

Report of the Working Group on Open Access and Open Educational Resources

As the world moves inexorably towards adopting a knowledge currency, India has the opportunity to participate as one of the planet's forerunners in utilizing a demographic comparative advantage and translating that into immense economic success. Unfortunately, that advantage cannot be sustained unless India, and more specifically, the Indian government, continues to review and upgrade our education system. One area that is in desperate need of change is our higher education network. Even though India has world-class institutions, they are far out-numbered by weaker institutions that have lagged behind the technological curve that has gripped the Indian economy. As such, it is of paramount importance that the Indian government takes significant strides to improve, adapt, and grow the overall knowledge capital and its availability to all Indian students in our higher education system. To serve this purpose, the National Knowledge Commission (NKC) has recently made a few recommendations to the Prime Minister. This report is a continuation of these past recommendations and can serve as valuable tool to improve the access to and quality of our higher education system.

Currently, there are many problems in the higher education system that need to be tackled immediately. Some of the more pressing, important issues which need attention are: the paucity of high-quality teachers, inadequate infrastructure of the universities and more specifically their libraries, and the poor quality of Educational Resources utilized at the various universities and colleges. If these problems are not solved expeditiously, the overall impact on Indian economy can be disastrous. The number of students graduating from our nation's institutions will be greatly diminished as they seek better educational alternatives. The students that do graduate from India's colleges and universities will be less and less employable as they lack the necessary skills and relevant knowledge to compete in the global labor marketplace. And most frustrating of all, Indian students coming from socio economically disadvantaged backgrounds will find fewer and fewer opportunities for social and academic mobility due to quality constraints.

One of the many steps NKC recommends to address these pressing problems is to increase the amount of Open Educational Resources (OER) and Open Access (OA). If these goals can be accomplished, the easy and widespread availability of high quality educational resources will drastically change the paradigm of teaching for the better and improve the quality of education for all of our students. In addition, Indian students will have access to previously inaccessible information as well as the knowledge on how to access *global* educational resources. (See Annexure 1 for members of NKC working group assigned with the task of arriving at the means and methods of increasing OER and OA).

Open Educational Resources

Open Educational Resources can be defined as free and open digital publications of high quality materials organized as courses that include lectures, related reading materials, snapshots of discussions, assignments, evaluations, etc. Access to these

resources radically breaks down the barriers to quality education and allows everyone to access course material that is prepared and evaluated by experts. Further, the Educational Resources available under the OER format has been evaluated not only by subject experts but also education experts to increase the educational utility of this material. In recent years, Open Educational Resource material has been prepared in an open standard format and is interactive in nature.

Several universities in the United States are involved in Open Educational Resources generation. These include MIT, Utah State University, Carnegie Mellon, Yale, Johns Hopkins University, etc. Australian and Chinese universities are also participating in the development of open educational resources. Several hundred courses have already been made available from these universities. In addition, lectures on specific topics in the curriculum are also available as open educational resources (A list of some of the major Open Educational Courseware (OCW) and Open Educational Resources available in the world is given in Annexure II). As can be seen from this list, the open Educational Resources are in subject areas such as basic science and engineering, agriculture, health sciences, etc. However, OER for liberal arts, public health, agriculture, etc. are relatively fewer. The development of OER is mostly funded by foundations like the Hewlett and Mellon foundations and partially by the institutions themselves. These institutions are seeking financially sustainable models for OER development, maintenance, popularization, and periodic updating.

In India, there are three or four major initiatives for creating open educational tools and resources. However, all of them are directed towards OER in the basic sciences and engineering sciences areas. One of the major programs in India is the National Program on Technology Enhanced Learning (NPTEL). The NPTEL project is being carried out by seven Indian Institutes of Technologies (IIT's), the Indian Institute of Science, and other premier institutions around the country and being funded by the Human Resource Ministry. The NPTEL objective is to enhance the quality of engineering education by developing curriculum-based video and web courses for the students. Faculty from these various institutions are involved in developing their classroom course material in electronic form. Currently, the program has 120 web based courses and 115 video courses in the core sciences, computer science, civil engineering, electrical engineering, electronics and material engineering. The NPTEL also provides an opportunity for teachers and students from rural areas to learn from these high quality lectures and improve the quality of teaching in these rural colleges. The approximate cost of development of material per course is about Rs. 500,000 to 600,000.

The second important open educational resource project is the Ekalavya project launched by IIT, Bombay. In this project, the content is developed in various Indian languages and is distributed through the internet. The Ekalavya project has also developed an Open Source Educational Resources Animation Repository (OSCAR) and provides web-based interactive animations for teaching various concepts and technologies. OSCAR provides a platform for mentors/professors to suggest ideas for animation and for developers/students to create content based on the suggested ideas and

guidance. Funding for the Ekalavya and OSCAR project comes mainly from private industry.

E-Grid is the third main Open Educational Resources initiative of India that develops and maintains pedagogically sound and refereed Educational Resources in identified subjects. Subject specific portals are developed and these portals are governed by subject experts within the program. This project is supported by the Human Resource ministry at IIT, Kerala. Currently, this program also offers open Educational Resources only in the sciences and engineering sciences. Some of the other initiatives of Department of Science and Technology, Ministry of Information and communication Technology, and Human Resource Ministry are described in brief in the Annexure III. It also gives estimated costs of developing web based and video course material for various educational levels.

One of the main concerns regarding Open Educational Resource initiative moving forward in India is the necessity to develop OER in other subject areas. In particular, OER, in various regional languages, needs to be developed for the agricultural sector. In order to increase the usage of Open Educational Resources among teachers and students, standardized national evaluations must be performed using this OER material. Therefore, along with necessary development of more OER material, a question bank/problem bank corresponding to the OER materials needs to be created simultaneously.

In order to spur these developments, and speed up the creation, adaptation, and utilization of OER, it is necessary that our government launch a national *e-content* and *curriculum* initiative. This initiative will focus on the rapid production and acquisition of content. Towards this end, India should take the following steps.

- **Leverage the global open educational resource movement to take advantage of content initiatives.** Sustainable development of relevant, quality content is a difficult and expensive proposition, given the diverse needs of various sectors in our emerging knowledge economy. Additionally, ensuring a high level of quality is a challenge in itself. Emerging initiatives internationally and nationally are offering quality educational content as open resources. It is vital for India to leverage these initiatives as a readily available, economically viable source of quality content for adoption and adaptation, as well to serve as a model for indigenous content production.
- **Support the production of quality content by a select set of Indian institutions.** A set of key institutions should be selected and experts representing diverse knowledge areas like agriculture, engineering, medicine, arts, humanities, science, etc. to develop standards-based, customizable, high quality content and make it available not only for Indian institutions but also for global consumption. There should be a high priority for developing web-based, multimedia, interactive open content repositories for various subjects and in different regional languages.
- **Undertake a large scale e-Curriculum development effort directed toward adaptation and adoption support.** This effort should build adoption

support for content delivery through training teachers at various universities around the country. Centers at specific institutions should be identified so that the faculty of those institutions will eventually own, modify, and expand these OER repositories.

The *e-content* and *curriculum* initiative should initially focus on the rapid production and acquisition of content in high need areas like **agriculture, teacher training, basic and applied sciences and engineering, technical education, liberal arts and social sciences, communication skills, ethics and values, public health, and high end skills including management**. In these areas, some of the course material needs to be developed in different regional languages. To further extend the efficacy of this OER system, a distributed method of e-evaluation needs to be created to measure both teachers and students utilizing the system.

Develop network-enabled delivery infrastructure

Along with the national initiative for content, India must develop a network-enabled delivery infrastructure with the focus on two primary areas; access and delivery. For access to the network, high bandwidth connections across institutions and a national backbone that provides advanced networking capabilities are major requirements. Thus, there is an urgent need to establish an Indian Research and Education Network/ Knowledge Network where each educational and research institute is connected by at least 100 Mbps or 1Gbps. Additionally, connectivity to global networks is essential. The centers where the broad band connectivity is available should use Triple Play broad band services. These services will help students to get OER materials on demand and they can use their TV sets instead of PC. Currently, the Maharashtra Knowledge Corporation (MKCL), Pune, has recently deployed this technology on experimental basis along with BSNL.

Delivery of the OER content is equally important and the working group makes the following suggestions.

- Create distributed repositories of educational resources for managing the acquisition, upkeep, and preservation of educational content.
- Increase the availability of educational applications such as “Learning Management Systems” and other quizzing, authoring, and collaborating tools which can be used for a wide range of courses and programs.
- Create open, standards-based service-oriented software architecture that facilitates the interaction of applications with educational content, enables localization and contextualization of resources, and allows integration of various academic systems like the repositories, digital libraries, etc. with administrative systems such as those for student information and human resources.

These steps will permit us to link our education community worldwide and provide easy access to the full range of intellectual resources. Students and teachers from rural and

urban areas alike would be able to communicate and collaborate online with experts from within the country and abroad.

Faculty and Institutional Development Program

Concurrent with establishing the proper access and delivery options of the Knowledge Network, India must create a faculty and institutional development program. Faculty development and teacher training is widely seen as the primary area that needs to be addressed in order to attain the benefits of extended access and quality through OER. To accomplish this, the faculty and institutional development program's goals should be threefold in nature.

- The program must develop domain competencies and teaching skills for quality education using quality faculty and high quality materials
- Integrate OER into university curricula and organizational structures
- Develop new OER and contextualize existing Educational Resources to bridge the gap of the human resources trained in the best universities and the other universities.

The working group suggests the creation of the Institute for Virtual Knowledge Resources and Management (VIKRAM) to monitor and support the implementation, adoption and sustainability of the network-based education resources. The activity and approach recommended here engages multiple areas (IT, education, research, innovation etc.). Therefore, it is imperative that VIKRAM while having linkages to existing educational and IT organizations, remain independent. This organization will provide leadership and coordination of network-based open education resources by undertaking the following activities:

- Select institutional collaborations for developing content
- Develop adoption support strategy institutions
- Recommend and monitor standards for content development and adoption.
- Advise on policy implications vis-à-vis licensing, intellectual property rights, etc.
- Identify and set benchmarks based on global best practices
- Establish relationships with global OA and OER initiatives
- Implement change management in educational institutions and government agencies involved in the pilot program.

An expert group should be formed that would work out the details of the management and governance structure of VIKRAM with the principles and activities mentioned above.

Open Access Resources

Open Access is a term used to describe published academic papers, books, reports, and other periodicals that are electronically available to readers without financial

or technological barriers. The importance of open access for fundamental as well as applied research and education cannot be over emphasized.

Only a small proportion of the information generated throughout the world is in the open access domain. Majority of the world population cannot access the research findings from the developed nations, where most of the cutting edge research is being conducted, because of the financial constraints. At the same time, research conducted in third world countries representing 80% of the world's population is largely invisible to the global research community due to financial and governmental restraints. Yet, solving many of the world's problems like emerging infectious diseases, the HIV/AIDS epidemic, environmental disasters, or climate change cannot be achieved without the participation and incorporation of research conducted in developing countries as well. Open Access will help scientists around the globe to develop collaborations with previously unknown colleagues and avoid repetitive research while tackling major regional problems. Open access increases the usage and citation of the published research. Recent studies have shown that Open Access articles are cited 25 - 50% more than non-Open Access articles from the same journal and year. The researchers are benefited due to the Open Access policies as their research work gets widely disseminated and can be read by anyone with Internet access without any restriction. Similarly books, articles, and art forms will enjoy worldwide patronage when available in open access domain.

Published books out of copyright protection are a prime target for Open Access to help disseminate vital information contained in these books. In India, there are a large number of these books but they are held in a few libraries scattered across the country and their content is not widely available to the scholars and students of our country. Open Access will drastically change the availability of these books and the knowledge contained in these texts. Electronic, searchable versions of the books will be greatly helpful in translating the content into other Indian languages, increasing the book's scope past its original text. The NKC has earlier recommended on the formation of a translation mission and translating Indian language books to other Indian languages and English. This will also reduce the skewed nature of libraries in India. Currently, major libraries only exist in urban areas and rural India doesn't have access to the resources present in these large libraries. Open Access remedies this problem by allowing socially and economically disadvantaged individuals to access all the information if there is a free internet connection.

In recent years, Open Access is becoming a movement in a few countries. There are 761 registered Open Access repositories at the present time (A list of some of the major Open Access databases is given in Annexure IV). In the Open archives, there are several million searchable records and are presented in a standard, interoperable, and searchable Open Access format. The number of usable records is increasing every day as more and more countries are adopting OA policies. Similarly, a number of scientific journals are also increasingly available from different countries around the world as OA material. For example, a number of journals from the United States, Europe, and even Latin America are available in open access. Many African countries have also started to

put their journals in Open Access. Recently, Germany has created a national web portal for Open Access materials. In addition, many countries are making digitized books available to the public. China has digitized more than 600,000 books so far. The United States, under the Carnegie Mellon University's Million Books on the web Project, as well as Google Inc, have digitized several hundred thousand books that are available under Open Access.

India has done fairly well in the Open Access area by making 81 scientific journals accessible under OA. The Indian Institute of Science, Bangalore, is coordinating the Digital Library of India project along with Carnegie Mellon University. In this project, 21 other Indian institutions are also participating and have digitized more than 450,000 books, out of which 220,000 books are now web-accessible. This digital book collection includes the entire collection of the library in the Rashtrapati Bhavan. The books thus far digitized are from a variety of languages such as Sanskrit, Telugu, Tamil, Marathi, and Hindi to name a few. Furthermore, several Indian newspapers, both in English and regional languages, are available in Open Access. Similarly, a large number of government reports, including those of NKC, notifications, and Supreme Court opinions are available to anybody with internet access.

The lack of awareness among potential users and broadband connectivity are impeding the growth of Open Access material in India. Insufficient government funding and the absence of helpful policies have further constrained Open Access's ability to reduce the cost and improve the quality of research and human development in India. On a technological front, new methods for the digitization of printed material and converting it into a searchable database need to be developed as the fonts used in old books, journals, and manuscripts cannot be directly converted into ISCI/ASCII using our standard Optical Character Recognition (OCR) programs.

The working group, after taking into consideration the current status of Open Access in India and worldwide, has the following recommendations to increase Open Access content from India, increase the public awareness and utilization of OA material.

- On a policy level, all research articles published by Indian authors receiving any government or public funding must be made available under Open Access and should be archived in the standard OA format on his/her website. Further, as a national academic OA portal is developed, these same research articles should be made available through this portal.
- The government should allocate specific funding to increase the current digitization efforts of books and periodicals which are outside copyright protection.
- Separate funding should be allocated to develop a new higher quality OCR software package so that new and old fonts in many different Indian languages can be converted into ISCI/ASCII code.
- A training program needs to be developed to take the materials available under Open Access to remote towns and villages. One possible mechanism for this is to outfit a vehicle with mobile internet connectivity and a high

speed printer and binder. With these resources, the “OA” vehicle could travel to rural locations, print and bind the book or material requisitioned by the users at the location, and charge the users only the cost necessary for printing and binding.

- On a systemic level, our nation’s universities and various academic institutions need high bandwidth connections and a national backbone which will provide advanced networking capabilities. There is an urgent need to develop Indian Research and Education Network/ Knowledge Network where each connected institution will have at least 100 Mbps or 1 Gbps connectivity. This level of connectivity will not only advance the OA activities nationally, but provide global connectivity as well. Soon, the NKC will provide detailed recommendations in this regard.

Sustainability

The impact of implementation of the working group recommendation can be felt only if the sustainability of the programs is ensured. The development cost of open educational resources materials is high, but the much higher translatable, measurable rewards resulting from an expansion of the OER universe makes it a clear case for the government to ensure its sustainability. Initially, the government can create a grant for the generation and distribution of OER material to students and teachers from all over the country. Private industry should be the second major source of funding for developing OER on an ongoing basis since the industry stands to benefit immensely from the improved quality of education. Private industry should be offered tax credits in return for funding and developing OER content. These partnerships with private industry will help defray the costs of development of OER material.

India’s Open Access project cannot be modeled after any of those which have been tried out by different countries. India will have to design and develop its own unique model that suits its needs and the available resources. The working group suggests the following model to continue and expand the number of research papers being put in Open Access.

The publishers of any Open Access journal will recover the cost of publishing and maintaining the journal on the web from the individual authors. Thus, the authors have to pay for each research article that they publish in such journals. To make this possible, the authors’ parent institution should pay the publication cost. The institution should get a certain percentage as reimbursement through government grants depending upon the citation index of the journal. The institute will get more than 100% of the cost it has incurred if the paper is published in a journal with high impact factor. In this manner, the author will not have to pay from his/her personal funds or grant money and at the same time there will not be too high a financial burden on the authors’ parent institution. As such, the government will ensure that India’s research scientists publish high quality papers.

A second model could be that the government establishes a specific fund for Open Access research publications. At the end of each fiscal year, money should be transferred to each OA journal depending upon the number of papers published by Indian authors. With these two initiatives, the government would have provided incentives for authors to produce high quality papers and given journals a reason to publish within the OA universe.

Expectations

No government program should be created, researched and supported unless all involved parties have an understanding as to what the long run possibilities are for the program. Once India embraces the concept and expands on the available Open Access and Open Educational Resources, the intellectual development of the nation will be accelerated. It is reasonable to expect that after 5 years of full implementation of the above suggestions, everyone in rural and urban areas will get the same quality training at a level that far surpasses what is given today. This will be possible since the OA and OER resources will create higher quality teachers with a new benchmarking standard for themselves. Along with the benchmarks that identify successful teachers, the OER and OA content will help teachers change their overall pedagogy for teaching.

As the nation's teachers get better, the students will become better students. One of the expectations from the exercise of making world class teaching material and methods available to the teachers and students freely, is that the students will develop the skills critical to the creation of new knowledge and advancement of technology that are necessary to maintain the tempo of economic growth. These skills include the ability to define the problems precisely, design the solutions that are right for the country and develop those solutions indigenously. Better teachers with the help of contemporary material will create better students that are naturally inquisitive about their local and global surroundings with a thirst for learning as opposed to the current paradigm of students being spoon-fed data and information about a certain topic.

An additional benefit of adopting the above recommendations is a much larger student base for India. Currently, many rural and socio-economically disadvantaged students cannot gain access to any higher education institutions because the overall cost is much too high. With the inclusion of Open Access and Open Educational Resources materials, the cost of providing education to these students comes down drastically. Moreover, these and other students will have access not only to specific higher education, but also professional education, the key to social and economic mobility. If the lower strata of India's population have the possibility for social and economic mobility, then the overall growth of the country is inevitable.

Annexure I

Names and positions of Members of Working Group on Open Access and Open Courseware

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Annexure II

This is an indicative list of open courseware available online.

Open [Free] Courseware

A. MIT Open Courseware <http://ocw.mit.edu>

MIT OCW is a large-scale, web-based electronic publishing initiative whose goals are to: Provide free, searchable access to MIT's course materials for educators, students, and self-learners around the world, and extend the reach and impact of MIT OCW and the "opencourseware" concept.

B. SOFIA – Sharing of Free Intellectual Assets <http://sofia.fhda.edu>

As of February 2006, content for eight courses was available online freely thru the Sofia open content initiative. The Sofia project is an open content initiative launched by the Foothill – De Anza Community College District with external funding support.

C. JHSPH Open Courseware <http://ocw.jhsph.edu>

The Johns Hopkins Bloomberg School of Public Health's OpenCourseWare (OCW) project provides access to content of the School's most popular courses. Includes undergraduate and graduate subjects available on the Web, free of charge, to any user anywhere in the world.

D. Tufts Open Courseware <http://ocw.tufts.edu>

Tufts open courseware includes course content in: life sciences, with a multidisciplinary approach, an international perspective, and an underlying ethic of service.

E. Utah State University OpenCourseWare

http://ocw.usu.edu/About/index_html/ECDocument_view

USU OCW is a free and open educational resource for faculty, students, and self-learners throughout Utah and around the world. OCW supports USU's mission to serve the public through learning, discovery, and engagement.

F. Open Learning Initiative at Carnegie Mellon

<http://www.cmu.edu/oli/overview/index.html>

A collection of "cognitively informed," openly available and free online courses and course materials that enact instruction for an entire course in an online format.

G. Information Management Resource Kit (FAO) <http://www.fao.org/imark>

The Information Management Resource Kit (IMARK) is a partnership-based e-learning initiative to train individuals and support institutions and networks world-wide in the effective management of agricultural information. IMARK consists of a suite of distance learning resources, tools and communities on information management. IMARK is being spearheaded by FAO in collaboration with over 30 partner and contributing organizations.

H. THE OCW Consortium.

<http://www.ocwconsortium.org/>

I. EduCommons

<http://cosl.usu.edu/projects/educommons/>

eduCommons is an OpenCourseWare management system designed specifically to support OpenCourseWare projects like USU OCW. EduCommons will help you develop and manage an open access collection of course materials.

J. Hewlett Foundation

<http://www.hewlett.org/Programs/Education/OER/>

Among the projects that the Foundation has underwritten in whole or in part are MIT's OpenCourseWare program, which has published virtually all MIT courses on the program's Web site; Carnegie Mellon University's Open Learning Initiative, a highly interactive approach designed to measure the effectiveness of the teaching; African Virtual University's development of an open educational resources strategy, which provides digital and printable material to train teachers in sub-Saharan Africa; and Creative Commons, a nonprofit organization that helps creators of intellectual property preserve a range of rights while sharing content.

A few more universities and initiatives that offer open courseware are:

AESharenet, Australia

Athabasca University, Canada

Guadalajara University, Mexico

Japan Open Courseware Consortium (JOCW)

John Hopkins University, USA

Macquarie University, Australia

Monterrey University, Mexico

Open University, UK

Stockholm Institute, Sweden

"La téléuniversité" TELUQ, Canada (French Language Open University)

Tufts University, USA

University of Crete, Greece

Virtual Labs

Howard Hughes Medical Institute: <http://www.hhmi.org/biointeractive/vlabs/>

The Howard Hughes Medical Institute offers virtual labs in different subjects as a means of spreading education about science and technology. These include the transgenic fly virtual lab, the bacterial identification lab, the cardiology lab, the neurophysiology lab and the immunology lab.

Virtual Labs and Simulations:

<http://www.hazelwood.k12.mo.us/~grichert/sciweb/applets.html>

The page is a collection of links to sites on the web that have computerized simulations of physics principles. These include a number of links on fundamentals, mechanics, momentum, rotational mechanics, thermodynamics, optics, waves, astrophysics, and other topics in physics.

I-labs: <http://icampus.mit.edu/ilabs/>

iLabs (promoted by MIT) is dedicated to the proposition that online laboratories – real laboratories accessed through the Internet - can enrich science and engineering education by greatly expanding the range of experiments that students are exposed to in the course of their education. Unlike conventional laboratories, iLabs can be shared across a university or across the world. The iLabs vision is to share expensive equipment and educational materials associated with lab experiments as broadly as possible within higher education and beyond.

Online Agricultural Degrees

[Agricultural Masters Australasian College](#)

AGFA College delivers agriculture programs through distance learning to Australian and international students. Training opportunities include beef and sheep breeding, pasture management, animal nutrition and husbandry, cropping, marketing, risk management, occupational health and safety, wool and sheep classing, shearing, animal health, horticulture, organics, hydroponics and training in natural resource management. Accredited by the Australian National Training Authority.

[Agricultural Masters Australasian College](#)

(<http://www.agmacollege.com/>)

AGFA College delivers agriculture programs through distance learning to Australian and international students. Training opportunities include beef and sheep breeding, pasture management, animal nutrition and husbandry, cropping, marketing, risk management, occupational health and safety, wool and sheep classing, shearing, animal health, horticulture, organics, hydroponics and training in natural resource management. Accredited by the Australian National Training Authority.

[Iowa State University](#)

(<http://www.lifelearner.iastate.edu/>)

Iowa State University offers the following degree programs in agriculture:

- [Master of Agriculture](#)
The core 13 credits of the program emphasize leadership development, technological change, use of statistics, economic issues, and sustainability issues. You select the remaining courses, 14 credits, in consultation with your graduate committee to meet your individual needs and interests. The capstone of the program is a creative component of 4 credits that lets you explore a particular

- interest area. The creative component is a demonstration of independent creativity with a written report of laboratory, field, or library research.
- Master of Science in Agronomy
The computer-based program emphasizes practical, professional, and technical skills involved in crop management, soil and water management, and integrated pest management. It is a non-thesis degree.

Programs are delivered statewide via the Iowa Communications Network; and in the U.S. and Canada via CD-ROM and internet. Accredited by the North Central Association of Colleges and Schools.

Kansas State University

(<http://www.dce.ksu.edu/dce/degrees.html>)

Kansas State University offers the following online degrees:

- Master of Agribusiness
The Master in Agribusiness at Kansas State University provides agribusiness professionals the knowledge and skills to excel in today's rapidly changing and increasingly complex food and agricultural global economy. Two one-week segments per year on-campus visits required.
- Bachelor Degree Completion Program - Animal Science and Industry
The program builds on a liberal arts foundation with a concentration in animal science and includes substantial coursework in agriculture, biological and physical sciences, mathematics, statistics and computer science, business and economics.

Kansas State University is accredited by the Northwest Association of Colleges and Schools.

Online College of Oklahoma

(<http://www.okcollegeonline.org/>)

Online degrees in agriculture offered by Oklahoma State University:

- Master of Agricultural Education
- Master of Agriculture

Delivery methods incorporate interactive video, telecourses, Internet, audioconferencing, computer assisted instruction and audiotape.

Oregon State University

(<http://ecampus.oregonstate.edu/>)

Oregon State University offers an online Bachelor of Science in General Agriculture degree completion program. Accredited by the Northwest Association of Schools and Colleges.

Texas A&M University

(<http://mag.tamu.edu/>)

Texas A&M University offers the following online agriculture degree program:

- **Master of Agriculture**

The degree program is intended to prepare individuals for leadership roles in education, natural resource management, the extension service, and many professional careers in agriculture and life sciences. This is a non-thesis degree program which emphasizes the development of problem-solving skills and the practical aspects of academic coursework. A highly individualized degree, you can select degree plans in the following areas:

- Agricultural Development
- Fisheries
- Plant Sciences
- Natural Resources Development
- Poultry Sciences
- Wildlife

Delivery methods include Internet, videoconferencing and CD-ROM. There are no residency requirements. Accredited by the Southern Association of Colleges and Schools.

Texas Tech University

(<http://www.dce.ttu.edu/>)

Texas Tech University and Texas A&M University offer a joint Doctor of Education in Agricultural Education. Courses are taught using the Trans-Texas Videoconference Network, a web-based design using WebCT, the Internet, and a variety of other methods, including appropriate face-to-face meetings. Texas Tech University is accredited by the Southern Association of Colleges and Schools.

University of Georgia, Center for Continuing Education

(<http://www.gactr.uga.edu/is/turf/index.html>)

University of Georgia, Center for Continuing Education offers the following program in turfgrass management:

- **Principles of Turfgrass Management**

This course is designed for all professionals in this fast-growing industry, including those affiliated with private lawn care companies, public parks and recreation areas, school grounds, sod production, landscape management firms, golf courses, cemeteries, athletic fields, and other public and private turf facilities.

Successful completion earns the designation "Certified Turfgrass Professional." The Georgia Center also offers certification for those who wish to pursue a series of college credit courses in turfgrass management and related subjects.

University of Florida

(<http://www.fcd.ufl.edu/>)

The University of Florida offers a Master of Agriculture via distance learning technologies. Courses are delivered via interactive videoconferencing, videotape lecturing, and online.

University of Illinois Online

(<http://www.online.uillinois.edu/>)

University of Illinois Online offers the following online certificate program:

- **Professional Development Sequence in Dairy Science**
The professional development sequence in dairy science includes a series of structured courses delivered by the Internet using an interactive course delivery system. A certificate will be awarded to students who successfully complete the introductory class (Phase 1), a minimum of two of the advanced classes (Phase 2), and a minimum of two of the lab techniques (Phase 3). The certificate will be valuable to adult students needing advanced training including veterinarians, livestock nutritionists, extension educators, livestock producers, and herd managers.

The classes are taught on the Internet and CD ROM. Accredited by the North Central Association of Colleges and Schools.

University of Nebraska - Lincoln

(<http://ianrhome.unl.edu/distanceEd/masterofag/degree.shtml>)

The University of Nebraska - Lincoln offers a Master of Agriculture degree through distance education technologies for working agricultural professionals. Students are able to individualize their particular curriculum programs to best meet their own career objectives. Accredited by the North Central Association of Colleges and Schools.

University of Northwestern Ohio

(<http://www.unoh.edu/academics/collegedl/index.html>)

The University of Northwestern Ohio offers a Diploma in Agribusiness Management entirely online. Students completing this one-year program will be prepared for entry-level positions in the agribusiness management community - wholesale, retail or production. Accredited by the North Central Association of Colleges and Schools.

University of Tennessee at Martin

(<http://www.utm.edu/onlinestudies.html>)

University of Tennessee at Martin offers online a Master of Science degree in Agricultural Operations Management. The MSAOM curriculum is based on two primary knowledge bases: agricultural systems science (which includes management science and agricultural engineering technology) and agribusiness/business. The breadth of the MSAOM degree is enhanced with courses in international agriculture, agricultural

science, and statistics/advanced mathematics. Accredited by the Southern Association of Colleges and Schools.

Washington State University

(<http://distance.wsu.edu/>)

Washington State University offers the following online degree programs in agriculture:

- **Master of Science in Agriculture**
Emphasis of the Master of Science in Agriculture program is on the agricultural professional, practitioner, and educator.
- **Bachelor of Science in Agriculture**
The Bachelor of Science in Agriculture is an upper-division degree completion program that enables students to complete the final two years of a bachelor's degree without going to a Washington State University campus.

Courses are delivered directly to students using distance education technologies. Accredited by the Northwest Association of Schools and Colleges.

Veterinary Science Degrees Online

Penn Foster College

(<http://www.worldwidelearn.com/penn-foster/index.php?program=veterinary-technician>)

Established in 1890, Penn Foster College is one of the oldest and largest distance learning institutions in the world. Students can study online, in print, or a combination of each—you decide which method best suits your learning style.

- **Veterinary Technician Associate Degree**
There are certain skills you need to begin a career as a veterinary technician. With Penn Foster distance learning, you can earn your Associate in Specialized Technology Degree and become a Veterinary Technician quickly and conveniently. Course includes Animal Anatomy and Physiology, Medical Mathematics, Veterinary Office Management, Animal Nutrition, Reproduction, Genetics, Aging and more.

Penn Foster College is licensed by the Arizona State Board of Private Postsecondary Education and is authorized to award Associate of Science Degrees. Penn Foster is nationally accredited by the Accrediting Commission of the Distance Education and Training Council (DETC) in Washington, D.C which is listed with the U.S. Department of Education

Penn Foster College offers affordable, all-inclusive pricing—among the lowest of all career schools—and 0% interest financing and customized payment plans.

Canadian residents: Penn Foster's partner school, ICS, offers similar programs to residents of Canada.

[St. Petersburg College](http://www.spcollege.edu/hec/vettech/vt1.html)

(<http://www.spcollege.edu/hec/vettech/vt1.html>)

St. Petersburg College offers the following veterinary programs through distance learning:

- Associate in Science in Veterinary Technology
The program is designed for veterinary hospital employees seeking a veterinary technician degree. The program is accredited by the Committee on Veterinary Technician Education and Activities of the American Veterinary Medical Association.
- Veterinary Hospital Manager Certificate
The business courses identified in this certificate program will meet the educational requirements for the Veterinary Hospital Managers Association examination for Certified Veterinary Practice Managers. The eight courses will cover the areas of personnel, accounting and finance, marketing, legal requirements, budgeting, planning, and computer use and applications. Each course is specifically designed for individuals currently working in veterinary hospitals or those with previous experience in veterinary hospital management.

St. Petersburg College is accredited by the Southern Association of Colleges and Schools.

The Australian Center for Correspondence Courses:

(Agriculture courses online)

http://www.acseduonline.com/courses/product_listings.aspx?CatID=15

(agriculture and animal husbandry certificates and diplomas by correspondence)

http://www.acs.edu.au/courses/product_listings.aspx?catid=Agriculture

(horticulture certificates and degrees)

<http://www.acs.edu.au/courses/horti.aspx>

(examples)

http://www.acs.edu.au/courses/product_listings.aspx?catid=general%20horticulture

A different model of distance education in agriculture: University of Idaho

<http://aee.ag.uidaho.edu/distance/programs.htm>

Hybrid model at the Colorado State University:

<http://www.learn.colostate.edu/degrees/agriculture.asp#curriculum>

(Emphasis on Extension education)

Imperial College DL program offers two PG courses in Agri Business and Agri Economics

http://www.imperial.ac.uk/distancelearning/course/aeb/ag_econ.htm

University of Manitoba, Canada

<http://www.umanitoba.ca/afs/school/distanced.html>

North Carolina State U LEAP:

<http://www.cals.ncsu.edu/agexed/leap/#1>

An important program in natural resources management operated by a consortium of US-based institutions.

<http://cnr.iddl.vt.edu/>

From the Purdue University:

http://www.geaps.com/dist_learn/index.cfm

From the New Mexico State:

<http://vrc.nmsu.edu/distance/degrees/details.cfm?id=46>

The Pullman-based WSU program in DL mode:

<http://www.msag.wsu.edu/MS-Ag-ovrvw.htm>

University of Queensland in Australia has a comprehensive DL program in agricultural and veterinary sciences

<http://www.uq.edu.au/nravs/index.html?page=44567>

Non-degree online courses in agriculture

<http://www.aglearn.net/>

from Saskatchewan, Canada:

<http://www.siastr.sk.ca/virtualcampus/educationtraining/agriculture/agvirtual.htm>

IICA-Jamaica project: non-degree DL training

<http://www.agroinfo.org/caribbean/iicacarc/jamaica/adltcnew.htm>

Non-degree online training offered by the USDA:

<http://www.fns.usda.gov/wic/aboutwic/>

http://www.nal.usda.gov/wicworks/WIC_Learning_Online/index.html

Annexure III

Cost estimates for the development of open web based and video courses in India and a brief description of some of the Government of India initiatives

Video Lectures of high quality (broadcast):

- A studio infrastructure for recording, editing and distributing video streamed lectures using a video-on-demand mode: If real estate is available, state-of-the-art technology will mean about 2 crores per studio catering to the development of about 50 video courses of 40 lectures each. On an average one can record efficiently three to four lectures per day and post-process the same in an editing laboratory whose cost is included in the above. A five-day, 40-week work schedule per year means 20 courses maximum by the Institute.
- Video lectures on Demand (VOD) set up needs high bandwidth and can be put at approximately 1 crore per year per 50 mbps at preset. However the cost of bandwidth is coming down and with establishment of national knowledge network this can be brought down considerably. The server will cost anywhere between 25 to 50 lakhs.
- An operational (recurring) cost of Rs. 3 lakhs per course for manpower, software up-gradation, video equipment and consumable maintenance and a suitable honorarium for the content developer (Rs. 2500 per a lecture of one hour duration).
- Deployment of the video through VOD implies conversion of the DVFormat to a suitable MPEG4/H.264, 256 kbps bit rate, or a 1mbps bit rate for LANs in Institutions or DVD for individual users. Our preliminary estimate for 120 video courses is 1.5 crores.

Simple Web based Instructional material of the same style as OCW (PDF) or NPTEL (a mixture of PDF and Html):

A content development cell containing enough computers, a variety of commercial and open source operating systems, and application software needs to be established. For a laboratory developing approximately 50 courses in two years, infrastructure cost and professional software cost will be about Rs. 1 crore.

Approximately Rs. 6 lakhs per course will be necessary to create content for the Web based course of 40 lectures that includes an honorarium of Rs. 2 lakhs for the faculty providing a complete course. Development of a web course takes almost twice the time or more as that for a video lecture course. Building query management and feedback for the effectiveness of the learning process will be in the form of workshops and budget for workshops is a must. For a workshop for 30 participants for two days with TA/DA is about Rs. three lakhs.

Educational content development for colleges is a much less complicated exercise as compared to content creation for other levels. For Sciences and Arts, Humanities etc UGC curriculum can be used as a reference point. For engineering curriculum, AICTE model syllabi are good reference sources. However for high schools the reference points

are many and also there is the local language issue for each state. Resource creation must take into account a modular form of state curriculum.

Vocational training modules: Open universities may be identified to provide electronically rich resources and move away from print resources. They would be able to provide studio, hardware estimates and laboratory spaces based on the number of modules.

There is a parallel exercise by the Ministry of Human Resource Development for developing content quality metrics for each level and establishing standards for e-content. The total budget the Ministry has proposed is about 100 crores.

The third initiative which must be considered along with content creation and arriving at quality parameters is the set of tools to be developed for delivery through the web. It is not an easy task if statistics are to be generated and the effective usage, uniform access of the content etc. have to be incorporated. The Ministry of Information and Communication Technology has an e-learning division. In the last three to five years the Ministry (Officer-in-charge: Shri Pankaj Agarwala, Joint Secretary, MCIT) has sanctioned a little more than 10 to 15 crores for creation of effective tools and teacher-training methods which could be made use of immediately. This includes a Brihaspathi portal (learning Management system) by IIT Kanpur, computer literacy training and software training to teachers by the DOEACC Kolkata and Aurangabad, Cognitive and interactive tutoring tools by C-DAC Mumbai, and e-learning standards and development of successful online courses by C-DAC Hyderabad among others.

Annexure IV

This is a brief list of some resources that are available online for **open access**. Dissemination of these links can be very useful for enriching the teaching learning process in Indian higher education institutions.

Open Access Resources

Digital Library of India: <http://dli.iiit.ac.in>

Budapest Open Access Initiative: <http://www.soros.org/openaccess/>

Open Access News: <http://www.earlham.edu/~peters/fos/fosblog.html>

eIFL Open Access Program: http://www.eifl.net/services/services_open.html

Directory of Open Access Journals: <http://www.doaj.org/>

Directory of Open Access Repositories: <http://www.opendoar.org/>

SPARC (Scholarly Publishing and Academic Research Coalition):

<http://www.arl.org/sparc/about/index.html>

Bioline International: <http://www.bioline.org.br/>

Public Knowledge Open Access Project:

<http://www.publicknowledge.org/issues/openaccess>

CERN Workshop on Innovations in Scholarly Communications (OAI4):

<http://oai4.web.cern.ch/OAI4/> (presentation abstracts and streaming of presentations very informative)

JISC Briefing Paper on Open Access: http://www.jisc.ac.uk/uploaded_documents/JISC-BP-OpenAccess-v1-final.pdf

Public Library of Science: www.plos.org

BioMed Central: <http://www.biomedcentral.com>

Hindawi Publishing: <http://www.hindawi.com/>

EPrints: <http://www.eprints.org/>

DSpace: <http://www.dspace.org/>

Guide to Institutional Repository Software: <http://www.soros.org/openaccess/software/>

RESOURCES FOR LIBRARIANS IN DEVELOPING COUNTRIES

Research resources for librarians in developing countries; Especially for institutions, governments and nongovernmental organizations in low-income and low-middle income countries.

SCHOLARLY RESOURCES -- Freely Accessible Full Text Journals

Full Text Journals

1. Open Access/Almost-Open-Access Online Journals (any country)

a. Directory of Open Access Journals (DOAJ) <http://www.doaj.org>

DOAJ covers free, full text, quality controlled scientific and scholarly journals, aiming to cover all subjects and languages. As of February 2006, there are 20014 journals in the directory.

b. African Journals On Line (AJOL) <http://www.ajol.info>

Provides access to citations and fulltext of over 230 African journals covering most subject areas. AJOL also offers a document delivery service which is free to users and participating journals. Document delivery requests from outside of developing countries are not free.

c. Bioline International <http://www.bioline.org.br/journals>

Features 30 peer-reviewed journals from Brazil, Cuba, India, Indonesia, Kenya, South Africa, Uganda, and Zimbabwe. Subjects include: health (tropical medicine, infectious diseases, epidemiology, emerging new diseases), biodiversity, environment, conservation and international development).

d. Electronic Journals Library <http://rzblx1.uni-regensburg.de/ezeit/index.phtml?bibid=AAAAA&colors=7&lang=en>

University Library of Regensburg offers the "Electronic Journals Library," which contains over 25,000 titles, of which over 10,500 journals can be read free-of-charge.

e. Highwire (Stanford University) <http://highwire.stanford.edu/lists/freeart.dtl>

Highwire facilitates access to over 1.1 million full text scholarly articles on medical/biomedical topics. Most journal titles covered include back issues older than 12-24 months.

f. Scholarly Journals Distributed via the World Wide Web (University of Houston Libraries)

<http://info.lib.uh.edu/wj/webjour.html>

Provides links to established Web-based scholarly journals that offer access to English language articles. No user registration or fees required.

g. British Library for Development Studies <http://blids.ids.ac.uk/blids/elibrary/ej-list.html>

[click on: "List only free Internet editions"]

h. Ideas at RePEc <http://ideas.repec.org/search.html>

Journals Accessible Freely for selected developing countries - some may require registration

1. Electronic Information for Libraries <http://www.eifl.net>

eIFL.net is an independent foundation that strives to lead, negotiate, support and advocate for the wide availability of electronic resources by library users in transition and developing countries. Its main focus is on negotiating affordable subscriptions on a multi-country consortial basis, while supporting the enhancement of emerging national library consortia in member countries.

2. AGORA -- Access to Global Online Research in Agriculture

<http://www.aginternetwork.org/en/journals.php>

AGORA provides free access to more than 500 journals from major scientific publishers in the fields of food, agriculture, environmental science, and related social sciences.

AGORA is available to students and researchers in qualifying not-for-profit institutions in eligible developing countries. For more information, contact agora@fao.org

3. HINARI - Health InterNetwork Access to Research Initiative

<http://extranet.who.int/hinari/en/journals.php>

The Health InterNetwork Access to Research Initiative (HINARI) provides free or very low cost online access to the major journals in biomedical and related social sciences to local, non-profit institutions in developing countries. As of February 2006, over 3100 journals are accessible thru HINARI.

4. OARE – Online Access to Research in the Environment

<http://www.springer.com/sgw/cda/frontpage/0,11855,4-198-2-172659-0,00.html>

OARE is being developed under the sponsorship of the United Nations Environment Programme with infrastructure provided by Yale University. OARE is scheduled to be launched in January 2007.

5. Highwire Press (Stanford University) <http://highwire.stanford.edu/lists/freeart.dtl>

Highwire press provides a list of journals offering free online access to developing economies. Individual publishers use the World Bank's list of low income economies for determining access. You do not need to register for this service as highwire software automatically detects the country you are connecting from and grants access accordingly.

6. Oxford Journals - Developing Countries Offer

http://www.oxfordjournals.org/access_purchase/developing_countries.html

Oxford University Press offers developing countries free (or greatly reduced rate) access to many of our journals via our Developing Countries Online Collection offer. The offer via the International Network for the Availability of Scientific Publications (INASP) for established not-for profit educational institutes from qualifying countries and provides access to an Online Collection of journals.

7. Global Development Network (GDN) - Free Journal Access Portal

<http://www.gdnet.org/middle.php?oid=245>

GDN has linked policy research institutes from 11 regions and more than 100 countries. GDN offers a range of journals services to address the difficulty faced by many researchers in the global south in accessing journal articles to support their research.

8. TEEAL - The Essential Electronic Agricultural Library

<http://www.teeal.org/about.html>

TEEAL is a full-text and bibliographic CD-ROM library of more than 140 of the world's most important scientific journals in the field of agriculture. It is available well below cost to more than 100 of the lowest-income food-deficit countries.

C. Directories / Indexes for Determining Publisher Open Access Status

Index of Author-Archiving Status

Romeo lists the status of publisher copyright policies and author-archiving policies of academic journals, indicating, by a color scheme, which publishers allow authors to archive preprints and/or post-prints. Journals are classified by color as green, blue, yellow, and white levels. <http://www.sherpa.ac.uk/romeo.php?all=yes>

2. INSTITUTIONAL REPOSITORIES

Full Text Open Access Repositories

1. Directory of Open Access Repositories (OpenDOAR) <http://www.opendoar.org>

OpenDOAR lists the wide variety of institutional and subject-based Open Access research archives and repositories which have grown up around the world.

2. OAIster <http://oaister.umdl.umich.edu/cgi/b/bib/bib-idx?c=oaister;page=simple>

OAIster is a collection of freely available, previously difficult-to-access, academically-oriented full-text resources searchable without restriction. OAIster includes over 7 million records from over 600 institutions worldwide.

3. ARC - A Cross Archive Search Service <http://arc.cs.odu.edu>

Arc is an experimental research service of Digital Library Research group at Old Dominion University. ARC searches across over 178 international repositories (listed here: <http://arc.cs.odu.edu:8080/oai/admin.jsp>) through a unified search interface.

4. ePrints-UK project <http://eprints-uk.rdn.ac.uk/search/?view=advanced>

ePrints-UK aims to provide national, discipline-focused searching for access of journal articles, technical reports and web pages in electronic institutional archives of 30 selected UK universities and colleges.

5. Bielefeld Academic Search Engine (BASE) <http://www.base-search.net/index.php?i=a>

BASE is the multi-disciplinary search engine to scholarly internet resources at Bielefeld University. BASE complements the current metasearch system for catalogues and databases of the Bielefeld Digital Library by allowing searches to be limited by type of document, including scholarly full text archives, digital repositories and preprint servers available on the World Wide Web.

Full Text Institutional Repositories focusing on development

1. FAO Corporate Document Repository / FAO <http://www.fao.org/documents>

The repository provides full text access to publications, articles and meeting documents produced by the FAO.

2. Development Experience Database / U.S. AID <http://www.dec.org>

Provides access to abstracts and full text documents from USAID, including: Reports, development project documents, and citations of documents held by USAID Information Centers.

3. World Bank "Documents & Reports" Database <http://www-wds.worldbank.org>

Provides access to all publicly available World Bank operational documents (project documents, analytical and advisory work, and evaluations), formal and information research papers, and most World Bank publications. Includes over 15,000 full text documents.

4. Development Gateway / Development Gateway Fdn

<http://www.developmentgateway.org>

Promotes knowledge sharing by providing access to fulltext documents across a wide range of development topics. Also includes 38 Country Gateway Portals serving local development information needs.

5. Eldis Gateway to Development Information / Inst of Dev Studies

<http://www.eldis.org>

Over 16,000 full text, abstracted development-oriented documents are available from Eldis. Documents are of "strategic, policy or practical interest" for development practitioners based in both the North and the South.

6. UN Best Practices Database <http://www.bestpractices.org>

Includes descriptions of over 2,150 award-winning solutions to common social, economic and environmental problems in over 140 developing and developed countries. Searchable by country, scale (global, national, regional, village, etc.) and by subject category. Best Practices is a joint product of UN-HABITAT and The Together Foundation and is supported in part by the Dubai Municipality, the Best Practices Partners, and the Government of UK. Coverage: 1996 – present.

7. Projects & Operations – World Bank <http://www.worldbank.org/projects>

Search thru projects, project documents, and analytical-and-advisory work of the World Bank. An advance search feature is available. The database is also browsable by: Region, country/area, theme or sector.

Free Statistical Data Sources focusing on development topics

1. World Development Indicators (text display) / World Bank

<http://www.worldbank.org/data>

Query database selections here: <http://devdata.worldbank.org/data-query>

World Development Indicators (WDI) is the World Bank's annual compilation of data about development. The 2005 WDI includes more than 800 indicators in 83 tables organized in 6 sections: World View, People, Environment, Economy, States and Markets, and Global Links. Data are shown for 152 economies with populations of more than 1 million and 14 country groups, plus selected indicators for 56 other smaller

economies. Limited access to statistical database. Full access available via subscription only.

2. **FAOSTAT Database** / Food and Agriculture Organization <http://faostat.fao.org>
Multilingual statistical databases containing over 1 million time-series records covering international statistics in the areas of production, trade, food balance sheets, fertilizer and pesticides, land use and irrigation, forest products, fishery products, population, agricultural machinery, and food aid shipments.

3. **LABORSTA Database** / International Labour Organization <http://laborsta.ilo.org>
Contains yearly statistics of employment, unemployment, hours of work, wages, labor cost, consumer price Indices, occupational injuries, strikes and lockouts on over 200 countries (data since 1969); monthly statistics of employment, unemployment, hours of work, wages, consumer price indices (data since 1976); and economically active population estimates and projections, 1950-2010.

4. **Creditor Reporting System (CRS)** / OECD & World Bank
<http://www.oecd.org/dac/stats/idsonline>
Contains data on Official Development Assistance (ODA), Official Aid (OA) and other lending to developing countries and countries in transition as collected by members of the Development Assistance Committee, the World Bank, and the regional financial institutions. The system is sponsored jointly by the OECD and the World Bank and operated by the OECD.

5. **DAC Online** / OECD <http://www.oecd.org/dac/stats/idsonline>
DAC measures the flows of aid and other financial resources to aid recipients. Collected annually from the Members of the OECD's Development Assistance Committee, these statistics are broken down by major category of expenditure: capital projects, budget and balance of payments support, food and other commodity aid, technical cooperation and emergency relief.

6. **UN Monthly Bulletin of Statistics** / United Nations <http://unstats.un.org/unsd/mbs>
Includes current monthly economic statistics for most countries and areas of the world. The statistics are obtained by from official sources in the various countries, except where otherwise stated in the notes to the tables. Updated monthly.

7. **UNSTATS UN Common Database** / United Nations <http://unstats.un.org/unsd/cdb>
Draws selectively on statistics from throughout the UN system, covering all countries, areas and over 300 series from more than 30 specialized international data sources. Time series data is generally available from 1970 or 1980. Many series are disaggregated to show underlying distributions. The source includes comprehensive footnotes and meta-information on sources, definitions, and frequency of updates, and provides technical definitions and standards verbatim from their original sources. Users may view data, compile graphs, calculate derived measures, and export data.

Free Citation Databases

1. Online Journals Requiring Subscriptions / Global Development Network

<http://www.gdnet.org/middle.php?oid=247#online>

This site lists databases providing full text access to online journals, mostly by subscription. Other services, such as citation searching, email alerts on new journals, abstracts and table of contents alerts are usually freely available.

2. JOLIS Library Catalog / World Bank/IMF <http://jolis.worldbankimflib.org/e-nljolis.htm>

The Jolis Library Catalog is the catalog of the IMF/World Bank Library Network. The catalog, which contains over 1 million items includes references to a wide variety of development related materials from hundreds of different publishers. The catalog also includes references, and links to many published IMF and World Bank materials.

3. Global Jolis Library Catalog / World Bank <http://jolis.worldbankimflib.org/e-nlglobaljolis.htm>

Global Jolis is the library catalog for World Bank Country Office PIC (Public Information Center)/Libraries. It includes materials in most country offices around the world. The catalog includes references to books, journal articles, working papers, conference proceedings, technical reports, electronic resources, and country-specific reports from local government agencies, nongovernmental organizations, special collections of local language and indigenous knowledge materials.

4. ERIC / US Department of Education [English, French, Spanish]

<http://www.eric.ed.gov>

ERIC includes references to journal articles and non-journal material covering all aspects of education. The database contains over 1.1 million citations from 1966 to the present. More than 107,000 full-text non-journal documents (issued 1993-2004) are available. For technical issues contact: library@ed.gov

5. FAOBIB -- FAO Library Catalog / Food and Agriculture Organization

<http://www4.fao.org/faobib>

FAOBIB is a multilingual, on-line catalogue of documents and publications produced by FAO since 1945, books added to the library collections since 1976, and serials held in the FAO library. Full text links are now provided for all documents which are available in electronic format.

6. Agricola / U.S. Department of Agriculture <http://agricola.nal.usda.gov>

A comprehensive source of bibliographic citations covering U.S. agricultural and life sciences information, Agricola contains Over 3,500,000 citations to journal articles, monographs, theses, patents, software, audio-visual materials, and technical reports related to all aspects of agriculture. Coverage is from 1970 to the present, with monthly updates. Some citations in French.

7. **UNESBIB** - UNESCO Documents Database <http://unesdoc.unesco.org/ulis>
UNESBIB includes over 100,000 citations for books, articles and UNESCO publications, some with full text links. Languages included are: English, French, Spanish, Arabic and Russian.

8. **Red Latinoamericana de Documentacion e Informacion en Educacion (REDUC)** [Spanish only] <http://www.reduce.cl/homereduc.nsf/?Open>
REDUC es un sistema cooperative de recopilacion, procesamiento y diseminacion de documentos relevantes en el campo de la educación en la region de America Latin y el Caribe. [Cooperative education database covering Latin America and the Caribbean at the regional and national level]

9. **PubMed** <http://www.ncbi.nlm.nih.gov/entrez>
PubMed provides access to over 11 million citations from the U.S. National Library of Medicine and other related databases. Links to selected online journals, some freely available, are also included. Updated monthly. Covers 1960s to present. Some citations are in French, Portuguese, or Spanish.

10. **Popline** <http://db.jhuccp.org/popinform/basic.html>
Popline is the world's largest bibliographic database on population, family planning, and related health. Citations also cover sexually transmitted diseases including HIV/AIDS, reproductive health, law, and policy issues. The database includes abstracts of journal articles, monographs, technical reports, and unpublished works. Updated twice per month. Some citations in French, Spanish or Portuguese.

11. **Science Direct** <http://www.sciencedirect.com>
A collection of over 1,000 journal title citations with links to the full text by subscription only. ScienceDirect focuses predominantly on science, technology, and medicine, but mathematics, economics and other disciplines are represented. Some citations in French.

12. **UNBISnet** / U.N. Dag Hammarskjöld Library <http://unbisnet.un.org>
Catalogue of United Nations(UN) documents and publications indexed by the UN Dag Hammarskjöld Library and the Library of the UN Office at Geneva. Also included are commercial publications and other non-UN sources held in the collection of the Dag Hammarskjöld Library. The coverage of UNBISnet is from 1979 onward, however, older documents are being added to the catalogue on a regular basis as a result of retrospective conversion. UNBISnet also provides instant access to a growing number of full text resources in the six official languages of the UN (Arabic, Chinese, English, French, Russian and Spanish), including resolutions adopted by the General Assembly, the Economic and Social Council and the Security Council from 1946 onward.

13. **Google Scholar** <http://www.google.com/scholar>
Google Scholar facilitates citation searching of scholarly literature, including peer-reviewed papers, theses, books, preprints, abstracts and technical reports from a broad range of research areas.

Scholarly Journal Document Delivery Support Services for Developing Countries

A. electronic Journals Delivery Service (eJDS) Programme <http://www.ejds.org>

The electronic Journals Delivery Service (eJDS) Programme is geared to facilitate free access to current scientific literature. The goal is to distribute individual scientific articles via email to scientists in institutions in Third World countries that do not have access to sufficient bandwidth to download material from the Internet in a timely manner and/or cannot afford the connection.

B. African Journals OnLine (AJOL) <http://www.ajol.info>

AJOL offers a free document delivery service for developing countries. There is a document delivery fee for requestors outside of developing countries.

C. Electronic Supply of Academic Publications to and from universities in developing regions' (ESAP) <http://www.fiuc.org/iaup/esap> A project of the International Association of University Presidents (IAUP) in cooperation with the International Federation of Catholic Universities (IFCU), SAP aims to set up a sustainable electronic document delivery systems for scholarly publications between universities in the North and the South as well as on a South-South basis, and thus assist in the supply of academic publications to as well as from the developing world.

D. A Library in your Letterbox: The GDN/BLDS Document Delivery Service http://www.gdnet.org/online_services/journals/gdn_journal_services/document_delivery/index.html Accessing the latest development knowledge is a key challenge for many researchers in developing and transition countries. Recognising these challenges, the Global Development Network and the British Library of Development Studies (BLDS) have teamed up to bring GDN/BLDS Document Delivery service to meet the information needs of research institutes in the South.

E. International Network for the Availability of Scientific Publications(INASP)/Programme for the Enhancement of Research Information (PERI) <http://www.inasp.info/peri>

This network provides access to scientific and scholarly information through electronic means. It includes more than 10,700 full-text online journals, current awareness databases, and document delivery of major scientific, technical, medical, social science, and humanities materials from a wide range of sources. For more information contact inasp@inasp.info.

F. FreeForAll http://www.geocities.com/wfb_2/freeforall.html

Free for all is an international collaboration of libraries whose mission is to provide underserved nations with health science journal articles for free.

Open Resources and Open Courseware in Health and Medical Education

Anatomy	http://www.leeds.ac.uk/chb/humbmods.html
	http://www.auburn.edu/academic/classes/zy/0301/comparative_home/comparative_home.html
	http://www.neuropat.dote.hu/document.htm
	http://rmoskowitz.tripod.com/ap1_lecture_notes.htm
	http://www.latrobe.edu.au/humanbio/hpa_lecture_notes.html
	http://www.anatomy.wisc.edu/teaching.html
	http://anatomy.uams.edu/anatomyhtml/medcharts.html
	http://endeavor.med.nyu.edu/public/
Bacteriology	http://iberry.widged.com/html/ihl.htm
	http://www.textbookofbacteriology.net/
	http://books.google.co.in/books?id=9N2DXmYdlxkC&pg=PA1&lpg=PA1&ots=fUzsfXViMq&dq=Bacteria+n
	http://www.cbs.dtu.dk/staff/dave/roanoke/genetics980309.html
Biochemistry	http://www.biozone.co.uk/CELL_BIOL_AND_BIOCHEM.html
	http://www.med.unibs.it/~marchesi/subjects.html
	http://www.dqb.fc.ul.pt/docentes/lcyrne/linksinteng.html
	http://www.varsitynotes.com/biochemistry/medical_biochemistry.html
Biodiversity	http://ibis.nott.ac.uk/biodiv/cware.html
Bioinformatics	http://www.sbc.su.se/~pjk/molbioinfo2001
	http://www.bcbp.gu.se/~leckner/structure/PPT/
	http://lectures.molgen.mpg.de/online_lectures.html
	http://www.lmb.uni-muenchen.de/groups/bioinformatics/01/ch_01.html
	http://ocw.mit.edu/OcwWeb/Biology/7-91JSpring2004/LectureNotes/index.htm
	http://www.bioinformaticscourses.com/
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	http://www.cs.iastate.edu/~cs544/Lectures/lectures.html
	http://www.bioinfo.rpi.edu/~bystrc/courses/biol4540/lecture20/index.htm
	http://www.uni-konstanz.de/FuF/Bio/Bioinformatik/biv201/index.htm
	http://home.cc.umanitoba.ca/%7Efrist/umbioinf/bookmarks.html
	http://www.sanbi.ac.za/downloads/lectures_tutorials.html
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	http://www.uni-tuebingen.de/plant.biochemistry/links/Bioinflink.html
	http://www.bioinformatik.de/cgi-bin/browse/Catalog/Research_and_Education/Online_Courses_and Tutor
	http://bioinformatics.unr.edu/seqbx/tutorials.htm
	http://home.cc.umanitoba.ca/%7Efrist/umbioinf/bookmarks.html
	http://home.nc.rr.com/scottsauerbach/
	http://baygenomics.ucsf.edu/education/workshop1/lectures/index.html
Biology	http://science.nhmccd.edu/biol/bio1int.htm
	http://hsc.utoledo.edu/lib/rowMay2002.html
	http://www.ocw.titech.ac.jp/index.php?lang=EN
	http://www2.okbu.edu/academics/natsci/biology/BiologyLinks.html
	http://www.urmc.rochester.edu/path/Internet/neted.htm
	http://serendip.brynmawr.edu/biology/links99.html
	http://dmoz.org/Science/Biology/Directories
	http://www.bio12.com/menu.htm
	http://bioresearch.ac.uk/
Cancer	http://ocw.tufts.edu/Content/20/Lecturenotes/300759
	http://cancerguide.org/intro_home.html
	http://lysine.pharm.utah.edu/netpharm/netpharm_00/notes.html
Clinical Genetics	http://www.kumc.edu/gec/
	http://www.genetests.org/servlet/access?id=8888892&key=Hs4vQtfyVAJTU&fcn=y&fw=3UL4&filename=/c

earth science	http://www.ukesc.co.uk/about/aboutmods.html
Entomology	http://www.cals.ncsu.edu:8050/course/ent425/tutorial/index.html
Environment	http://wvlc.uwaterloo.ca/biology447/
Forensic	http://www.stfrancis.edu/ns/diab/ForensicCoursePPT/Ch10webToxicology.htm
	http://www.dundee.ac.uk/forensicmedicine/notes/notes.html
	http://www.chemlin.net/chemistry/forensic_chemistry.htm
Free online	http://www.free-ed.net/free-ed/FreeEdMain01.asp
	http://www.freeonlineeducation.info/2005/10/28/free-open-courseware-classes/
John Hopkins University	http://ocw.jhsph.edu/courses/BioinformaticsComputationalBiology/lectureNotes.cfm
Kyoto University	http://ocw.kyoto-u.ac.jp/en/
	http://www.ocwconsortium.org/use/index.html
Martindale University	http://www.martindalecenter.com/Medical1.html
	http://web.indstate.edu/thcme/mwking/home.html
Medical Botany	http://www.ars-grin.gov/duke/syllabus/
Pathology	http://www.mcl.tulane.edu/classware/pathology/medical_pathology/overview.html
	http://aladdin.wustl.edu/MedStudents/Pathology/hematol.nsf
Statistics	http://www.brettscaife.net/statistics/introstat/
	http://www.mas.ncl.ac.uk/~njnsm/medfac/BMedSci/notes.htm
	http://www.stat.ufl.edu/vlib/statistics.html
Microbiology	http://www.tulane.edu/~dmsander/WWW/109/Lectures.html
	http://dmoz.org/Science/Biology/Microbiology/Education/
	http://microbiol.org/vlink_material.htm
	http://www.kcom.edu/faculty/chamberlain/
	http://www.keele.ac.uk/depts/ms/resources/anatomy/store/mcwilliam/micro.htm
	http://www.kcom.edu/faculty/chamberlain/Website/Lects/Content1.htm
	http://gsbs.utmb.edu/microbook/toc.htm
	http://www.bmb.leeds.ac.uk/mbiology/ug/ugteach/icu8/introduction/head.html
MIT courseware	http://ocw.mit.edu/OcwWeb/Health-Sciences-and-Technology/index.htm
	http://ocw.mit.edu/OcwWeb/Health-Sciences-and-Technology/index.htm
	http://ocw.mit.edu/OcwWeb/Global/all-courses.htm

Online Courseware	http://www.collegeanduniversity.net/Main/HomeSearch.cfm?AffID=358&searchType=1 http://www.collegeanduniversity.net/Main/HomeSearch.cfm?AffID=358&searchType=1 http://www.college-university-online.com/computer_science_college/index.html http://www.merlot
	http://www.varsitynotes.com/ http://www.varsitynotes.com/ http://iberry.widged.com/html/isc.htm
	http://endeavor.med.nyu.edu/public/
Osaka University	http://ocw.osaka-u.ac.jp/courses.php?cname=30&contype=3&lang
Pathology	
	http://www.mcl.tulane.edu/classware/pathology/medical_pathology/New_for_98/CourseDescription98.htm
	http://www.medev.ac.uk/resources/links/links_database/search_free_internet_resources
Protozoology	http://www.tulane.edu/~wiser/protozoology/pwpt/
Rai University	http://www.tulane.edu/~wiser/protozoology/pwpt/
Royal Colleges	http://www.medev.ac.uk/resources/links/links_database/search_free_internet_resourc
Texas University	http://cellbio.utmb.edu/cellbio/
Tufts Courseware	http://ocw.tufts.edu/
Universities World wide	http://www.chemlin.net/chemistry/universities.htm
Virology	http://web.uct.ac.za/depts/mmi/jmoodie/welcome1.html
	http://www.mcb.uct.ac.za/tutorial/virtut1.html
	http://www.tulane.edu/~dmsander/WWW/224/224Virology.html
	http://www-micro.msb.le.ac.uk/3035/index.html
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	http://csm.jmu.edu/biology/virology/lecture%20notes%202000a.html
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	http://www.netactics.co.uk/virology.html
	http://web.austin.utexas.edu/wlh/index.cfm
Software	http://www.educational-software-directory.net/science/
Bioinformatics	http://bioinformatics.org/
	http://www.cmu.edu/oli/registration/index.html
	http://cnx.org/content/browse_course_titles
	http://opencontent.org/ocwfinder/
	http://opencontent.org/googleocw/

	http://textbookrevolution.org/ocw
	http://www.colfinder.org/public/index.jsp
	http://www-304.ibm.com/jct09002c/university/scholars/courseware/
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