org/views/oped/peizer.shtml)

Shirley, S. L. 2000. OITP Technology Policy Brief: The Digital Divide. Office for Information Technology Policy. American Library Association.

Swaminathan, M. S. 2001. Special contribution- The antyodays approach: a pathway to an ever-green revolution. p. 75. In: *The Human Development Report 2001*. Making new technologies work for human development. Published for the United Nations Development Programme. Oxford University Press Inc. New York.

The Human Development Report. 2001. Making new technologies work for human development. Published for the United Nations Development Porgramme. Oxford University Press Inc. New York.

UNDP. 1999. New technologies and the global race for knowledge. Produced by: Human Development Report Office (HDRO). (http://ntl.ids.ac.uk/cgi-bin/dbtcgi.exe?RNO=DOC7058&$TEXTBASE_PATH =d:%5Cinet…

Ventura, A. 1997. National information and communication technology strategies for development: A United Nations Commission on Science and Technology for Development perspective. UNCSTD, New York.

Ventura, A. 2001. Let's reward innovative action against poverty. p.1021. In: *Nature, Vol. 410, 26 April 2001*.

Welty, C. 1998. The ontological nature of subject taxonomies. In: Proc. of the formal ontology in information systems (FOIS '98), June 1998. Frontiers in Artificial Intelligence. IOS-Press.

Williams, M. J., Nandeesha, M. C., Corral, V. P., Tech, E. and Choo, P. S. (eds.). 2001. International Symposium on Women in Asian Fisheries: Fifth Asian Fisheries Forum, Asian Fisheries Society. 13 November 1998, Chiang Mai, Thailand. 156pp.

Williams, M. J., Chao, N. H., Choo, P. S., Matics, K., Nandeesha, M. C., Shariff, M., Siason, I., Tech, E. and Wong, J. M. C. 2002. Global Symposium on Women In Fisheries: Sixth Asian Fisheries Forum, 29 November 2001, Kaoshiung, Taiwan. 209pp.