The Future of World Agricultural Information Networks

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ABSTRACT

THERE IS A STRONG AND DYNAMIC FUTURE for agricultural information networks. This article reviews present day information networks, and how they have evolved as a result of new information technologies. The needs of the end user and how they influence the design of information networks; as well as how the increased demand for technology transfer and the evolving role of information systems, in this transfer process, have influenced the structure of national, regional, and international agricultural information networks are discussed. There is a recognition that information networks are not ends in themselves, but rather are critical tools to ensure the exchange, transfer, and utilization of information which will facilitate the increased quality and quantity of agricultural production.

The concept of networks in the field of library and information science is not new. *Networking* and *resource-sharing* are terms which appear in the classical library and information science literature and are subjects studied by students of the history of these disciplines. To focus on the question of the future of networks as they relate to agricultural information, it is necessary to review present day information networks in the proper context—i.e., how information networks have evolved as a result of new information technologies; how the needs of the end user have affected the design of information networks; and how the increased demand for technology transfer and the evolving role of information systems in this transfer process have influenced the structure of national, regional, and international information networks.

In setting this context, it is important to examine briefly the prere-

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quisite for a successful research network. For networks to be viable, it is evident that basic principles must apply regardless of the discipline or sector. Plucknett and Smith (1984) list the prerequisites:

1. The problem must be clearly defined and a realistic agenda for action must be drawn up.
2. The problem must be widely (commonly) shared.
3. Strong self-interest drives productive networks.
4. Network participants must be willing to commit resources—e.g., personnel, funding, facilities.
5. The availability of trained personnel to represent member institutions and make useful contributions to the network. Participants should be technically competent to undertake specific tasks and participate actively in network coordination meetings.
6. The existence of a strong leadership consisting of a steering committee and a coordinator. All participants should be involved in the decision-making process affecting the activities of the network and be treated as equal partners.

With these parameters established, a viable research network can be defined as a "voluntary association of research organizations with sufficient common objectives to be willing to adjust current research programs and invest resources in network activities in the belief that they will meet their objectives more efficiently than conducting all the research alone" (Banta, 1982).

If one substitutes "information" for "research," a similar definition and set of parameters can be applied. Thus an information network is "a systematic organization of separate units, interconnected for the purpose of achieving some goal that is more than any one of the units can achieve individually" (Duchesne, 1982, p. 1). More specifically, an information network refers to: "a formal association among libraries, documentation centres, archives, and global or regional information systems created with the aim of coordinating their efforts and sharing resources to satisfy information needs of users in a subject area and/or geographic region of mutual concern to network members" (Hailu, 1989).

Under the rubric of information networks, there are at least four categories relevant to the discussion in this article:

—*Resource Network.* A systematic organization of separate units, interconnected for the purpose of making information materials available. This concept is not restricted to libraries and library materials but includes information in a variety of formats. This type of access will grow rapidly over the next few years. Developments which will contribute to this growth include the spread of electronic publishing and of videotex service, and progress toward the realization and use of nationwide open computer/communications networks for information interchange.

—*Communications Network.* The complex of telecommunications and transportation services and systems for the transfer from one location to another of information, images and/or electronic versions of documents, and documents. Information transferred includes bibliographic and nonbibliographic information. For some purposes, it is helpful to consider the communications network as comprising telecommunications and transportation components.

—*Bibliographic Network.* A systematic organization of separate units interconnected for the purpose of engaging in the shared creation, maintenance, or use of bibliographic files and/or bibliographic databases, or in the provision of access to these files and/or databases. The files and/or databases may serve one or more of several different functions and provide service parameters. This definition includes both manual and computer-based activities and resources.

—*Library Network.* Two or more libraries engaged in resource sharing. Library networks consist of two major components: a bibliographic and communications network and a resource network. The bibliographic and communications network encompasses bibliographic file-based resource sharing, and the shared use of library processing services, and the hardware, software, and organizational arrangements required to provide these services. The resource network component is concerned with resource sharing relating to library materials and collections. (Duchesne, 1982, pp. 2-3, 5)

Stevens (1980, p. 405) provides a restricted definition of the term *library networks* referring only to those state, multistate, and national library organizations that are:

—supported primarily by payment for services from participating libraries;
—directed by a full-time staff;
—controlled by an independent government body with a high level of involvement (generally through a board of directors from participating libraries);
—built around a cooperatively maintained bibliographic database in machine-readable form;
—linked online by a telecommunications system.

In the current environment of information processing, dissemination, and utilization, the term *library network* will be increasingly superseded by terms more oriented to functions, services, and transactions—e.g., *information network, document delivery network,* and *bibliographic processing network* (Duchesne, 1982, p. 5).

The Role of AGRIS

Within these parameters of information networks, the question of agricultural information networks may be addressed. There is little doubt that this discussion must begin with an overview of AGRIS

(International Information System for Agricultural Sciences and Technology), based in Rome at the Food and Agriculture Organization (FAO) of the United Nations. It is not possible to discuss the future of agricultural information networks without understanding the role of AGRIS in the acquisition, processing, and dissemination of information to various target audiences in the agricultural sectors, and its role in the information transfer process particularly to the benefit of developing countries. It is true that there are many difficulties facing AGRIS today, but if one wishes to be in a position to discuss clearly the future of agricultural information networks, it is essential to underscore its present day status with all its strengths and weaknesses.

History reveals that the prime objective of the founding fathers of AGRIS was to merge the large agricultural databases of CAB International (CABI), formerly the Commonwealth Agricultural Bureaux (CAB), and the National Agricultural Library (NAL) with several other databases to form an improved world agricultural information system. A group of experts was also appointed in the early 1970s to evaluate existing agricultural information services and propose possible frameworks for an improved worldwide agricultural information system. What emerged instead was a third major force in agricultural information services, AGRIS (Mann, 1986).

It is widely recognized that the agricultural sector will continue to remain a highly subsidized one. This is particularly true in developing countries. It follows that agricultural research and development, and the information services required to support them, should be regarded as service type rather than commercial type activities. Indeed, the information services of AGRIS and the NAL appear to have been conceived with this philosophy in mind, with the ultimate goal of creating a single, coordinated, global system for agricultural and food information. AGRIS, with its unique worldwide network of more than 130 national and regional input centers, is providing the necessary framework and impetus. CAB International was founded with similar objectives, and its recent success in obtaining full international status would appear to be a clear indication of the move to greater international cooperation (Mann, 1986). CABI is no longer limited to supporting the information needs of commonwealth countries. In the identification of services and products, the needs of all countries, developing and industrialized, can be considered.

In the AGRIS model, a formula has been found for information sharing which responds to global needs and places no country in a position of dependency. The strength of AGRIS is that, as a cooperative international information system or network, it is a mechanism which provides for effective north-south collaboration on the basis of equity and which helps the suppliers of information services, whether public or private, to augment the resources which they can offer to their target audiences. Currently the main deficiency of AGRIS is that it lacks an

effective document delivery component to support the bibliographic citations contained in its database. The frustration, on many levels, which this causes to the potential user has been discussed at length in other forms (Woolston, 1984).

It must be acknowledged, however, that an attempt has been made to address this weakness in the AGRIS network. The David Lubin Memorial Library at FAO has played a major role in the AGLINET (Agricultural Libraries Network). This network was established in 1974 based on statutes formulated at a joint FAO/IAALD (International Association of Agricultural Librarians and Documentalists) symposium in 1971. The goal of this international cooperative network was efficient document delivery through flexible and effective cooperation among the large agricultural libraries of the world and regional decentralization of responsibilities. By 1986 membership had increased to twenty-three and the new idea of adding broad specialized libraries as members had been accepted. There is clearly no single solution to satisfying user demand for agricultural documentation. If there is to be equity among all participants in the global information system, then developing country libraries need to be established and strengthened. In addition, responsibilities in the industrialized world should be clarified as well as decentralized, and AGLINET libraries should be responsible for delivery of national imprint material (David Lubin Memorial Library, 1986).

Information Technologies

The question can be posed, To what degree will the rapid developments in the field of information technologies have a positive impact on the viability of information networks and more specifically agricultural information networks? In this article, little attention is placed on new information technologies and their significant role in aiding the explosion of information processing, transfer, and utilization. However, in considering the future of networks, it is essential to shed some light on the boundaries which have been expanded due to the introduction, development, and enhancement of information technologies.

Martin (1987) indicates that the most significant impact on the nature of the automated network in future years will be the fact that the traditional library is unlikely to change very quickly from its current physical form or mode of serving users to any other form. She states:

> If past experience is a guide, each change in library networking between 1986 and 1990 should not be significant in and of itself, but the totality of the changes will make the networking structure of 1990 rather different from that of 1980. Also, in this case, past experience may not be sufficient to provide us with clues regarding the future. Too many significant issues lie unresolved, and too many technologies which have the potential to affect networking are under development, to allow a simple extrapolation from the network structure of 1986. (p. 31)

With the exponential growth of information, especially in the scientific

and technical domain, the need for effective and efficient methods for the transfer of information is becoming even more pressing. Data communication techniques, which are nonreal time and relatively low cost in nature, with hard copy outputs if desired, can facilitate information exchange and transfer. Computer-based messaging, bulletin board, and conferencing systems are increasingly being used as the computer and telecommunication technologies converge.

There are at least three technological trends which are significantly increasing the potential role of information networks and their infrastructural components:

> 1) Decreasing costs, increasing reliability, and relative ease of use of much recent communications technology.
> 2) Considerable technical development in the transmission of information, both globally through a rapidly growing network of communication satellites...and more locally through cable networks and small-scale transmitters which open up opportunities for community-based radio and television services.
> 3) Integration of the various components of communications technology, especially the bringing together of the data processing and storage capacity of computers with the ability of telecommunication systems to transmit electronically-coded data extremely quickly. (Garforth, 1986, p. 186)

Although this article, as previously mentioned, does not dwell on the growing impact of information technologies on agricultural networks, it is important to attempt to make the distinction between the use of these technologies for facilitating the transfer and exchange of "information about information"—i.e., bibliographic citation exchange—and the transfer and exchange of "information." Some of the documented uses of information technologies demonstrate this distinction.

At the present time, the most common use of CD-ROM technology in the field of information handling and exchange is to provide access to bibliographic references. Often abstracts are available but rarely is full text provided. It must be underscored that these comments are limited to the application of CD-ROM technology to information networks and, most specifically, to agricultural information networks.

Two years ago, The International Development Research Centre (IDRC) participated in an evaluative study with CAB International to determine the viability of CD-ROM as an information technology to facilitate equitable information access and utilization (Beaumont, 1988). From a wide range of users—i.e., librarians, information specialists and subject specialists—it became evident that the accessibility of CD-ROM in stand-alone microcomputer workstations, with potentially powerful online retrieval capabilities, encouraged use of information systems by researchers, policy makers, and other end users who had not traditionally had access to online searching. It was determined that the technology would fit easily into existing organizations and would be one way to allow libraries and information centers to become more proactive rather than reactive in providing new and enhanced services.

In the study it was found that in using the technology for retrieving references, most users searched for references to items or subjects already known to them. The availability of abstracts did allow searchers to assess the value of individual articles more effectively. However, the participants in the study stressed the need for access to a wider variety of full-text databases. Once more the issue of "document access" or "document delivery" presents itself. For many of the participants there is a sense of isolation from the mainstream of information and library technologies. CD-ROM, in conjunction with microcomputer technology, has the potential to support the distribution of many bibliographic and reference tools that until now have been unavailable or beyond the budget of many organizations, particularly in developing countries.

Reference-based information technologies are also being investigated by the NAL. The use of laser videodisc technology is being evaluated as a means for disseminating agricultural information (André, 1985). The study is being funded as part of a strategic planning effort by the U.S. Department of Agriculture to assess long-range opportunities in the utilization of technology as it relates to agriculture and agricultural information. There is a growing awareness within the agricultural community of the great potential of computer technology for information access and delivery. This videodisc/microcomputer evaluation will provide significant information on the potential uses of these technologies. The focus of the evaluation is the potential of laser videodisc technology used in conjunction with microcomputers for storage and dissemination of agriculturally related full-text databases. The system will include all hardware and software necessary to store and retrieve a full-text file together with a videodisc as the storage medium for the database selected.

Laser technology has the potential to change significantly the means by which publications and databases are stored, distributed, and used. The results of this evaluation will provide data on user acceptance of microcomputer/laser videodisc systems as a means of access to textual agricultural information (André, 1985). This is an extremely important study, for it can point the way toward addressing the problem of document access which is a major obstacle in achieving a fully viable information network.

As stated in the beginning of this section, information technologies have facilitated the transfer, exchange, and utilization of information and have brought dramatic change in the structure and function of information networks. Nowhere is this more apparent than in the agricultural sector. Information technologies have also influenced the profile of the participant in the information network. The end user is viewed as the active network participant, especially in those networks which are based on information exchange and not reference or bibliographic citation exchange.

An important end user and a critical participant in information

networks is the agricultural extension worker. When the distinction between reference-based and information-based information networks is considered, it is very important to understand how this target group uses information. Sattar (1984) reported on an interesting study which examined the information-seeking behavior of agricultural extension specialists. In his paper, he stated that extension specialists were in constant need of information, and that most of them turn to personal sources to seek this information. The study found that information sources accessible through libraries were not perceived as useful by extension specialists. Sources such as indexes, abstracts, and databases were rated very low and of little relevance when ranked by the specialists. This of course means that they tend not to use these sources to answer questions or to solve problems.

There are two interesting examples of microcomputer-based and videotext information systems which have strengthened the "networking of people" at the grassroots level. It is perhaps significant that the examples come from the United States, for it is in the industrialized countries where the use of information technologies for problem-solving rather than for the documentation of problems already solved and recorded in the literature is most apparent. If there is a negative aspect to this reality, it can perhaps be argued that these technological developments may indeed be a factor in exacerbating the gap between the "have" and "have not" regions of the world.

In the United States, which has a history of capital-intensive farming, the microcomputer is being used for generic functions such as calculating budgets and a host of user-specific functions such as calculating optimal land use for a specific farm. Another function for the on-farm computer is to provide communication capabilities with national agricultural databases and to establish electronic mail systems among farmer interest groups. Using a microcomputer and a modem, farmers can link up with a wide range of computer networks. These networks provide information on weather conditions and forecasts, commodity prices, and current market prices for livestock (U.S. BOSTID, 1986).

The Agricultural Computing Network (AGNET) celebrated its tenth anniversary in January 1985. It was a nonprofit international network designed to be a user-friendly management tool for the agricultural community with participants in forty-seven American states and ten other countries. The user profile was varied with many sectors represented—e.g., education, agribusiness, producers, government, credit institutions, farm managers and consultants, computer dealers, and software distributors.

AGNET developed into a system that offered three basic types of services: management models, current information, and electronic communications. Participants could use any combination of services depending on the nature of their business, and all had access to every

program in the general AGNET library. The various models in AGNET helped participants make decisions in the general areas of crop and livestock production and marketing, financial management, and home economics. During its first decade of existence, AGNET evolved from a handful of management models for use by university personnel to an international network where private and public concerns worked together to serve the diverse agricultural community (Murray, 1985). Although AGNET ceased operations in December 1988, it successfully demonstrated the utility of such networks.

The final example of an information-based network, directed to the grassroots end user and utilizing videotext technology, is the Green Thumb system. The U.S.-based Green Thumb system was designed especially for farmers and was jointly funded by the U.S. Department of Agriculture and several university communities. Through the Green Thumb system, farm families can access information dealing with farm markets, weather news, agricultural innovations, home economics, occupational information for youth, and news of local farmers' meetings. The Green Thumb videotext system is seen as a natural combination of the microprocessor and existing telecommunications equipment—i.e., the TV set and the telephone.

The new microprocessor-based information technologies are beginning to influence the nature of U.S. agriculture. Case (1987) argues that there is evidence of the transformation of farming to more of an information occupation. This development also highlights the critical gap between the north and the south. It is becoming evident that the technologies of the 1980s are working to the disadvantage of some rural people. For example, cable television is generally unavailable outside the city limits, and the rate of adoption of microcomputers by farmers is clearly lower than that of nonfarmers.

During this decade, a variety of information-based agricultural information networks somewhat similar to the Green Thumb system have become available, though not all have been successful. For example, the Grassroots videotext system, based in Manitoba, Canada, had a great beginning and was full of potential, but, most likely due to a poorly defined target audience, its services could not be sustained.

Information technologies, in their various structures and formats, have placed information specialists in a position to consider many facets of the information handling process, and to bring the needs of the end user more effectively into the design and implementation of the information network. Clearly information technologies are a critical factor in setting the agenda for the future of agricultural information networks.

Obstacles

There are some obstacles which threaten the viability of agricultural information networks of the future. These obstacles can be defined as

the nonexistence of the prerequisites for a successful research network which were cited at the beginning of this article (Plucknett & Smith, 1985). Within the context of agricultural information networks, this could mean that:

—the subject scope has not been clearly defined and/or the parameters have not been firmly established;
—among the potential participants, there is no commonly shared view of the subject scope, the boundaries of the network, or of the services or outputs to be provided;
—the network participants do not believe strongly that they will personally benefit by being active participants and that these benefits will outweigh their costs;
—there does not exist a sufficient number of adequately trained personnel, representing member institutions, to make useful contributions to the network. Specifically, participants are not technically competent to undertake specific tasks and to participate actively in network coordination meetings;
—network participants are not prepared to adhere to established governances, nor to commit resources—human, financial, or physical; and
—networks lack a strong coordinating structure in the form of a coordinating committee and a coordinator. As well, network participants are not considered equal partners, and they are not involved in the decision-making process.

Henriette Avram and Mary Ellen Jacob are recognized for their work in the area of information networks and resource sharing. Both have written about the future of information networks and some of the key issues which must be addressed to ensure their continued viability. Avram (1986) has stressed four areas of important network issues:

—local systems: where the temptation of autonomy may subvert the desire to link with others;
—linking: with the development of the LSP (Linked Systems Project) having gone beyond just a promise, but not far beyond;
—linking standards development: a sine qua non for network development; and
—database ownership: a problem that has taken on increased importance, now that linking is more possible.

Touching on some of these same issues, but from a slightly different perspective, Jacob (1985) provides insightful commentary about five broad areas which can have an impact on future information networking: (1) She predicts poor economic conditions, including shrinking resources leading to reallocation, a need to question who pays for what, and continued concern for telecommunication costs especially in some regions of the world; (2) from the perspective of technology, she stresses

standards, increased control, including international barriers, and the need for more service-based research and development, such as intelligent gateways; (3) her comments about social factors include changes in demographics and a shift in values toward the perception of information as a commodity; (4) she envisages much more retraining which she refers to as "lifelong learning"; a need for computer literacy; and increased obsolescence of the physical plant, equipment, and staff; and (5) finally, in the area of government and legislation, she addresses the problems of access to government-funded information; a possible tax on information as the information services sector grows and the "hard" industries decrease; and control and ownership of information.

Changing Profiles of the Agricultural Sector

The environment within which agricultural information networks exist and contribute to the transfer of information has changed markedly over the years. The information needs of the agricultural research community have changed, and the demands made by users of this information have become more complex and focused. As discussed previously, the ultimate end users of the results of the research—the agricultural extension specialist as well as the farmer—have become key players in the information transfer process. Their presence has already had a major impact on the design, organizational structure, and services of the networks. These changes are not country or region specific, and, in fact, one can see the impact that some of the information technologies have had on modifying some of the local or national information networks that are international in scope and access.

This article examines some of the information-based agricultural information networks located in the United States. It is not intended to give the impression that the major developments in information networks in the United States are solely due to the switch in emphasis from reference-based information networks to information- or problem-based information networks. Of course, the entire structure of U.S. library networks has been undergoing change. There are layers upon layers of networks, including national, regional, state, and local networks. This is often referred to as the "network within a network" phenomenon (Kenney, 1988). This will allow a start to be made in addressing the issues and concerns raised by Avram and Jacobs.

To date, in the United States, computer-based library networks have developed in a vacuum with little connection or coordination with other national computer networking efforts. The networks developed by the major bibliographic utilities in the 1970s are a good example. There must be a convergence between library networks and general computer networks, and libraries must enter the mainstream of national computer networking. This will result in an entirely new condition as the utilities take on new responsibilities as database servers, and library systems and widespread computer networks allow equal access to the

full range of available databases (Kenney, 1988). This will allow a start to be made in addressing the issues and concerns raised by Avram and Jacobs.

Change is evident in other regions of the world. The literature documents the significant growth in agricultural information networks in Europe and North America. What is perhaps of interest is the development of regional and national agricultural information networks in many of the developing regions of the world. One can see as well the information needs of the end user being taken into account as the networks are being designed. Some networks are clearly directed toward the needs of information intermediaries while others are focused on the needs of the farmer through the intervention of the agricultural extension worker.

Worthy of mention is the system proposed by the Arab League Documentation Centre (ALDOC). Agriculture is a major sector of the economy and social structure of most developing countries, including many Arab nations. In spite of very large investments in this sector, agricultural development in the region is not satisfactory. In addition, the production of agricultural information within the region is very meager. To address the problems of information collection, processing, dissemination, and access, ALDOC will develop and manage a regional agricultural information network.

If this goal is reached, this regional network will assist in providing bibliographic control and exchange of information with possible advantages in economy of scale, deployment of financial and human resources, and speed. With strong leadership and coordination, national centers will be able to concentrate their efforts on identifying relevant information and transmitting data to regional agencies for processing. With a strong regional center, financial viability will not be an obstacle which must be overcome (Chaudhry, 1987).

In China, it is not surprising that the situation is somewhat different. The focus of this massive country is on agricultural education and extension. It is crucial to get the information into the hands of those who deal directly with the farmer. Agriculture is a key, if not the central, component of the Chinese economy, as more than 80 percent of the 1.2 billion population live in rural areas, and more than 350 million are in the rural work force.

The Chinese government places a high priority on agricultural development, partly because of the problems of feeding the huge population, but also because of the declining area of land suitable for cultivation. The expansion of urban areas, combined with problems of land degradation and environmental pollution, continues to exacerbate the situation. As well, the government places a very high priority on improving the quality and quantity of agricultural education as a means of increasing the flow of information required to maintain sound and sustainable agricultural systems.

In the past, agricultural extension has not been closely allied to agricultural education. Such a service is provided by agricultural extension centers in each province and sometimes by village level centers. Today there is a recognition of the need to link the extension centers and the sources of agricultural information which exist in the agricultural universities and research institutes. Attention will now be paid to how information is sought, used, and transferred into action, and, perhaps more precisely, how the characteristics of new ideas and technologies influence the acceptance rate by the farmer (Judge, 1986). Within this developing country context, the integration of the end user into the design and structure of the agricultural information network seems essential and inevitable.

In concluding the discussion on the changing environment within which agricultural information networks function, it is important to underscore the inequity in the access to information by industrialized and developing countries. There seems to be a clear indication that the changes which have occurred in the structure and outputs of the networks only heighten this inequity. The viability of the networks of the future will depend upon reducing, if not eliminating, this inequity or imbalance. To a large measure, due to the introduction of new technologies in the information processes, networks are indeed becoming global and thus participants are coming from all regions of the world. It is therefore essential that all participants have "ownership" of the network and feel committed to its success.

The Future of the Agricultural Information Networks

It is recognized that the problem of information control in electronic form by industrialized countries is not unique to the field of agriculture. However, there are several aspects of agricultural information that set it somewhat apart from other disciplines and thus account for some of the difficulties of creating adequate information networks for its dissemination. First, agricultural information is scattered across many disciplines. The interdisciplinary nature of agriculture means that relevant information exists in many different databases and that an agricultural information specialist must be knowledgeable about, and able to access, a wide variety of sources. Second, a great deal of the output of agricultural research and extension activities exists in a grey or unpublished literature form, thus it is not widely available. Third, as mentioned earlier, agricultural information must exist on many levels to serve many target audiences, from researchers through policy makers and extension workers to farmers. Finally, agricultural information is being generated throughout the world—research is being undertaken, data collected, and techniques developed, modified, and transferred in all geographical regions and in many languages. Even the very small

and very poor countries have the potential to contribute to the international body of agricultural information (Griffiths, 1985, pp. 1-3).

A report prepared by the U.S. Congressional Research Service, U.S. Library of Congress (1983), identified several key issues in an attempt to highlight the various dimensions of mounting and sustaining an imaginative support effort which could adequately furnish far-flung rural people with timely, comprehensive, accurate, and relevant information of considerable variety. The issues considered in the report are pertinent to the debate on the future of agricultural information networks, for they clearly point to where the networks must place their emphasis if they are to continue to be critical to the information transfer and utilization process. The congressional report identified the following issues:

—The kaleidoscopic roles and responsibilities of established and emerging entities, both in the public and private sectors, who serve as information providers for the agricultural community.
—A consistent requirement to determine to what extent and under which conditions government collected data could be accessed by private vendors.
—The conditions under which individuals or groups at the local level could influence, even to a modest degree, the information offerings (content, frequency, form) made available to them.
—The extent to which formalized responsibility could be assigned to information providers and systems implementers regarding such post-installation activities as training, maintenance, and the modification of files and software.
—The ramifications of private organizations acquiring government-developed data files and/or software which would then be modified, resulting in "value-added" products and services, with particular attention to ownership of such improved elements.
—The diversity of hardware and software offerings which has raised vociferous arguments for and against standardization imposed by either the government or the information industry.
—The need to examine efforts which could be undertaken at present to protect the confidentiality of personal and corporate data being entered into some of the agriculturally oriented online files. (U.S. Library of Congress, 1983)

Regardless of the subject scope or parameters of the information network, or the agreed upon common problem(s) which it may seek to address, Wasserman (1984) sets the context for agricultural information networks in the future. He states:

> the idea of a network is one which transcends technological process. What it suggests is that there is utility and validity in combining strength through ties and links, thereby enhancing effectiveness of each group member beyond his individual capabilities. Moreover, once the concept of interdependency is accepted, far more is feasible than before. Duplication of effort is reduced, but

> what then comes to be implied is the need for extended understanding. This leads swiftly beyond the level of documentation and bibliography. For it implies the conduct of inventories first of publications, then of ongoing research. It implies factual details and knowledge of organizational strengths and research capabilities. And ultimately, it leads to the recognition of precisely what it is that is necessary in recourse [sic] to information sources external to the culture itself. When this happens, the group transcends the limits of the local scene and more surely finds its footing in the context of the international structure. (pp. 8-9)

There is a strong and dynamic future for agricultural information networks. This is true, whether the emphasis is on bibliographic citation/reference-based information networks or on information-based/problem-oriented information networks. It is also true regardless of the target audiences, be they researchers, policy/decision-makers, extension workers, or farmers. Finally, this is true, regardless of the geographical location (i.e., industrialized or developing countries) or regardless of the level (i.e., national, regional, or global).

This is not to say that there are not many obstacles to overcome. There are many issues to be addressed before the agricultural information networks of the future may be considered viable. Nevertheless, a key ingredient for a strong future is implied—the existence and commitment of those who must be responsible for the design, implementation, management, and ultimate use of the networks. There is also a recognition that the agricultural information networks are not ends in themselves but rather are critical tools to ensure the exchange, transfer, and utilization of information which will facilitate the increased quality and quantity of agricultural production.

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