IDRC's Experience in Providing Information Technology Support to Developing Countries

presented by

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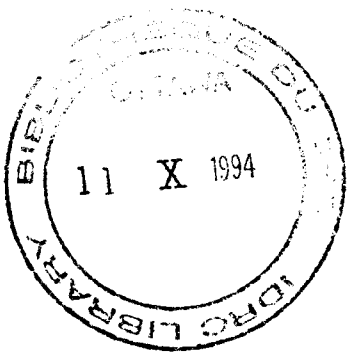

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Information Technologies Have Been Part of IDRC Since Its Early Days

IDRC has been actively involved with information technologies (ITs) since its inception 25 years ago. Today of course many of us live in a world where computers and telecommunications are becoming more and more pervasive in our work, where we cannot pick up a newspaper, turn on a television, or connect to an electronic database or service without reading about, seeing, or experiencing "the information revolution", "information superhighways", or even "cyberspace". Although this is especially true for the North, it is becoming more so for the South despite a very real technology gap.

But in IDRC's early days, information technologies meant expensive mainframe computers tended by specialists, requiring arcane language skills and much care and feeding. Remote sensing was a new science and the analysis was mainly visual, not digital. Telecommunications in developing countries? Email? Computer conferencing? What a notion when the telephones often did not work (at least according to some sceptics at the time, although fortunately not everyone was such a sceptic![1]). Nonetheless, the framers of the Act of Parliament[2] which established IDRC planted the first seeds in the Act with references to "information and data centres and facilities for research". This early recognition of the importance of Information Sciences to research and development led to the establishment of programs in this field at IDRC[3]. IDRC and its partners in Canada and in developing countries have accumulated valuable experience in the field of information, IT, and development over the last two decades.

In addition to IDRC's international character and autonomy, there are a number of reasons why IDRC provides an enabling environment for promoting and supporting advances in information and knowledge management technologies in developing countries. IDRC specializes in fostering and supporting research. It provides effective support to indigenous researchers without attempting to exert influence over them. In its cooperative research projects between developed and developing-country institutions, all partners gain. The IDRC approach tends to nurture independent researchers whose future research and activities are hampered only by lack of continued funding or operational infrastructure in their countries.

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[1] See the discussion on IDRC's Telematics Program below.

[2] International Development Research Centre Act, Revised Statutes of Canada 1970, 1st Supplement, Chapter 21.

[3] See for example: R. Valantin. A Conceptual Model for Support for Information Technologies Research for Developing Countries. Ottawa. IDRC. 1985.

What Are Information Technologies and Why Are they Important to Development?

First a quick definition. "**Information technologies**" are primarily electronic-based technologies which can be used to collect, store, process, package, and communicate information and provide access to knowledge. The emphasis is on technologies which are "informatics"-compatible, that is, which can be integrated with computing capacity to provide for assisted information and knowledge processing. IDRC has concentrated on technologies that are at the "leading edge" of their development, so that developing countries can have experience with their design, adaptation, and use before the development/introduction cycle fully solidifies and excludes their interests.

A key common element here is the computer, which is a prime example of a "generic technology" if ever there was one. Through appropriate programming ("software") and interface devices ("hardware"), a computer can analyze data, control industrial processes, act as a telecommunications switch, provide "expert" advice, or integrate multimedia presentations for entertainment or education.

As the world economy speeds up and becomes even more globalized, the issue of access and utilization of knowledge governs the survivability of all actors. The effective use of information technologies is an essential ingredient of success in this process. Without appropriate adoption, adaptation, transfer, development, and use of information technologies, developing-country organizations and individuals will continue to participate in the global economy from an uncompetitive position: their disenfranchisement will grow. That is one of the reasons IDRC decided to provide support for information technologies in its programs.

IDRC's Approach to Information Technology and Development

Two key elements of IDRC's philosophy, as reflected in its Corporate Strategy, "Empowerment through Knowledge"[4], are partnerships and capacity building. These are reflected in IDRC's approach to IT and development, and its support to developing countries in this area. This approach can be summarized in the following principles:

1. **Work with the newest and best information technologies.** Keep on the "leading edge", because that is where developing countries must also be for their survival. Try to anticipate technological trends and use imagination. Involve developing-country researchers in experimentation with new technologies and their application as early as is practical in their development.

2. **Support developing-country capacity building, through a mix of technology transfer, partnerships, and local technology research and development activities.** Program activities should strengthen human and institutional resources in the area of IT research in developing countries. For collaborative projects, developing countries should be considered as full partners in research and development, and not simply as test-beds for technologies developed elsewhere.

3. **Look for research which is practical and results-oriented,** as opposed to theoretical or purely academic. It should lead to practical development applications and the solution of real-world

[4] Ottawa. IDRC. November 1991.

problems. In many cases, this will require linkages to other programs and a multidisciplinary approach.

4. **Where appropriate, place emphasis on generic or generalizable outputs of global interest, rather than only those specific to a particular country or institutional situation.** Such projects should aim for a high multiplier effect and maximizing their impact. Where possible, link general global IT solutions to local/regional problems.

5. **Foster international collaboration in IT, through South-South, South-North, and East-West partnerships.** Networking (both human and electronic) is a key element, ensuring that developing-country scientists and researchers are connected to colleagues and sources of information and knowledge wherever they may be located.

6. **Support quality research work.** Research should be carried out according to established scientific principles. Researchers should have a strong commitment to the activity and be capable of assuming principal responsibility throughout the project process, including proposal development, research, management, implementation, and dissemination.

7. **Support projects which can promote interest in this research area by other potential donors.** IDRC is a relatively small research funding agency and clearly cannot do the job alone. It concentrates on research, often (but not always) at the demonstration or proof-of-concept stage. IDRC is eager to work with other donors and development actors in this field.

8. **When appropriate, link the technologies and tools to past investments in the information content.** For example, over the last two decades IDRC's Information Sciences and Systems Division (ISSD) has supported the establishment of databases, and information and communications systems and services over two decades. Some of these can now provide extensive materials which can be restructured or repackaged using modern knowledge representation methods and new information technologies for access. Many of the institutions with which the Division has been working are becoming very aware of the importance to development of information technologies, and are eager to begin work in the area.

9. **Support activities based upon both identified user needs and technological opportunities.**

   In the case of projects based on **user needs**, some criteria to consider are:

   - such projects must have a capable institution on the technology research side and one on the user interface/ liaison side (in some cases, both of these capabilities may be within the same institution)
   - the technical solution should enable the user to benefit through either cost-benefit considerations or through increased functional capabilities
   - the user institution should have the capacity to secure resources required to ultimately implement the solution developed.

   For projects based upon **technological opportunities**, some criteria are:

   - a reasonable chance of success, although risks should be entertained if the stakes are high enough (i.e. large potential impact, multiplier effect, marketability)
   - work with "winners", i.e. institutions which have proven track records of successful research

- ensure that developing-country interests and issues can influence the global information technology research agenda.

10. **Encourage sensitization, evaluation, and dissemination activities which are vital to ensuring support for IT research and the effective utilization of research results** (see also point 11 below).

11. **Support policy research which can provide an important framework for decision-making and allocation of resources.** For example, IDRC recently created an Information Policy Research Program within ISSD with the objective of influencing the information and information technology policy environment, in order to promote and facilitate more effective utilization of information and related ITs in support of sustainable and equitable development. In order to effect change with respect to the adoption and sustainable use of information technologies, it is not enough simply to carry out technical research projects, pilot projects or feasibility studies. To make technologies workable, both broad and specific evaluations must be carried out, case studies must be analyzed, linkages must be forged, project results must be disseminated, awareness must be increased, and enabling policies must be nurtured.

12. **Establish specialized programs to support information technology research and development (R&D) and applied research.** These programs should be in addition to support for "straight-forward" implementations or applications of information technologies in other program areas. Since the technologies are complex and fast-moving, organizations need expertise in-house, not only to provide good technical advice and assessments, but also to interpret and understand the more specialized technical advice and assessments which they will have to obtain outside! **Within IDRC, there are two programs with such a specialization within the Information Sciences and Systems Division: Information and Communication Technologies (ICT) and Software Development and Applications (SDA).**

    The objective of the Information and Communication Technologies (ICT) Program is to enable developing countries to carry out and/or benefit from research on new ITs in order to permit them to effectively utilize such technologies for solving their information problems and for improving access to knowledge for development. The Program supports the assessment, development, adaptation, testing, and transfer of technological innovations, as well as research on the social, economic, and political issues associated with their introduction. It has supported research in a wide range of IT disciplines: **informatics** (including software development; expert systems and related knowledge engineering methods; computer-based training; information- and knowledge-presentation and knowledge-communicating technologies such as multimedia systems; computer-based modelling tools; and system design and integration methods); **telematics** (computer-based communications and networking; satellite-based communications); and **geomatics** (automated cartography, remote sensing, Geographic Information Systems, Global Positioning Systems).

    The Software Development and Applications Group (SDA) within ISSD aims to increase capacity within developing countries to manage the software development process, and to provide an effective mechanism for increasing the availability of software products of practical application in the developing world. A specific example is the MINISIS software package.[5]

[5] See the discussion on MINISIS below.

Examples and Case Studies

To illustrate IDRC's approach and the principles stated above, a number of examples are presented below from the ICT and SDA Programs in the Information Sciences and Systems Division:

- **Telematics: Linking People and Information for Development**
- **Informatics: Providing Software for Development**
- **Geomatics: Connecting Geography and Development**

Telematics: Linking People and Information for Development

Access to information technologies is uneven throughout the world. The inequity is greatest (and unfortunately is still growing) in developing countries. This has serious implications for the increasing disparity between the "haves" and the "have-nots". Developing-country institutions need to improve their access to and use of information technologies in order to compete in the 21st Century and to minimize the tendency towards a widening development gap.

One of the most basic functions which illustrates this disparity is the access to and availability of computer-based communications technologies (email, bulletin board systems, computer conferencing, and more recently Internet). It could indeed be argued that the level of access and availability is not only a distinguishing feature of a country's level of development but also a necessary prerequisite for personal, corporate and national development. Recognizing this growing disparity, in 1981 IDRC organized a week-long workshop, Computer Based Conferencing Systems for Developing Countries[6], to explore the state of the art and receive advice on the role for donors. At that time, only a few developing-country institutions were involved in related research activities. The recommendations of that workshop led to the creation of a Telematics Program at IDRC.

Throughout the 1980s this Program supported and promoted initiatives to facilitate more informed decisions by developing-country institutions concerning the transfer, adaptation, and utilization of data communications techniques. Examples of the type of initiatives supported include:

- the organization in 1983 of one of the first international computer conferences involving developing-country institutions[7]

- support for a feasibility study and pilot project on the implementation of a data transfer network for the CGIAR institutions (these small investments in 1982 led to the creation and continuing

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[6] D. Balson, R. Drysdale and B. Stanley. Computer-Based Conferencing Systems for Developing Countries. Report of a Workshop held at Ottawa, Canada, 26-30 October 1981. Ottawa. IDRC. 1981.

[7] D. Balson. International Computer-Based Conference on Biotechnology: A Case Study. Ottawa. IDRC. 1985.

growth of the CGNET[8] which has facilitated the research of these important institutions while saving them millions of dollars)

- research in Latin America on the appropriateness of different conferencing and messaging systems within the NGO world and the trade information sector respectively
- software development in North Africa involving communications protocols and Arabization
- policy aspects related to Transborder Data Flows
- research concerning the use of low-earth-orbit (LEO) satellites to solve "last-mile" communications problems[9].

The early years of this Program can be characterized as ones of promotion and sensitization since there was, with a few exceptions, next to no recognition of the importance of information and communication technologies in the development process. Towards the end of the 1980's the emphasis was placed geographically on Africa, where the needs were greatest and progress was minimal. A number of inter-related networking projects were developed to achieve the objectives of the Program in this region. Examples of these include:

- NGONET Africa: linking four nodes and many NGO end users in Nairobi, Harare, Dakar, and Tunis for information exchange in the context of the lead-up to UNCED
- ESANET: linking five universities in Kenya, Zambia, Tanzania, Uganda, and Zimbabwe to experiment with different data communication topologies
- HealthNet: linking health institutions in Africa including medical faculties, hospitals, and medical researchers using packet radio and LEO-satellite technology
- ARSONET: linking standardization offices in Nairobi, Addis Ababa, Dakar, Tunis, and Cairo
- PADISnet: a regional pilot effort in utilizing a variety of data communications technologies to link development institutions in Africa, designed as a networking of networks project and coordinated by PADIS/ECA[10] in Addis Ababa.

While these projects and others were being developed, an external evaluation of the Telematics Program was carried out. This evaluation confirmed the value of IDRC's investments in telematics for development. It also concluded that: the Program was unique in the development/donor environment in supporting computer-based networking at the time; the basic premises of the Program were valid; positive results had been achieved; and that more emphasis was required on human resource

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[8] G. Lindsey, K. Novak, S. Ozgediz, and D. Balson. The CGNET Story: A Case Study of International Computer Networking. Ottawa. IDRC. 1993.

[9] More on this topic is provided later in this section.

[10] PADIS: Pan African Development Information System
ECA: Economic Commission for Africa

development, institutional capacity building, basic infrastructure development, and broader and more timely dissemination of the results of experiences.

In response to the lessons learned through the constellation of projects supported in Africa, and the recommendations of the evaluation, a major networking capacity building project, Capacity Building in Electronic Communications for Development in Africa (CABECA), was developed. These lessons include:

- the fact that it makes more economic sense to build networking capacity for a collection of user groups and substantive networks rather than looking for unique networking solutions for each substantive network of interest to its proponents or funder
- the need to address networking at the national level with interconnections between countries
- the importance of developing a business-like approach, taking sustainability seriously
- the necessity of developing systems where users are able to purchase services with local currencies
- the necessity of developing a comprehensive ongoing training and troubleshooting regime, first at the sub-regional level but later at the national level with support close at hand
- the importance of indigenization of skills (network implementation, system operation, training)
- the value of national user groups representing providers and users of services to setting policies related to network operation
- the need for involving institutions with the appropriate mandate, outlook and capabilities
- the importance of collaboration and sharing of resources.

The project, coordinated by PADIS/ECA, is using FIDO-like software technology and dial-up communications over the existing telephonic infrastructure to build national nodes in Sub-Saharan African countries. These national nodes are accessible by all types of institutions and interconnected internationally by long-distance polls and through gateways to the Internet. There are close to 20 such systems at various stages of development at this time in Africa. When compared with what needs to be done, this IDRC-supported project actually represents quite a modest investment (approximately CAD 750,000). It will clearly not solve all of the problems related to access to communication capabilities in Africa. Rather, it should demonstrate a model solution and act as a stimulus for others to build appropriate partnerships to address these formidable challenges. IDRC's commitment hopefully will provide leverage in bringing more financial resources to bear on this problem.

There are two potential impacts to be noted. If successful, this project should empower many individuals and institutions, including many donor-supported institutions, through the provision of ongoing access to information and communications. Secondly, if successful in some countries as expected, the demonstration of a truly sustainable system in the difficult African environment could influence attitudes about development possibilities. Since this project has started only in the last year, it remains to be seen what impact it will have. However, confidence in the approach and the increase in the recognition of the need for such access has led to an attempt to replicate this approach by IDRC's Regional Office in Singapore for countries in both South and Southeast Asia.

IDRC has had an ongoing involvement with the exploration of solutions for last-mile communications problems in developing countries and involving developing-country institutions in related research. At the 1981 workshop which led to the creation of the Telematics Program, one of the developing-country participants proposed the concept of a developing-country led initiative to build a low-earth-orbiting (LEO) satellite dedicated to text communication among developing countries for development purposes.

This proposal sparked considerable excitement both in the workshop, and then later in other international fora such as UNISPACE '82. It stimulated the development of a prototype payload which was launched on the UOSAT-2 satellite, and since then more sophisticated payloads on subsequent satellites. IDRC promoted the development of this concept through presentations of the concept, demonstrations at conferences, a research project with an African telecommunications authority, and finally through IDRC's acquisition of capacity on UOSAT-3 and support for the HealthNet: Satellite Communications Research for Development project mentioned earlier. This project is supporting the implementation of 20 ground stations and the development of information exchange utilizing the satellite within the health sector. On the one hand it will empower many institutions within this sector by providing access to both information and communication where little existed before, and, on the other, act as a demonstration of alternative solutions for difficult infrastructure problems in poor countries. It is interesting to note that more than a dozen African countries already have "operational" systems using this LEO technology within the context of this project and are involved in the transfer of this technology to other African countries, while Motorola's 77 satellite IRRIDIUM system, Microsoft's recently announced USD 9 billion TELEDESIC LEO system, and others, are only in the design or construction stage. This is an example of a low-cost development-centred initiative preceding global high-cost initiatives!

There are a number of general conclusions that can be drawn from these experiences. Problems related to the transfer and utilization of networking technologies involve institutional and attitudinal issues much more than technical, and in many cases, financial issues. If donors and different sectoral actors work more collaboratively on addressing basic underlying problems, greater progress can be achieved in a win-win fashion. Some of the most important and enduring investments will be in the development of appropriate human resources, perhaps in the form of a cadre of indigenous consultants able to support local institutions on a timely basis. Issues of sustainability should be taken very seriously given the realities of the aid environment and the serious concerns of inequity raised earlier in this paper.

By 1993, IDRC felt that the original objectives of its Telematics Program had largely been realized: awareness had increased dramatically; expertise had been developed in many developing-country institutions; developing-country organizations and interests were "at the table" during related global events; and successful models had been demonstrated. Computer-based networking was being identified routinely by players on the development stage as being necessary to carry out their endeavours. While much research remains to be carried out, the primary concern was now an issue of operationalization. Within the current aid environment, IDRC is placing now more emphasis on policy issues related to information technology, in recognition of the fact that a greater impact might be realized through this route in a time of limited resources but growing demands.

Informatics: Providing Software for Development

Building local capacity within developing countries to improve the management and use of information is an important objective for IDRC. Software can be a valuable vehicle for achieving this objective.

MINISIS

MINISIS is a computer-based information management system used by institutions of varying size and purpose to automate the administration of bibliographic and textual collections. The software allows users the flexibility to manage text-based information. Interaction with the software and storage of data can be in a combination of multiple character sets and languages.

At an early stage of the development its program in Information Sciences in the 1970s, IDRC recognized the need for a text-oriented computer system capable of running on minicomputers. There was a requirement for an information storage, management, and retrieval system suitable for installation in developing countries which would enable them to participate effectively in international cooperative networks. MINISIS was the result and has since found a comfortable spread of uses in many areas including inventories, registries, student records, legislative full text, press clippings, real estate listings, etc. The software is generalized to allow users to adapt it to their local applications and requirements themselves, without the need to have a commercial organization reconfigure any modules. The ability to handle multiple languages and character sets permits the use of the software in the local language.

The MINISIS software is currently installed in over 350 organizations, including universities, government ministries, research institutes and international organizations, in more than 60 countries. It is used by organizations as diverse as museums and a genetics research institute.

Developing-country organizations have worked in partnership with IDRC to develop and enhance, as well as to disseminate and support the MINISIS package. Together, IDRC and developing-country partners have developed alternate character set processing modules which are used by organizations in both the South and the North. This has enabled the Arab League, for example, to use the MINISIS software and the Arabic language modules, which they developed, to establish a regional information system, ARISNET. The management and dissemination of information in Arabic and Roman scripts is a key component of this initiative.

Trainers from the MINISIS Resource Centres located in Beijing, Bombay, Addis Ababa, Cairo, and Mexico City have trained hundreds of developing-country information providers and technicians on how to use, manage, and apply a sophisticated information management tool in the development of which they have played an integral part. Developing-country MINISIS users have also produced applications and utilities which have been distributed to the entire MINISIS community through a library of user-contributed software. Most widely used contributions in this Library are the Chinese and Arabic language tools. These were developed by the local MINISIS Resource Centres for dissemination to users in the region, and they enable organizations to use the MINISIS software and to manipulate information stored in their local language.

Users of the software have developed the capacity to apply it in a broad spectrum of applications for their individual requirements. This goes beyond specialized bibliographic and text-based information systems. It includes land bank databases registering information about individual plots of land, germplasm databases, meteorological information systems, geological survey inventories, and varieties of applications which have been developed by the users to meet their own needs.

IDRC is now actively supporting the move to self-sufficiency of the developing-country MINISIS Resource Centres by supporting their activities relating to the commercialization of MINISIS products and services. This collaboration with developing-country partners is one aspect of ISSD's objective to promote the development, enhancement, marketing, and application of selected software of obvious benefit to developing countries.

REDATAM

In an another important software development activity, IDRC supported the development of the REDATAM[11] software package by the Latin American Demographic Centre (CELADE) of the UN Economic Commission for Latin America and the Caribbean[12].

The need for such software in developing countries was based on an analysis of the requirements of statistical, planning, and other agencies there during the 1980's. REDATAM was initially designed to provide access to selected subsets of sample data (for example, data from a national census) according to small geographic areas, and to provide a variety of analytic functions. For example, a planner intending to construct a hospital in a municipality might wish to know how many women of child-bearing age live in selected districts around the proposed site in order to estimate the number of maternity beds required. This data could be buried in a national census, but very difficult to extract. REDATAM provides support for just such a task using a microcomputer. In addition, REDATAM can store and work with the complete census, or other similar survey sets, data for small- or medium-size countries (or regions or cities within a country), and can be used to generate statistics such as frequencies, cross tabulations, and averages. Recent work on interfacing REDATAM to Geographic Information System software has extended its functionality and ease of use.

The software has been installed in more than 30 countries where it serves as a platform for developing specific applications in various domains: economic planning, impact assessment of the tourist industry, poverty alleviation programs, social services planning, etc. Government and non-government institutions in developing countries use the REDATAM software in their own areas of interest. For example, in an IDRC-supported project in Bangladesh, "Monitoring Adjustment and Poverty" the Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP) is using REDATAM to process the data on key economic and social indicators relevant to the project. REDATAM has been installed at the Municipality of Conchali (Chile), for the Pockets of Poverty study. It is being used by the National Statistics Office in Costa Rica to provide services to users across a large variety of applications. The General Statistics Office and Institute for Information Technology in Hanoi recently produced a Vietnamese version of REDATAM and are working on integration with the POPMAP package. The integration will allow them to generate maps for geographical presentation of data processed by REDATAM.

In a current project phase, CELADE, in cooperation with the University of Waterloo, will develop new generic applications in Chile, Costa Rica, and St. Lucia concerning the following problems:

- Delivery of Primary Health and other Services with Equity and Target Group Focalization (Chile, Costa Rica)
- Planning for Urban Growth with Constraints on Expansion: Encroachment of Urban Areas on Agricultural Land (Costa Rica)
- Assessment of the Effect of Tourism Development on Local Environment and Population, with Special Consideration for Small Island Countries

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[11] **RE**trieval of **DAT**a for Small **A**reas by **M**icrocomputer

[12] Related funding was also provided by UNFPA and CIDA.

Research institutions in Rwanda, Ghana, Mali, Egypt, Burkina Faso, and Cameroun became familiar with REDATAM at a workshop held in 1992 in Ouagadougou. IDRC is now working with them to develop a dissemination and support project for Africa.

Expert Systems

An expert system is "a computer program that uses knowledge, facts and reasoning techniques to solve problems that normally require the abilities of a human expert". "The goals sought by expert system builders include helping human experts, assimilating the knowledge and experience of several human experts, and providing requisite expertise to the project that cannot afford scarce expertise on site."[13] Expert systems are an example of knowledge-based information technologies.

Since 1986, IDRC has supported projects in expert systems and advanced data base applications in developing countries such as Peru, Indonesia, and Philippines. Regional seminars on artificial intelligence applications have also been held in Africa and the Far East. In the view of researchers in developing countries, emerging knowledge-based technologies should not be only a subject of technology transfer, but also a field of genuine collaboration and exchange of expertise.

An important goal of IDRC's expert systems projects has been capacity-building and eventual delivery of operational expert systems. A recent example is expert system development at BIOTROP[14] in Bogor, Indonesia. As a part of a larger project, a group of researchers developed a prototype expert system for weed identification and management on rubber plantations. In February 1994, BIOTROP organized a regional workshop in which 23 researchers from Malaysia, Thailand, Philippines, and Indonesia participated. The program included familiarization with expert systems technology and hands-on experience in applying the Weed Identification and Weed Management expert systems. Researchers from the agricultural institutions which attended received copies of the prototype systems, which they will evaluate and use to identify their particular requirements regarding expert system technology. Delivery of a fully operational expert system for weed identification and management and its potential commercial value will be also discussed by them.

Some of the lessons learned from IDRC projects in the area of knowledge-based systems development are[15]:

- Researchers in developing countries are interested in the application of knowledge-based technologies and have already produced interesting results.

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[13] Ch. K. Mann and S. R. Ruth. Expert Systems in Developing Countries: Practice and Promise. Boulder. Westview Press. 1992.

[14] Southeast Asian Regional Centre for Tropical Biology

[15] Z. Mikolajuk. Expert Systems in Developing Countries: Learning through IDRC's Experience. Proceedings of the 1993 DND Workshop on Advanced Technologies in Knowledge-based Systems and Robotics. Ottawa. November 1993.

- A long-term strategy is needed in capacity building and supporting access to advanced development tools.[16]

- Collaboration and sharing of information are very important.

The potential of advanced information technologies, particularly knowledge-based systems, in developing practical applications for agriculture, health services, environmental protection, and decision-support has been recognized by many researchers in developing countries.

IDRC will continue to support projects in this area and is developing its program strategy aimed at achieving practical results. It will concentrate on the following points:

- building interdisciplinary teams which can identify real problems and the domain knowledge required to solve them

- identifying research teams which have sufficient expertise in computer technology to adapt and use advanced software tools

- identifying institutions which can make a long-term commitment to the development of knowledge-based systems

- fostering collaboration between recipients of grants in developing countries and Canadian researchers

- identifying applications with potential commercial value and wide distribution.

Geomatics[17]: Connecting Geography and Development

With the continuing evolution of geomatics-based information technologies over the last three decades, spatial or geographic information is increasingly being used for strategic decision-making in all aspects of earth resources assessment, management, and monitoring. Three sets of spatial information technologies have proven to be of particular importance to environmental and natural resource information management in developing countries. They are: remote sensing (RS), which, because of its ability to obtain data on large areas on the earth and surrounding atmosphere, is seen by Southern researchers as a suitable tool to acquire information often lacking about their territories; Geographic Information Systems (GIS), which can assist in the management, analysis, and presentation of information in a form suitable for policy- and decision-making; and Global Positioning Systems (GPS), which allow for the rapid determination of geographic positions required in medium-scale cartography

[16] For example, IDRC recently agreed to sponsor the establishment of a new interest group on the Internet dedicated to expert system technology in developing countries.

[17] Geomatics refers to the science and technology of spatial information management. It includes technologies such as automated mapping, remote sensing, Geographic Information Systems (GIS), and Global Positioning Systems, and covers the acquisition, storage, processing, and analysis of data and the production of geographically-referenced information products.

and cadastral mapping for land registration and titling purposes. Incidentally, all three of these are also areas of technology in which Canada has demonstrated technical leadership, from the perspectives of technology development, implementation, and technology transfer.

Unfortunately, new geomatics technologies are often still perceived as the monopoly of the North, with the exception of a few developing countries such as India and China which have developed some of their own systems (such as satellites and software). Southern countries are often considered as potential consumers of data, or at best as test-beds for applications that often cannot be undertaken in the North (e.g. those related to tropical rain-forests, high-mountainous environments, drought and desertification, mangroves, etc.).

In the late 1970s, IDRC recognized the potential offered by geomatics technologies for meeting the needs of developing countries for mapped information, and began to support applied research involving their use in several sectors, including forestry, agriculture, fisheries, rural development, and natural resources management. Projects have been funded in over 25 developing countries, including Bangladesh, Brazil, Burkina Faso, Bolivia, Colombia, Chile, China, Costa Rica, Côte d'Ivoire, Egypt, India, Jordan, Kenya, Morocco, Mali, Malaysia, Nepal, Nigeria, Philippines, Senegal, Sudan, Tanzania, Thailand, Uganda, and Vietnam. These projects represented different experiences in technology transfer and applications research, and have provided an opportunity to test the feasibility of applying satellite data, GIS, and GPS for the production of thematic information of importance to development. Many of these projects dealt with the assessment, monitoring, and conservation of land and water resources.

IDRC advocates three main approaches in spatial information technology research: validation of technologies and/or their adaption to the local environment; investigating the potential of new technologies for developing countries; and technology research and development. The approach selected depends on the state of readiness of the technology and the researchers who are to work with it.

For example, when a new technology is already operational and has proven its utility to solve development problems in the North, IDRC's strategy consists of stimulating the introduction and adaptation of the technology in developing countries to help solve similar problems through heuristic research (learning by doing). The technology transfer approach involves helping recipient-country researchers and practitioners to acquire the technology and test it in "solution-oriented" research projects. This is the case of most of the research projects supported by IDRC's Geomatics Program. For example, in Morocco, a two-phase project contributed strongly to the promotion and strengthening of remote sensing and GIS disciplines in that country and in neighbouring ones (through the development of similar projects on different applications). Phase I, "Remote-Sensing Contribution to Soil Mapping, Morocco", dealt with medium-scale soil mapping inventories in semi-arid areas using remotely-sensed data. Phase II, "GIS for Agricultural Development, Morocco", is still active. It deals with the integration of data derived from various sources, maps, remote-sensing imagery, and statistics in an operational information system for agricultural development of semi-arid lands.

When a promising technology is still under development and testing in the North, its usefulness and capacity to aid in solving development problems in the South can often be explored. IDRC believes that an efficient way to prepare people to use a technology is to encourage their participation in its early fine-tuning. IDRC's strategy in this case is to stimulate the participation of developing-country researchers in global applications development plans together with researchers from the North. This is the case of a series of Synthetic Aperture Radar (SAR) projects which IDRC has been supporting world-wide. For example, the "Radar Remote Sensing, Costa Rica" project involved over 20 institutions

and 40 research topics and was carried out in partnership with the Canada Centre for Remote Sensing. A larger "GLOBESAR" project involves over 14 countries, with 10 developing countries in Africa, the Middle East and Asia, and over 60 institutions. GLOBESAR's primary objective goes much deeper than other projects, since developing countries researchers are actively associated with the development of applications in anticipation of the launch of the first Canadian earth resources satellite, RADARSAT, in 1995. This kind of partnership between North and South should go a step further towards the participation of developing countries in R&D and in sharing the resulting technological wealth.

IDRC also supports geomatics R&D in developing countries, in both the software and hardware areas. This is done when a number of developing-country institutions and researchers have the required capacity to undertake R&D in areas of interest to them and to IDRC, and when it is believed that the research and any resulting product has potential use in sustainable development and can be exploited commercially to generate income. IDRC's strategy is then to support the development of the product and assist developers in patenting and distributing the product for the benefit of development. For example, IDRC is supporting the development of an active GPS Point System which will be used for cadastral mapping in Argentina (hardware and software). It is also working with the Canada Centre for Remote Sensing and a number of international partners to produce an Electronic Atlas of Agenda 21, with its first chapter on Biodiversity (software and databases).

Conclusions

The informatics revolution is bringing about many changes in the work which we do and in the way we do it. It provides both tremendous opportunities for progress and transformation (in the global economy, regions, countries and country blocs, societies, cultures, communities, institutions, and individuals) and tremendous challenges (in issues like equity, information policies, social impacts, employment, privacy, access, etc.). This is especially true for developing regions which can benefit from effective use of new information technologies but also run the risk of a dramatically increasing the information and technology gap. Faced with an ever-changing environment (about which the only thing that is constant is change), the development community generally, and organizations like IDRC in particular, need to carefully examine these opportunities, challenges, and risks and to establish strategies for the effective utilization of IT in their operations, programs, and relationships with partners. IT is also a key ingredient in organizational change, enabling new modalities of operation and relationships, with instant access to information. IT is **transformative** technology.

IDRC has invested a relatively modest amount of money in the IT area over its 25-year history, but believes that this has been a wise investment in development. For example, the ICT Program mentioned above has supported around 100 projects for a total investment of about CAD 15,000,000 over the last 10 years.

The development assistance community is becoming more conscious of the value of information and related information technologies. This is not necessarily a new phenomenon.[18] Other agencies are investing heavily in IT, although mainly as components of other projects. A recent study from the

[18] R. Valantin and M. Arkin. Informatics and Development - Selected Programmes and Considerations. In: K. Haq [editor]. The Informatics Revolution and Developing Countries: Papers prepared for the North South Roundtable Consultative Meeting in Scheveningen, The Netherlands, 13-15 September 1985. Islamabad. North South Roundtable. 1986.

World Bank[19] indicates that although they do not have an information program per se, it is lending hundreds of million of dollars a year for information technology. At an informal consultation on IT and Development organized by IDRC and the Commonwealth Secretariat in January 1993, selected donors and developing-country participants met to examine ways of working more closely together in this field. It was discovered that a significant stumbling block was the lack of identified programs or focal point within some of the agencies involved.

Nonetheless, donor agencies are considering IT much more actively in their support and work. Of course, developing countries have also recognised this and the demand for projects that would bring the benefits of these technologies and improve to access to information and knowledge has increased in recent years.[20] It is recognized that collaboration in the field of IT can lead to win-win situations among partners. Partners include not only development assistance agencies and developing-country recipients, but also the private sector, the information industry in the North, and the information industry now starting up in the South.

Collaboration can also be facilitated by the effective use of IT. At a meeting of donors at the Bellagio Study and Conference Center during November 1993, it was decided to create a flexible and effective mechanism to enhance information sharing and collaboration among donors. To support this initiative, a communications and information system tentatively called DonorNet is to be established. IDRC is supporting some of the preliminary research on this. Work is currently underway on a conceptual model for the technical, administrative and organizational aspects of DonorNet. This will be reviewed by a Steering Group consisting of IDRC, SAREC, UNDP, CSD, Rockefeller, World Bank/GEF, and the MacArthur Foundation in order to refine further the implementation options with specific suggestions for possible roles for different responsibility centres. A key feature of the model being proposed is that it will build on the existing resources and strengths in donors for information management and communications where these are located. This is an exciting initiative, and I am certain it will help us all work more closely together on the important issues raised in this paper, as well as many others.

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[19] N. Hanna. and S. Boyson. Information Technology in World Bank Landing: Increasing the Development Impact. Washington, D.C. World Bank. 1993.

[20] R. Valantin. Information Tools and their Transfer. In: M.S. Swaminathan [editor]. Information Technology, A Dialogue. Madras. Macmillan India Limited. 1993.