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NEW HORIZONS IN AGRICULTURAL INFORMATION MANAGEMENT

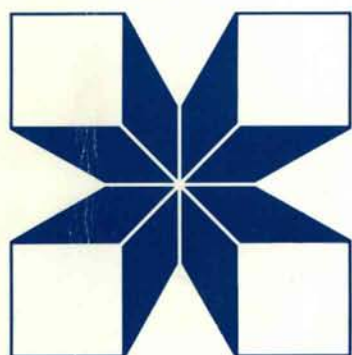
PROCEEDINGS

OF AN INTERNATIONAL SYMPOSIUM

MARCH 13-16, 1991

BEIJING, CHINA

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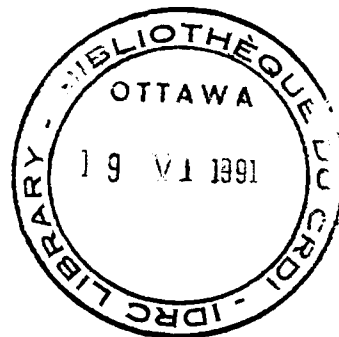
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New Horizons in Agricultural Information Management

Proceedings of an International Symposium,

March 13-16, 1991, Beijing, China



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Problems, Issues, and Challenges for Agricultural Information Systems and Services in the Developing World

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1. Introduction

Agricultural development is the key to the alleviation of the problems of poverty and low standard of living in most developing countries. This fact alone has resulted in large investments in agricultural research and development everywhere in the world. Significantly, knowledge arising out of agricultural research and development in one country or region has validity and application in other parts of the world. Access to such knowledge and the effective communication and utilization of this knowledge is therefore a vital component in global developmental efforts. Information is the most fundamental of all resources in the sense that all other resources depend on information and knowledge; it is the perception and evaluation of resources which makes their use possible (Ploman, 1985). There is increasing evidence that a country's capability to develop is strongly correlated with its capability not only for research but also its capability to provide access to information and knowledge required in furthering its economic development strategies and goals.

Information workers -- by which term I include librarians, documentalists, information system analysts, computer professionals, communications specialists, media personnel language specialists, extension workers, authors, editors, publishers, data analysts, graphics designers, reprographics personnel, database designers, and other intermediaries -- have undoubtedly played an important role in ensuring that useful information and knowledge is properly captured, stored, retrieved, communicated, transmitted, interpreted, translated, analyzed, and repackaged. Each of these categories of information workers has his own tool box comprising software, hardware, theories, models, norms, practices, procedures, and techniques which distinguishes him from the other categories of information workers. The common thread that binds all these different specializations is the concern for access to information and its communication. Emerging products, systems, and services made possible by new information technologies are enabling the apparently different streams to converge in ways that were

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not possible before. The potential of these emerging technologies goes much further than merely providing more efficient means to access information. They have the potential to amplify our relationships with the social and physical environment, and more importantly reshape the information content and our perceptions of society (Ploman, 1985). There is no doubt that we are living in an exciting era where as information specialists we can contribute significantly to the developmental goals of the countries we work for.

The questions that we need to ask ourselves in the developing world are: "How ready and equipped are we to utilize the new and emerging technologies? What is it that we can do to make ourselves more capable of effectively utilizing these new technologies? and What are the technologies that seem to be potentially most useful?"

The present paper is an attempt to answer some of these questions.

2. Agricultural information in the developing world

I believe that the agricultural information scene in the developing world in comparison with that in other sectors such as industry, health, etc., is indeed quite encouraging. My optimism is based on several facts.

First is the fact that many developing countries, even the small ones, have shown that they are conscious of the need to, and willingly participate in a global effort such as AGRIS. As of 1989, eighty of the ninety developing country members of the United Nations participated in AGRIS. The number of new countries joining the AGRIS network has steadily increased since its inception. Although there may be some who feel that the level of participation of developing countries is still not adequate, the very fact that there is such participation today as compared to even a decade ago is encouraging. The challenge of course is to see how the participation can become more substantive than today, how the quality of participation can be improved, and most importantly how users of agricultural information can be provided easier and wider access to information required in planning, research, development, technology transfer, problem solving, and decision making.

A second significant fact is that in the last decade or so several special libraries and information centers have been set up in the developing world. The Technical Centre for Agricultural and Rural Cooperation's (CTA) directory (Niang et al., 1988, p. vi) on information sources on tropical agriculture lists 337 libraries/information centers or services in the ACP (African, Caribbean, Pacific) countries as of 1988. Of these, 255 or 76% were set up between 1960 and 1987. West Africa alone has 121 libraries or 36% of the 337 centers. Undoubtedly, many of these libraries/information centers are operating in sub-optimal conditions, with inadequate resources and limited skills. The important point is that these new centers were set up using resources that could well have been spent in other sectors. This fact alone is proof enough of the concern for access to information. The challenge is to see how these new centers can be made more

effective agents in the drive to provide better access to information for the users in these regions.

A third fact is that in the last decade or so, several specialized information analysis centers (SIACs) have been set up at national, regional, or international research or academic institutions in the developing world. SIACs are highly focused centers with well-defined mandates and objectives, and provide a variety of information retrieval, analysis, and dissemination services to carefully selected clientele in one or more countries of the developing world. The databases developed and information services of the International Buffalo Information Center (IBIC) in Thailand, the International Irrigation Information Center in Israel, the Bamboo Information Center in the People's Republic of China, and systems in the International Agricultural Research Centers (IARCS) of the Consultative Group on International Agricultural Research (CGIAR) are examples of SIACs that have filled a real need in the developing world. SIACs have been able to build good rapport with potential end-users and often coverage in their areas of interest is better than that of global databases in agriculture. Further, in recent years many SIACs have taken quite successfully to the utilization of new information technologies considerably improving their capabilities to handle information.

Another notable fact of the information scene in the developing world is that of the regional initiatives that have taken place to improve access to agricultural information. The Agricultural Information Bank for Asia (AIBA) in the Philippines, Centro Interamericano de Documentación e Información y Comunicación Agrícola (CIDIA) in Costa Rica, the Caribbean Information System for the Agricultural Sciences (CAGRIS) in Trinidad and Tobago, and réseau Sahélien d'Information et de Documentation Scientifiques et Techniques (RESADOC) in Mali, West Africa are some examples of regional initiatives. The setting up of a regional agricultural documentation and information center in 1989 in Bangladesh under the auspices of the South Asian Association for Regional Cooperation (SAARC) is yet another example of a regional initiative in the area of agricultural information.

3. Issues and problems

3.1 Capacity utilization and user-sensitization

It is clear that new capacity for the management of agricultural information in the developing world has been created mostly in the last ten or fifteen years. Most of these capacities have not yet reached their full potential. There is a consensus among information workers in many developing countries that existing services are not adequately utilized. On the other hand, there is the feeling among users that services of many agricultural information centers do not always meet their needs.

The reasons for poor capacity utilization are not difficult to see if we remember that many of the facilities, recent as they are, have concentrated mainly on resource building, and in improving their skills and information handling capabilities. They have had little or no time and funds to sensitize users to their resources and services. Nor have they attempted systematically to understand user needs. The result is that users have not

been adequately prepared to utilize built-up capacities. Many users in developing countries are not aware of the value of information in general, and the kinds of services they can and should seek from information systems such as represented in this symposium. This situation is further exacerbated by the fact that, by and large, training and education in the developing world is still not adequately oriented to making students/researchers sensitive to the value of libraries and published information as integral components of the educational/research process. It is also true that decision-making on the basis of facts and upon analysis of trends has yet to become the norm while intuitive judgement and person-to-person communication remains the most common source of information in developing countries. In particular, policy makers, planners, and administrators have not yet realized the role of qualitative and analytical data and other types of information in overall social and economic development.

The lack of end-user sensitivity to information obviously has implications for the priority and support that information systems and services get from the governments of the developing world. Information systems will grow and be valued only if they can demonstrate their usefulness. And, to demonstrate their usefulness, information systems need to go headlong into the user community to improve their understanding of user needs, and so that users get a better appreciation of what information systems can do for them. I believe that user sensitivity is so fundamental to the well-being and continued growth of information systems and to the effective use of information, that the conduct of user-awareness and information use promotion programs must be given the highest priority. Efforts in this direction are even more important, according to me, than the application of new technologies to the management of information. Mere application of new technology will not bring about a change in the behavior or attitudes of users. Deliberate and conscious effort is called for and I think such effort is an essential preparation for the effective application of new information technologies.

3.2 Coordination and networking

Some of the main reasons for user dissatisfaction with the services of agricultural and other information systems in the developing world may be said to be as follows:

- absence of customer-orientation in services,
- poor collections of information resulting in poor document delivery services and inadequate access to primary information,
- lack of exhaustivity and timeliness in information provision,
- inadequate capability to access external sources of information,
- inefficient methods of information storage and retrieval, and
- lack of skills for repackaging and consolidation.

Some of the above lacunae may be traced to the limited funds available to most agricultural information systems. Some gaps in performance exist because of the lack of skills, while a third category of reasons can only be addressed by the use of newer technologies. Last, but not the least, one or more of the above mentioned lacunae can be redressed by better coordination and networking.

It would be naive to think that financial resources for the sustenance and growth of agricultural information systems will change for the better. On the other hand, given the rising costs of informational materials (e.g., journal subscriptions), salaries of professional staff, and costs of other services (e.g., photocopying), it would be realistic to assume that available funds in real terms will at best be at the level of what they are today. Donor funding of agricultural information systems also is not likely to change substantially. Much of the donor funding until now has been for local capacity development and indications are that there will be a shift towards funding for systems that would enable better sharing of resources. There is no doubt that it would be in the long term interest of agricultural information systems to devote resources and effort to bring about better sharing of their resources and improved coordination in their operations and services.

Concepts of library and information networking are not new. Some elements of networking existed even before computers and data networking, e.g., centralized cataloging. In more recent years, however, a combination of circumstances triggered mainly by falling funds for libraries and the need to deal with increased information flows forced the pace of library networking in the west. The opportunity afforded by new technologies (e.g., computer-communications networks, microcomputers, user-friendly software, exchange formats, downloading) enabled libraries to cooperate with each other in interlending of publications, mutual access to their catalogs and databases, development of union catalogs, etc. Similarly, libraries were able to coordinate their acquisitions, technical processing, software and hardware acquisition, and training as a result of formal networking.

Coordination and networking is the weakest facet of agricultural and other information systems in the developing world. This is undoubtedly something to be concerned about. Although some effort has been made, e.g., regional networks spoken of earlier, the real impact for the user in terms of efficient document delivery and wider access to information has been negligible.

Here again preoccupation with resource building has not directed enough attention to resource sharing and coordination. Also, the lack of formal structures and agreements set up specifically to promote resource sharing, and the absence of policies that encourage sharing and coordination has not been conducive to networking. The fact that computer-based networking is capital-intensive, requiring investments in imported equipment and costly telecommunications infrastructure by governments is another reason why such technologies have not yet made a significant impact in most developing countries.

Effective networking and sharing of resources requires reliable and rapid intercommunication between facilities and the means to quickly access and search remote databases. You cannot share resources without knowledge of each others' resources. Electronic mail and telefax together with vendor systems such as Dialog, and utilities such as OCLC have enabled rapid access to databases and effective intercommunication between libraries greatly facilitating interlending and other forms of cooperation.

The technology of library networking in the west began with large centralized bibliographic utilities (e.g., OCLC, RLIN) connected to libraries through leased lines. The trend is towards distributed processing and distributed networking and increased local autonomy made possible by the use of integrated automated systems usually bought from commercial vendors. However, local systems are acquiring the capability to link with each other and with the utilities for shared cataloging and interlending. The trend clearly is towards decreasing dependence on shared remote computer facilities and increased cooperation carried out on a small scale, among libraries with a very high affinity of interests (Hildreth, 1987). In the scheme of things, as they are emerging, there is a place for both the large utility as well as the local system.

I believe that there are lessons in the experience of the west for computer-based networking in developing countries. To begin with, I think the initiatives must come from a centralized agency with a perspective that decision and action will gradually devolve to local systems as they become more computer-proficient and as the communications infrastructure of the country improves. Another reason for suggesting centralized initiatives is the need to create a climate for cooperation and coordination, and for the provision of a forum for the development of methodologies, tools and skills. A third reason for suggesting centralized initiatives is that it would be more cost-effective to equip one center with the resources and skills required of such a center. Further, a star network configuration in spite of its disadvantages may be a good starting point for computer-based networking activities in a country with little or no experience in computer-based networking.

The feasibility of setting up at least one center in each country or region with no other operational responsibility than to promote coordination and cooperation among existing facilities is worth examining. Specifically such a center will perform the following functions:

- develop and maintain union catalogs, especially of serials and make available such tools in hard copy and machine-readable forms to local facilities and others,
- enable the exploitation of external databases for those local facilities that do not have resources and/or skills for such exploitation,
- promote the use of international standards in information handling,
- promote the development of local databases in specialized areas,
- advice on hardware and software acquisition,
- provide referral services,
- provide training in computer-based methods, use of microcomputers, database design, online searching, etc.,
- develop generic software or applications based on generic software, e.g., Micro CDS/ISIS, for distribution to local centers,

- assist in conducting user needs studies and user-awareness programs, and generally promote/market information services of the country/region,
- provide a forum where managers of local systems can meet regularly to discuss issues specific to coordination and cooperation, and
- liaise with other national, regional or international centers for mutual benefit.

3.2.1 International cooperation

The scope for sharing of resources, experience and expertise between IARCs and national/regional information systems is considerable given the comparative advantages that IARCs have. This fact was recognized in a meeting of Documentation and Information Officers of the IARCs held at ICRISAT (CGIAR, 1989) in India in 1989 in which several information personnel from national systems also participated. The meeting recommended, among other things, that one way of strengthening national agricultural information systems would be for the establishment of regional information networks as partnerships among national agricultural research systems (NARSs), regional agricultural information programs, and IARC information programs. It is envisaged that in such networks IARCs together with regional systems would be able to assist NARSs to articulate needs and demands and, ultimately to increase their service capacity. Also, it is envisaged that building on existing resources, network activities would address the following areas:

- Strengthening links between the three types of information service programs.
- The human resources and infrastructure needs of NARSs agricultural information systems.
- Collaboration between and, among IARCs, NARSs, and regional programs.

3.3 Information policy

Although several developing countries have enacted policies on food, education, population, environment, etc., policies relating to information activity is conspicuous by its absence. There is a widely held view that the information issue is of a sectoral dimension and not of an intersectoral or national one. Even where there is an information policy, it is not unusual to find that the connotation of information in the policy is a narrow one, e.g., mass media. The sectoral view of information has not been conducive to the emergence of an unified approach to information systems development. Some sectoral policies, notably in agriculture, have given rise to information sub-policies and therefore have provided the opportunity for information efforts to emerge in that sector. However, such sectoral policies have had little impact on information activities or use in other vital sectors.

The absence of well defined information policies in the developing world may be traced to the general lack of sensitivity among policy makers and planners to the role that good information systems can play in social and economic development. A large measure of

the responsibility for the absence of good information policies must rest also with information systems as they have not made a real impact.

Ideally, an Information policy for a country or region will have sub-policies for libraries; library and information networking; database development within the country; access to governmental information; copyright; education and training of information professionals; telecommunications and data networking, including policy for access to external networks; computer software and hardware, including the import and export of these; import and export of information products, e.g., journals, databases, training materials, CD-ROM products; electronic media; advertising; and on transborder data flows. Questions pertaining to tariffs, e.g., for use of data networks by libraries and for educational purposes as opposed to such use for commercial purposes need to be addressed in an information policy. Absence of such a policy leads to situations in countries where it is easier to import cosmetics than it is to import scientific journals.

Given the fact that information systems in agriculture predominate, and are probably the best endowed in terms of resources and skills in most developing countries, I believe that such information systems can play a useful role in formulating national policies on information. From an operational point of view, I believe that agricultural information systems should be acutely conscious of the intersectoral dimensions in planning their systems and in the provision of services. New information technologies fortunately provide us with the capabilities for integrating information from closely related sectors into the core sector and in the provision of services. Although this is not a substitute for a coherent information policy for a country, agricultural information systems by pursuing a broad perspective hopefully will be able to provide the leadership in bringing about needed and viable information policies with a national dimension.

I stress the need for a well thought out information policy in developing countries, because it is only through such a policy that well thought out information programs using appropriate technologies can be formulated. In the absence of a policy, all application of technology is likely to be ad hoc and piecemeal, and serving at best limited objectives. This does not of course mean that agricultural information systems should not use or experiment with new technologies. On the contrary, they should actively utilize new technologies and as far as possible consciously educate their clientele and the policy makers about the advantages of such use.

3.4 Human resources development

The importance of adequately trained manpower to manage and run agricultural information systems in the developing world is all too obvious to need any emphasis. The capacity for education and training of information workers in different parts of the developing world is highly variable, and in some countries it is non-existent. Further, facilities to train information personnel in skills required to utilize newer tools and techniques in information handling is seriously lacking. The situation requires a number of responses, some of which are given below:

- development of training materials, including self-learning kits and modules in specific areas,

- more opportunities for on-the-job and hands-on training of information workers in the better equipped information facilities of the developing world, e.g., at IARCs,
- strengthening of national training capacities through consultancies, sabbaticals, and opportunities for training of trainers,
- collaborative action by international agencies (IAALD, FID, UNESCO, CTA, etc.) to set up need-based regional training courses, and
- traveling workshops where one or two experienced information specialists spend a few weeks in selected national centers in training and demonstration, including addressing end-users of information systems.

4. Information technology

4.1 Microcomputers

The trigger technology of the information revolution is undoubtedly the computer (Olsen, 1989). The convergence of three key technologies, viz., computers, telecommunications and microelectronics, and the development of a whole range of media (magnetic, optical and now magneto-optic), software, products, and services constitutes the package being called information technology.

A recent publication (Feeney, 1986) on information technology provides a helpful categorization of the field into ten broad areas comprising hardware, software, practices, technical processes, and storage media. Even a cursory look at the categories and sub-categories is bewildering. Clearly the trend is the convergence of technologies used to create, store, and distribute information, while the options of doing so are becoming more prolific.

If I were asked today to choose the technologies with the most promise for developing countries, I would choose microcomputers, CD-ROM and Electronic Mail as the three candidate technologies. I believe that these three technologies, properly applied, can bring about substantial improvements in enabling easier and wider access to information for end-users of all kinds. This does not of course mean that other products or systems will not have a place or use in the developing world.

Developing countries, by and large, missed out on the early phases of the information revolution, viz., the mainframe computer, and to a great extent, the minicomputer eras. This was understandable considering the relatively high cost of these technologies. However, the development of microcomputers in the 1970s, the maturing of this technology in the 1980s, and the affordability of microcomputers by even small developing country institutions has truly democratized computing power.

Microcomputers are making slow but steady inroads into the developing world, and could well become the trigger technology of the information revolution in the developing world. Significantly, many recent developments in information technology are

microcomputer-related (e.g., CD-ROM, desk top publishing, local area networks, expert systems). Many of the developments in data communications also depend on developments in microprocessors, bringing about a reduction in costs of switching devices, communications controllers, and modems -- key elements in data networking. There has been a steady increase in microcomputer word size and speed from 8-bit systems to the present 32-bit machines. Random access memory (RAM) is no longer a limiting factor in microcomputer applications in libraries and information storage and retrieval. Similarly external read-write memory, mainly winchester disks, have increased in capacity over the years. Some of the 32-bit systems offer up to 140 MB of hard disk storage. There is then the promise of read-write magneto-optic disks with envisaged capacities of up to 256 MB.

While advances in computing and peripheral hardware have been spectacular, it is the software industry which is today the driving force of the information technology revolution. A key reason for this is the overwhelming demand from customers for packaged software that will let them apply computers to a broad range of tasks. The software market for microcomputers far exceeds that of mainframes and minicomputers and millions of non-technical users can use microcomputers today, thanks to user-friendly software packages.

Microcomputer-based software for library applications including integrated systems and information retrieval is now so plentiful that choosing and evaluating appropriate software for a specific application has become a specialized task. The range of software available for libraries and information centers is evidenced by several directories of applications software now in-print (Dyer and Brookes, 1986, Keren and Sered, 1983, Walton and Taylor, 1986). In addition to packaged software, there are application generators and database management systems (DBMS) packages which offer many facilities for the advanced information system analyst/programmer to develop special or general purpose applications.

Special mention must be made of the Mini-Micro CDS/ISIS software package developed by Del Bigio of UNESCO, first introduced in 1986 and now in its second version (Version 2.3). It is significant that this package has been distributed free of cost to over 3,000 sites in the developing world, and there is already evidence that a number of libraries/information centers have begun to use it to build local databases. The latest version of the package comes with a host language interface. It is possible to use a version of standard Pascal called CDS/ISIS Pascal to build interfaces to or applications using CDS/ISIS databases. Very importantly there are now several formal and informal CDS/ISIS user groups in the developing world actively exchanging news, experiences, and advice on using CDS/ISIS.

What is of some concern, however, is that many centers in the developing world are building databases without an underlying philosophy in their design, and without much concern for the standards and guidelines that already exist, thanks to the efforts of national and international bodies. This underlines the urgent need for training of information workers in the developing world.

4.2 Optical disks

The biggest addition to technologies aimed at increasing access to information has been optical disks including CD-ROM. Pilot scale optical disk applications of the U.S. Library of Congress and the U.S. National Agricultural Library have emphasized the conservation of fragile material (old photographs, posters, etc.) and integration of full text, half-tones and graphics, linked to an indexing database, affording easy access.

The CD-ROM, however, has the potential for a breakthrough in the transmission of scientific and technical information to developing countries. CD-ROM as a publishing medium has been exploited by database producers to package databases that were hitherto only available online on remote vendor systems. Significantly, all three major databases in agriculture, AGRICOLA, CABI, and AGRIS (just announced) are available on CD-ROM. In addition the database of the Royal Tropical Institute, Amsterdam, viz., Abstracts on Tropical Agriculture is also available on CD-ROM. Even more recently the French agency for international cooperation in agricultural research, the Centre de cooperation internationale en recherche agronomique pour le- developement (CIRAD) has produced a CD-ROM product called SESAME which allows access to valuable French literature on tropical agriculture. In addition to bibliographic databases on CD-ROM, reference publications on pesticides useful to agricultural information centers have made their appearance on CD-ROM.

Two projects which aim at packaging full text of agricultural literature on CD-ROM must be mentioned. The first of these being implemented by the CGIAR Secretariat in Washington, will include the full text (including the images and graphics) of publications of twenty IARCs. The idea is to make available a compact disc library of IARC publications to developing country institutions. A prototype of the product was recently evaluated in several sites all over the world. Results of the evaluation are awaited and it is envisaged that the final product comprising some 6,000 formal and informal publications of the twenty IARCs will become available by the end of 1991.

The second project (Olsen, 1989) is that of the Albert R. Mann Library of Cornell University which has begun work on identifying core literature that provides optimal value to agricultural research and education. The four-year project, begun in June 1989, will develop core lists in eight carefully delineated sub-disciplines of agriculture. Eight volumes, one each for the eight sub-disciplines will be published and will contain core lists of primary monographs, primary serials, reference publications, and specialized literature. Developing country lists are also being planned, and in addition it will be possible to divide the lists by geographic regions.

The Mann library project is unique in that this is the first time that such a comprehensive work has been planned. Further, the project uses a combination of bibliometric analysis and expert evaluation. The usefulness of the project is already being seen in the results achieved so far with the first volume on agricultural economics and rural sociology.

The aim of the project is to make available to CD-ROM publishers a definitive analysis and evaluation of the scholarly record in the agricultural sciences so that the full text

of such literature can then be put on CD-ROM for distribution to developing countries. When this happens, agricultural libraries around the world will have core agricultural libraries on CD-ROM greatly alleviating the problems of document delivery. Very significantly, donor agencies have shown interest in this project, the potentials of which are indeed far reaching.

It is clear that CD-ROM, particularly for agricultural information centers, is a medium that cannot be ignored by developing countries.

5. Conclusion

In this keynote address, I have attempted to mix reason with caution and optimism. I hope I have succeeded in providing some food for thought.

6. References

CGIAR (Consultative Group on International Agricultural Research). *Report of the CGIAR Documentation and Information Services Meeting, 16-20 Jan 1989*, ICRISAT Center, India, Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics, 1989.

Dyer, H., and Brookes, A. (comps.). *A directory of library and information retrieval software for microcomputers*. 2nd ed. Aldershot, Hants, UK: Gower, 1986.

Feeney, M. (ed.). *New methods and techniques for information management*. London, UK: Taylor and Graham, 1986.

Hildreth, C.R. Library networking in North America in the 1980s. Part 1: the dreams; the realities. *Electronic library* 5(4): 222-228, 1987.

Keren, C., and Sered, I. (eds.). *International inventory of software packages in the information field*. Paris, France: UNESCO, 1983.

Niang, T., Giovarmetti, J.F., and Hamilton, C.J. *Information sources on tropical agriculture*. Vol 2. ACP countries. Wageningen, Netherlands: CTA (Technical Centre for Agricultural and Rural Cooperation), 1988.

Olsen, J. K. Strategic issues in information: with special reference to developing countries. *IAALD Quarterly Bulletin* 34(3): 119-125, 1989.

Ploman, E. The changing information society. *Agricultural Information Development Bulletin* 7(4): 2-6, 1985.

Walton, R.A., and Taylor, N. *Directory of microcomputer software for libraries*. Phoenix, Arizona, USA: Oryx Press, 1986.