User Needs and Library Services in Agricultural Sciences

BEVERLEE A. FRENCH

ABSTRACT

THIS ARTICLE PROFILES the users of agricultural information and describes their information needs and behavior. It reviews the trends in agriculture and information delivery and the implications of these trends for users and for the relationship between information professional and user. It suggests roles which librarians and information professionals can assume in order to meet agriculturists' information needs.

INTRODUCTION

This article examines the users of agricultural information—their information-seeking habits, their information needs, and their responses to library services. The term *user* is employed to mean an *agriculturist*—i.e., a scientist, a farmer, an extension agent, or any individual involved in agriculture or its products. Every information professional in the agricultural sciences should be concerned with the user who is responsible for the application of information to the practice of agriculture or science.

The agriculturist is the critical agent in the transfer of technology. The central purpose of an agricultural library or information service is to improve agricultural research and practice. It is therefore important for librarians and documentalists to examine the effectiveness of their services and products vis-à-vis the user and to create mechanisms by which they can receive regular feedback. As Drucker (1976) implies in a talk on the public service institution, a library does not exist merely to collect books or even to practice librarianship but to provide information to people. It follows that understanding people deserves as much

Beverlee A. French, University of California, University Library, Davis, CA 95616
LIBRARY TRENDS, Vol. 38, No. 3, Winter 1990, 415-41

thought and effort as collecting and organizing information. Only by understanding how users obtain and use information can one see how the library or information service fits into the process of information transfer.

This review takes a step in that direction. It focuses on the complex interconnection, interdependence, and intercommunication between users and information professionals and consists of three sections. The first is a profile of users of agricultural information—who they are, some features they share, and problems they face. The second reviews trends in agriculture and information delivery. The concluding section examines implications of these characteristics and trends and suggests some recommendations based on them.

In spite of the evident importance of users, systematic concern with and interest in them is a comparatively recent development in agricultural librarianship. A review of the last thirty years of the *Quarterly Bulletin of the International Association of Agricultural Librarians and Documentalists* (IAALD) and of the World Congresses of the IAALD reveals a gradual shift of focus, beginning in the 1970s, from papers about collections, documentation activities, networks, secondary services, and automation to papers which address or examine the library user. At the fifth World Congress, Laux (1978) presented a paper on user requirements noting that, despite thousands of years of library history, very little attention has been paid to the user. While users have been statistics, only recently have individual users and their requirements been the focus of any inquiry (p. 27). This growing interest in the user is exemplified by the theme of the eighth IAALD World Congress to be held in Budapest in May 1990—"The User as the Aim of Information." In 1982, a "blue-ribbon panel" assigned to assess the National Agricultural Library (NAL) for the U.S. Secretary of Agriculture focused its examination on user needs. This approach would probably not have been the one taken for such an inquiry ten years earlier. In the words of the panel, "only through the eyes of its users could a true picture be derived of what NAL should and could be" (Interagency Panel on the NAL, 1982, p. 2). All of the panel's budgetary recommendations followed from user requirements and, in addition to specific proposals for services, the panel called for NAL to develop mechanisms for an ongoing survey of user needs (p. A-1).

Interest in users and their satisfaction seemed to coincide with the advent of online systems, although descriptions of user needs can be found occasionally in earlier reports about agricultural library services (e.g., Brookland & Watson, 1957). Reports or studies of user assessment of precision and recall of automated bibliographic retrieval systems, as well as surveys analyzing the reasons users requested searches, began to appear in the 1970s (e.g., Martin, 1977). Not only was there a large investment in these systems, but information-seeking behavior became easier to observe and satisfaction easier to measure through the online

search request. When the National Agricultural Library instituted the Current Awareness Literature Service (CALS) for the U.S. Department of Agriculture's Agricultural Research Service (ARS), periodic user studies were conducted to determine ways to make the service more responsive (Burton, 1976). Online bibliographic retrieval systems not only offered some relief from the tedium of literature searching, but they provided the opportunity for a new librarian-user relationship. Oyler (1975) observed that online retrieval is seen by users to "mark the library's advance to being a purveyor of information and shedding some of its curatorial image" (p. 2). It is in the library's role of supplier of information that the market or the client takes on increased importance.

Distinctive Features of Agriculture

Before examining what is known about users, it may be useful to review characteristics of agriculture that have particular implications, not always shared by other disciplines, for users and library services.

Unlike physical and chemical technologies, the practice of agriculture is highly dependent on location. Users are therefore extremely sensitive to their geographic differences. Issues of climate, soil, economics, and national policy are critical to specific applications of information. This is surely one of the most distinctive features of agricultural information.

Governments of all nations have a vital interest in sponsorship of agricultural research and dissemination of information. This has generally meant that most information is "open"—there are few trade secrets such as those which exist in other industries—and that governments play a pivotal role in information transfer, often through networks of agricultural extension agents.

Although information is open and available, its provision is complicated by at least three distinctive factors. First, agriculture is interdisciplinary at a number of levels—scientific, social, and economic. Agriculture encompasses the life sciences. In fact, Garfield (1978) found that agricultural scientists use and cite the same core of journals cited by all researchers in the life sciences, and believes that agriculture describes only the mission rather than the approach to a problem (p. 138). At the same time, agriculture is much broader than the life sciences, intersecting social sciences, physical sciences, and engineering.

Second, agriculturists are dependent on tremendous amounts of nonbibliographic, nonresearch data, some of it of a very timely nature such as price and weather information. Taxonomic, chemical, epidemiological, clinical, and genetic information constitute vast data files. These increasingly important and widespread factual databanks are discussed in various reviews (*Factual Databanks*, 1978; Porta, 1986).

Finally, unlike medicine, for example, where the practitioners may be fairly conversant with the language of research, there are special requirements for the treatment and presentation of information to

diverse groups of agriculturists. Agriculture in most countries is dependent on a structure of translators of technical information—i.e., agricultural extension agents. Information must even be packaged for illiterate practitioners. Lancaster and Beecher (1981) suggest that there is growing recognition of the needs of the nonscientific user of information—recognition of the fact that information must flow from research to extension services in a form suitable for practical application under local conditions (p. 199).

A Taxonomy of Users

What is really known about users of agricultural information? While conventional wisdom abounds and will be reviewed here later to some extent, there is a relative dearth of real knowledge about the users of agricultural information. This gap is evidenced in both industrialized and developing countries. While librarians are now exhorted, although not necessarily taught how, to examine user requirements, Broadbent (1977) submitted that no one is very sure what the user wants. According to Russell (1984), a scarcity of documented evidence on actual information needs of agricultural users continues into this decade in spite of a long history of government involvement in agriculture (p. 55). This discrepancy is particularly true in the United States, although both the library sector and the extension sector have produced some recent studies of agriculturists (e.g., Olsen et al., 1985; Richardson & Mustian, 1988a, 1988b). Undoubtedly the study of users is made more complicated by the vast scope of agriculture. In the United States, for example, it is the biggest industry with over 20 million people engaged in some phase of it (Frank, 1987, p. 293).

In order to make some inroads in developing a profile of information-seeking habits, sources, and needs of agriculturists, and barriers to their satisfaction, it is helpful to identify distinct groups of users. Although the usefulness of distinguishing between different groups of users is generally recognized, researchers do so in different ways. For example, Deirg (1973) lists only three categories—research/technical, advisory/extension, and research administration/planning (p. 66), while Russell (1983, 1984) distinguishes among policy makers and administrators, research scientists, diagnostic and analytical scientists, specialist advisers, general advisers, educators and students, agricultural service industries, and farmers and rural people (Russell, 1983, p. 43). Metcalfe (1981) proposed eleven categories arranged into two groups: those who use the primary literature (research scientists, industry, specialist advisers, educators, and students) and those who do not (planners, administrators, banking and commerce personnel, journalists, general advisers, highly educated growers, and other growers). He charts exactly which of more than a dozen different kinds of literature and other information delivery mechanisms are used by members of each of these categories (p. 117).

A classification which is a compromise among these approaches is adopted in this article. In terms of documented evidence regarding user groups, users can be conveniently classed as follows with some variations and overlaps: (1) scientists and researchers; (2) extension scientists or researchers; (3) extension advisers; (4) farmers/producers; and (5) others—policy makers/administrators, workers in agribusiness, educators, journalists, and even consumers.

Scientists

Scientists comprise the most studied group of information users and findings that apply to scientists in general—especially to life scientists—can be extended to agricultural scientists. Information needs of scientists are generally considered to be met through the well-established scientific journal system and secondary bibliographic services. Yet scientists' initial source of information is generally people—specifically their colleagues. Scientists communicate with their colleagues via telephone, electronic mail, correspondence, conferences, and so forth. They exchange preprints and proposals. Busch and Lacy (1983) observe that, although formal scientific communication is highly visible and the informal network difficult to observe, both are equally important (p. 86). The network of informal scientific communication is called the "invisible college," and it has been well documented (e.g., Crane, 1972) and can be traced back for centuries (Price, 1986). Others (Allen, et al., 1971; Cooney & Allen, 1974) expanded on the premise that the scientist's first and most important source of information is other scientists, by identifying what they call the "internal consultant" or "technological gatekeeper" who can be found in any scientific firm or organization (Allen et al., 1971, p. 38). In the Cooney & Allen study of An Foras Taluntais (Irish Agricultural Institute), a network which extends throughout Ireland, they found that certain individuals served as intermediaries between typical members of the group and external sources of information. These individuals showed "significantly greater use of the professional and scientific journals" and maintained "ongoing informal contact with colleagues in other organizations, particularly in universities and nonprofit laboratories" (p. 38).

In another work, Lancaster and Smith (1979) review scientific communication and major findings from user studies. Again, informal channels—the invisible college and private files of notes, preprints, offprints, etc.—are documented as important sources for scientists (p. 380). They report that scientists value convenience, improved selectivity in information services, and more rapid access to research results. The significance of the invisible college and the utility of private files suggests that minimizing effort is a major factor in scientists' information behavior.

Turning specifically to agricultural scientists, Olsen et al. (1985)

examined information habits at a major U.S. land-grant university. Their survey was motivated by the conviction that library service should add significantly to the research process and by the assumption that faculty are underserved in academic libraries. The study of Cornell University agricultural scientists confirmed that both personal contact and individuals' own private files were significant in their keeping informed of current research and literature (p. 13). Library services of greatest importance (i.e., more than 50 percent of the 327 respondents stated "essential" or "very important") to these users were materials loan, telephone reference, immediate photocopy service, self-service photocopying, reference librarians, and computer literature searches in that order (p. 14). Much lower ranked, but still very important to a sizable minority, were delivery of library materials to individual offices and availability of personal computers in the library.

Voss and Wiedeman (1981) provide a study of the information habits of grassland scientists in which respondents ($n = 272$) ranked importance of information sources. Not surprisingly, scientific journals ranked at the top, followed distantly in descending order by books, meetings, colleagues, abstract journals, literature retrievals, card services with abstracts, bibliographies, and information from libraries (p. 279).

Trueswell (1969) has discovered that demand for scientific journals parallels typical demand for inventories in business. He found that roughly 80 percent of user demands are satisfied by 20 percent of the collection in a variety of scientific and other libraries. Trueswell's rule was confirmed and exceeded in a recent study of Danish veterinarians and agriculturists (Hansen, 1981) in which 85 percent of the requests ($n = 2,839$) were for 7 percent of the serials (p. 89).

More than forty years ago, Gilman (1947) stated that the greatest needs of scientists were to be liberated from the increasing drudgery of literature searching, to be kept abreast of current information, and to be assisted by any tools which will help relate vast amounts of data and information (p. 331). While computers may have relieved some of the drudgery, the needs of scientists are still the same and have been intensified by the growth in the literature. The amount of time scientists spend seeking information is therefore worth examining in some detail, if only because a goal of information services should be to minimize that time. As Chen (1974) has pointed out, a library is effective only if it "can maximize satisfaction of user needs and minimize time loss to the user" (p. 272). The study at Cornell University (Olsen et al., 1985) found that 35 percent of the faculty spent 10 percent and 32 percent spent 5 percent of their research time in the library. Most also used graduate students and research assistants to perform library-related activities (p. 12). Deang (1977) reports that researchers in experiment stations spend 20 percent of their time seeking information and asserts that their biggest problem in making research proposals is the review of literature.

While journal literature may be reasonably accessible, scientists perceive and report at least two major barriers to information use—document delivery and the intractability of machine-readable data. The first of these is even a problem in industrialized nations as Voss and Wiedeman (1981) reported in the earlier-cited study of grassland scientists in West Germany, Austria, and Switzerland. Only 58 percent of the 272 respondents were able to obtain more than 50 percent of the journal articles recommended by literature searches. This barrier to obtaining documents helps explain why 95 percent also declared that abstracts are a "substantial advantage" in bibliographic products (p. 283). Speed in receiving publications or full-text, regardless of higher price, also has been verified by Olsen (1982) to be of great value to agricultural researchers and scientists.

A second important concern is lack of success in obtaining machine-readable information. Although not specific to agriculturists, a recent U.S. National Academy of Sciences report ("Information Technology," 1989) notes major barriers (e.g., idiosyncratic methods of organizing and retrieving data) encountered by scientists in their attempts to access electronic information (p. 27). The most fundamental impediment to use of existing information technology is the absence of an underlying infrastructure:

> Just as use of a large collection of books is made possible by a building and shelves,...a cataloguing system,...and reference librarians to assist users, so the use of a collection of computers and computer networks is supported by the existence of institutions, services, policies and experts—in short by an infrastructure. (p. 43)

This infrastructure has not yet been established in a systematic and comprehensive manner. Those not expert in the use of computer and telecommunication systems are therefore presently disadvantaged—vital but little-used data may well be lost in the system, and it is difficult for users with urgent needs to obtain timely assistance. These problems, among others, would be resolved with the development of the requisite infrastructure, a task that will require the joint effort of government agencies, universities, and libraries.

Extension Advisers

Extension specialists can be divided into two groups—researchers who use the scientific literature and advisers who assist farmers with practical problems. The first group is similar to scientists in information needs and use of the primary literature and will not be discussed in any detail here. The second group, whose job it is to transmit information so that it makes a difference to agricultural practitioners, is of particular interest. The extension adviser is found in many countries and embodies a mandate to disseminate information. As such, extension performs a kind of "translating" service from scientist to practitioner—it "collects, digests, combines, analyzes, [and] passes on results of scientific research in a completely new form" (Koster, 1971). In summarizing

the sixth IAALD Congress, Buntrock (1981) concludes that the information needs of extension advisers are not well met by the global, formalized information systems, and that more attention must be given to nonscientific users—that is, to extension advisers and farmers (pp. 335-36). Extension advisers are not concerned with the theoretical but with what is applicable to local conditions. Because of the difficulty in selecting these specific applications from a large international literature, Maltha (1972) considers service to extension one of the most difficult problems facing documentalists and information officers (p. 175). Extension advisers need to keep up with new developments and respond to inquiries. Like scientists, they have too much paper and not enough time; unlike scientists, they are generally far from any libraries.

Bernardo (1981) classifies extension workers into three categories: field technicians, subject specialists, and administrators. Field technicians need "packaged technology in simple language"; subject specialists—who undertake verification tests, conduct training, and develop packaged information—read scientific journals and technical bulletins; extension administrators use both scientific and management literature (p. 14). Peart (1978) provides an extensive review of the information needs and habits of advisers, noting the great breadth of subject matter on which they must be prepared to advise, the genuine urgency with which that advice is requested, and the need for information not only to be directly applicable to commercial farming, but also to be relevant to "local, often transient, circumstances of climate and economics" (p. 74). Peart reported that the main sources of information for the advisers employed by the Official Advisory Service in England and Wales were:

1. personal collection and private files which might contain extension leaflets, results of experiments, and private communications;
2. personal consultation with regional specialists; and
3. the invisible college—farmers, other advisers, university scientists; leading local farmers figured especially prominently in this network (p. 81).

Another study of advisers in Scotland and Northern England (Agar et al., 1984) confirmed that respondents relied heavily on personal contacts with other advisers, specialists, and farmers, because this was a convenient way to obtain information (p. 226). This study also revealed a large number of topics for which concise information is needed. The response to this need was to launch several bulletins and to develop a specifically tailored database of agricultural extension and development literature (p. 227). A European Community symposium (*Information Management...*, 1977) also concluded that extension needs are not met by existing information systems. Specifically, it cited the need for up-to-date scientific/technical information, familiarity with current work at research centers, market and price information, and information on new agricultural products (p. 9).

A related case is provided by the needs of the agricultural industry which can be defined as commercial enterprises which process agricultural produce or which sell products to agriculture. Maltha (1971) suggests that their information needs fall somewhere between those of scientists and advisers, with larger firms more interested in science (p. 274). A critical factor in the demand for information is the number of technicians in a particular industry—the more technicians, the greater the demand for information.

Farmers

Farmers and producers are the ultimate end users of agricultural information. Because farming is a technical activity, its practitioners face some of the same problems as scientists and advisers—agriculture's information base grows while problems facing farmers are ever more complex. A number of studies have explored the kinds of information farmers need and their preferred means of obtaining it. Although a videotext experiment with market, weather, and technical information was not a success, Case and Rogers (1987) found that farming in the United States has become an information intensive occupation with much time devoted to seeking information from farm magazines, extension, the media, and other farmers (p. 61). Chartrand, Carr, and Miller (1983) cite a National Opinion Research Center survey in which U.S. farmers were asked if they were dissatisfied with current sources of information. According to Chartrand, they reported lack of confidence in the accuracy and reliability of information and complained that available information did not apply to their locales, was too general or vague, too outdated, or too costly or difficult to obtain (p. 11). Warmann (1988) surveyed farmers in Virginia and found that although they were unsure about what type of information would be of greatest value to them, they viewed the extension service as a valuable source of information, and indeed as their most important source of production information. Studies by the North Carolina Agricultural Extension Service also confirmed the value of extension in delivering information and found farmers expecting to need more complex technical information in the future (Richardson & Mustian, 1988b), but not expecting to change their preference for traditional delivery methods (Richardson & Mustian, 1988a). Palmer (1986) reports that farmers in the United Kingdom rely on friends, the national farming press, the media, government and commercial advisers, and "very direct access to research" (p. 102).

The role of information in the adoption of new technologies or agricultural innovations also has been the subject of some investigation. Similar conclusions were reached in a number of case studies of agricultural innovations conducted by Consumer Dynamics for the U.S. Department of Agriculture (USDA) (Consumer Dynamics, 1980). Most farmers interviewed were found to be "serious, active, and relatively sophisticated users of technical information." Their central

sources of information were printed materials and interpersonal communication (p. 18). They did not rely heavily on mass media. It is also interesting to note that, although the printed information promoted awareness and understanding of new techniques and innovations, it was not usually the dominant factor in the decision to innovate (p. 18). Instead, a single strong intermediary, such as a local extension agent, was the important factor in those decisions. Additional personal contacts served to reinforce decisions. Duces and Strawhorn's (1981) case studies of the adoption of innovation also identified personal interaction as central in obtaining information. Another case study of innovation, conducted to assess the impact of the USDA's 100 years of information dissemination, found consonance with the individual's values, continuity with past practice, and testability on a small scale to be important factors in decisions (Sophar & Murphy, 1981).

Users in Developing Countries

Agriculturists—scientists, extension agents, and farmers—in developing countries have unique problems and at the same time share characteristics—albeit sometimes on a different scale—with their counterparts in industrialized countries. Because of their relatively smaller numbers, scientists in developing countries may not enjoy the benefits of invisible college communication which has been shown to be more active in the United States than in other countries, probably because of the number of American scientists (Busch & Lacy, 1983, p. 87). However, rapid growth in the number of scientists in developing countries should mitigate this disadvantage (Lancaster & Smith, 1979). At the producer level, Williams and Williams (1984) found that Nigerian farmers (n = 140) relied foremost on friends and village elders for information and very little on government agencies. While this result confirms the general propensity to consult colleagues first, it also may reflect both a scarcity of agricultural advisers and the illiteracy of the respondents.

Because of the importance of extension agents in digesting and applying information to local conditions, the inadequacy of existing extension programs is probably the major barrier to information transfer in developing countries. In addition, whereas scientists and researchers worldwide enjoy the benefits of a lingua franca, namely English, end users in developing countries often have no such advantage, and translating information into local languages for advisers and producers presents another barrier to its successful dissemination and application. This highlights the need for selective translation and dissemination services and, in fact, documentation efforts in many countries concentrate on translating from several languages into the vernacular. Illiteracy of farmers has been successfully confronted by using nonprint forms of information transfer—the mass media, training centers (Reddy, 1987), and portable audio and video (Storm, 1982). It is undoubtedly dangerous to make generalizations about users in devel-

oping countries. In fact, differences within a country may be as extreme as differences between countries; in some countries, for example, a large difference between information resources available to urban and to rural users has been observed (Gregorio & Sison, 1989).

As noted earlier, there is a relative paucity of data on U.S. users of agricultural information. By contrast, and in consideration of the numbers of librarians and documentalists, the literature reveals a substantial effort to obtain user feedback in developing countries (as well as in other industrialized ones) and to understand information needs. In a study of Nigerian veterinarians, for example, Ikpaahindi (1985) found that only 18.7 percent of the respondents ($n = 64$) were nearly always successful in satisfying their most important information needs (p. 149). Not surprisingly, delay in receipt of needed publications was a significant hindrance to these veterinary scientists and practitioners. User involvement in the design of information services in developing countries is especially important given the tremendous investments which must be made in core resources and infrastructure. This was recognized by U.S. Agency for International Development (USAID) officers, who, from the beginning, saw user feedback as critical to a project designed to extend the National Agricultural Library's Current Awareness Literature Service to developing countries (Dewey, 1981).

Common Elements

The foregoing review of distinct user groups discloses common elements as well as significant differences. A striking common denominator among these user groups is the importance of people in information delivery. This is true for the scientist who relies on colleagues in the invisible college, for the agricultural adviser who depends on a host of others, and for the farmer who relies on the extension adviser as well as other farmers. Personal contact seems no less important in industrialized countries than it does in developing countries. Rarely are librarians important people in this information chain. Indeed many of the users discussed do not use libraries at all. However, it is reasonable to say that all users expect libraries or information services to deliver needed information when required. They all need to be kept informed and to research a particular topic on occasion.

The hierarchy of information sources used most often by all groups emphasizes the importance of convenience in obtaining all types of information, be it for keeping current or for researching specific topics. In a rare presentation to librarians by a user, Dagnelie (1978) confirmed this propensity by suggesting that users will ignore a system if it becomes too complex, cumbersome, or expensive.

A number of common obstacles to obtaining needed information are also suggested by the foregoing survey.

—Document delivery capabilities do not equal bibliographic capabilities. Although not perfect, bibliographic capabilities are well developed in agriculture. Brennen (1975) even asserts that probably no

branch of science is more accessible than agriculture—e.g., the Netherlands Center for Agricultural Publishing and Documentation (PUDOC) publications are indexed in forty-three secondary services (p. 88). And yet users—at all levels and in both industrialized and developing countries—repeatedly report difficulties in obtaining their publications when needed. The knowledge that so much literature and information exists may even increase user frustrations. Of the 130,000 references added to AGRIS each year, 16 percent are considered "grey literature"—nonconventional materials which are difficult to obtain (Samaha, 1984). There has been far more emphasis in the profession on examining bibliographic retrieval systems than on either user satisfaction with those systems and or with the goal of bibliographic processes—namely, obtaining useful information. Even in the United States, one of the major recommendations from the USDA Agricultural Research Service (ARS)/National Agricultural Library review of library operations (National Agricultural Library Project Review Team, 1988) was that document delivery needed to be more timely and to achieve a better fill rate (i.e., provide a higher percentage of documents requested). Representative Robert G. Toricelli (1984), in speaking to the U.S. Congress in support of a bill to promote dissemination of biomedical information (the category of information often considered to be the most accessible), noted that scientists' needs are for immediate document delivery. Instead, "the search [for documents] is so frustrating and time-consuming that it is sometimes referred to as the 'paper chase'."

—Documentation and document delivery services are slow. Concern for speedier services receives prominent attention by users in many user studies and in all countries. Apart from the utility of timely information, Laux (1973) asserts that speed is a worthy end in itself, because it raises confidence in the information partnership, thus casting the librarian in the role of an active, effective, and involved colleague.

—The complexity and quantity of information coupled with user inability to exploit available resources constitute yet another barrier. Broadbent (1977) considered user ignorance and "basic inability to make use of existing information tools and services" to be the largest problem confronting efficiency in information systems (p. 15).

Documentation and Online Services

Documentation, or preparation of current awareness and abstracting and indexing tools, is central to librarianship and has in fact dominated much of agricultural librarianship. Automation of these services has especially demanded energy and attention in recent decades. Because of the tremendous intellectual and fiscal resources devoted to secondary bibliographic services, it is important to examine specific efforts to gain user feedback with regard to them. There are several indications of the critical significance of abstracts to users (von Frauen-

dorfer, 1959; Deang, 1977; Müller & Friis, 1980,), although their creation obviously reduces speed of publication, which is a competing user preference. Von Frauendorfer (1959) also found quasi-unanimity in accepting English as the language for an international abstracting journal. While these studies seem to confirm the value of such services to users, it is also useful, in examining the effectiveness of bibliographic services, to keep in mind their relative contribution as a source of information for many scientists and researchers. Hálaszi's survey (1970) of 664 visitors (mainly scientists and students) to university and institute libraries in Wageningen, Netherlands, found only 40 percent of the clientele interested in abstract journals (p. 19). Information tailor-made to local circumstances was more attractive. In Van Styvendaele's (1977) study of scientists at Antwerp State University Centre, users (3,458 replies) reported citations in articles as their main source of references to the periodical literature (54 percent), followed by current awareness tools such as *Current Contents* (21 percent), and conventional abstract journals (15 percent). The remaining 9 percent were from computerized literature searches (which might be considered a machine equivalent of abstract journals), browsing, and theses (p. 271). Their main source of references to books was publisher announcements (Van Styvendaele, 1981).

Studies of users of online services are plentiful but tend to focus on precision, recall, and purpose of request rather than on structure and content of particular databases. The Interagency Panel (1982) that reviewed the National Agricultural Library critiqued the quality, timeliness, and ease of use of AGRICOLA—all of which needed improvement from the user's viewpoint. In Cornell's study (Olsen et al., 1985), users ranked online services and abstracts and indexes ninth and tenth respectively as means to keep current in their fields. Heading the list were: reading journals in their own and related fields; using their own collections; references in articles, conferences, correspondence within and outside of their university, and consulting experts (p. 13). Preferences by users for hard copy over online also is occasionally reported (Maciuszko, 1989; "British Library Report," 1988). As users increasingly search databases themselves, these end users have become the subject of investigation at least in the medical field ("Survey of Individual," 1989; Marshall, 1989).

Trends in Agriculture

It is also useful to identify trends in agricultural research and practice which might affect users and which have implications for their information service needs.

In some industrialized countries there is a decrease in the number of farmers/producers and a growing sophistication of those remaining in the business. Jones (1978) maintains that the decline in the number of people engaged in agriculture implies a willingness by those remaining

to make a greater intellectual investment in farming (p. 108). Coupled with the increasing scale of farms, Jones suggests that the information needs of farmers may converge with those of workers in agribusiness and advisers. Remaining farmers must maximize economy, and information is important to doing so. In the United Kingdom, Read (1987) found that, with a rise in the general level of education, farmers tended even to bypass advisers and go directly to specialists (p. 35).

Both the United States and the United Kingdom have experienced decreasing government support for agricultural research and information activities in recent years. The increasing reliance on the private sector, as documented by Palmer (1986), Read (1987), and Kranich (1989), has implications for information and users. Palmer (1986) suggests that the decline in free government advice leaves the user confronted with a bewildering profusion of packaged advice, none of which will be free (p. 108). Already the end user who can afford to purchase information is increasingly catered to by the commercial information sector. In spite of the potential of technology to overcome rural isolation, it may actually exacerbate information inequality because of the cost of these commercial services.

There is growing public interest in agriculture and its role in creating and solving environmental problems as well as in assuring the safety of the food supply. The scope of agricultural information is expanding accordingly. A workshop sponsored by the Rockefeller Foundation (*Science for Agriculture,* 1982) focused on the need to strengthen agricultural research in order to meet "complex challenges facing American agriculture" (p. 5). Its participants called for greater institutional collaboration and interdisciplinary efforts. If the workshop's recommendations come to fruition, users of agricultural information should become even more diverse while the information needs of agriculturists will broaden in scope through the sciences and technology. Because everyone is a consumer of agricultural products, the growing interest of the public in the safety and nutritional value of food may translate into increasing numbers of consumers seeking technical agricultural information.

The staggering rate of the world population increase and the concomitant needs for food suggest the urgency of increasing the number of extension workers in developing countries. Packaging information for local circumstances is likely to increase in importance.

Trends in education affect faculty and students and therefore library services. Studies such as one conducted by the Pew National Veterinary Education Program suggest that learning how to exploit information resources in fast-changing fields is becoming essential to education (Pritchard, 1989). Although curricular changes are typically slowly implemented, this recognition by educators suggests a more vital educational role for the librarian.

Trends in Delivery of Information

While the rapid growth in scientific and technical literature is hardly a new concern, the rate of growth continues to accelerate. Other forms of communication have emerged, but the journal article, for all its

problems as a vehicle of communication, is not going to disappear in the near future. Indeed, the number of scientific journals and the size of existing journals have grown exponentially. This so-called explosion is perhaps most dramatically quantified in the field of chemistry. *Chemical Abstracts* now produces about a half million abstracts per year. Users at all levels find it increasingly difficult to read and digest all the relevant information. Besides the sheer quantity of information with which users must cope, other results of this proliferation include slowness of publication and increasing specialization which makes it more difficult for scientists and technicians to communicate with each other. Compounding the problem of information surfeit may be a relative decline in syntheses of the literature. Deirg (1973) asserts that the growth in scientific literature has been accompanied by a decline in the production of review articles, a phenomenon he attributes to lack of reward to scientists for this type of effort. Whether or not Deirg is correct, assisting users with this sea of unsynthesized information becomes ever more important.

The cost of scientific literature, which is only partly a function of the growth in the literature, has escalated rapidly in the 1980s. While much agricultural research is government sponsored and available in government publications, agriculture depends on the basic sciences. Inevitably, a smaller proportion of the primary literature will be at hand even at well supported U.S. land-grant universities. This trend implies not only a need for increased attention to speedy document delivery, but a greater need for partnership with users in order to shape collections for optimal satisfaction.

Recent years have witnessed another more subtle change for many users of agricultural information—the consolidation of departmental libraries. Budget and space constraints as well as the increasingly interdisciplinary nature of science and agriculture have contributed to this unification. This consolidation has occurred in the U.S. National Agricultural Library and in many land-grant institutions, where agricultural libraries have merged with other branch libraries to become science libraries. Olsen (1979) laments that with this trend has come an "inexorable reduction of services and use by researchers, advanced students and field practitioners" (p. 113). Less personal and less frequent contact with users may exacerbate barriers between librarian and agriculturist.

Technology

Technology has created new forms of information transfer and manipulation. While bibliographic databases have surely assisted the user in identifying material on a specific topic, Deirg (1973) asserts that the "computer has aggravated matters by its very thoroughness" in providing ever more information, not all of it relevant (p. 66). In its many forms, information technology has been recognized as important to agriculture and has become the focus of government attention. For a

review of information technology in the United States, see *Information Technology for Agricultural America* (1983). Considered later are several examples of recent developments in information technology—databanks, telecommunications, CD-ROMs, and personal computing.

The National Agricultural Library study (Interagency Panel on the NAL, 1982) revealed a nearly universal interest in a national system of agricultural databases and databanks all accessible via a telecommunications network (p. 2). In the users' vision, stage one should provide online availability of statistical series and complete texts of selected documents; stage two should be online availability of the latest confirmed findings:

> User queries to this system would yield specific answers adjudged to be the latest, most scientifically correct by professionals assisted by peer panels who would keep abreast of the literature in their areas of expertise and update the database accordingly. (Interagency Panel on the NAL, 1982, p. O-5)

Perhaps in response to the panel's recommendations, NAL has launched some full-text experiments, notably NAL's Text Digitizing Project and its *Pork Industry Handbook*. The impact on and response by users of these prototypes has not yet been assessed. At the same time, there are many databanks of factual information in agriculture, particularly for dated information—e.g., market and price reports—but they are not easily available through a single network. The library profession has a vital role in designing, on a national and international basis, the systems and infrastructure to realize the vision of these users.

That infrastructure is very much dependent on telecommunications networks which are already facilitating electronic publishing in agriculture. In the 1988 report to the U.S. Secretary of Agriculture, the Joint Council on Food and Agricultural Sciences described an electronic publishing venture designed to mitigate the fact that USDA Agricultural Research Service research results were not reaching state extension specialists until many months after research was completed (Joint Council, 1988). By mounting new, unpublished ARS research results on the Cooperative Systems Information Network (a computer-/telecommunications link consisting of the ARS TEKTRAN computer database and Extension Cooperative Systems Information Network's telecommunications capabilities), extension agents at land-grant universities and, in many states, county agents, could access immediately 100 to 125 new reports each month thus increasing availability and timeliness of information. A less pronounced, but very significant, side benefit was that the field test increased the direct contact between ARS researchers and Cooperative Extension Service specialists (p. 22). Contacts between individuals may be further facilitated by modern telecommunications capabilities which enable electronic mail and bulletin board use. To that end, the National Agricultural Library has recently launched Agricultural Library Forum (ALF), an electronic bulletin

board with potential for linking people, instant delivery of search results, and receipt of document delivery requests.

Regardless of costs, the online revolution has not had an impact where telecommunications infrastructures are weak. Not dependent on telecommunications, CD-ROMs may allow that revolution to reach the developing world. Kinney (1988) reports a positive experience with AGRICOLA on CD-ROM in Malawi in spite of document delivery barriers. The potential of CD-ROM for such locales was also recognized by a recently funded project at Cornell University to identify the core literature of agriculture and convert it to optical disc ("Project at Cornell," 1989) and in BLDSC's (British Library Document Supply Center) trial of document delivery through CD-ROM ("BLDSC Tests Delivery," 1989). At the same time, some expect that the various logistical difficulties associated with CD-ROMs will serve to refocus attention on online capabilities (e.g., Martin, 1989).

Farmers and extension agents increasingly are using personal computers for data manipulation and for direct access to databanks although there is some disagreement as to the extent of that use. Chartrand et al. (1983) observe that farmers and extension agents were among the first to use computers in the 1960s for record-keeping and farm management (p.11), and Read (1987) found increasing reliance on microcomputers by private consultants and public agricultural advisers in the United Kingdom. However, Case and Rogers (1987) asserted that only 6 percent of U.S. farmers have computers and that development of appropriate software lags behind other business sectors (p. 63). Microcomputer technology positions farmers and others to be direct users of information services, and there has been an accompanying rise in commercial services and at-home access. It even has been recommended that the U.S. National Agricultural Library could relate more directly to users (National Agricultural Library Project Review Team, 1988).

Implications for the Information Professional

What do these user characteristics and trends suggest for the role of the information professional and for information services? Unequivocally, they call for closer relationships between information professionals and users and among the users themselves. An analysis of the mechanisms for information transfer and application among agricultural users suggests several ways in which librarians and documentalists can be more effective.

Because of the centrality of personal contacts in information transfer, an important role of information professionals is surely in designing systems and services that can facilitate and enhance the relationships of scientists with each other. This is not a new idea but one that fully warrants repetition and reinforcement. Even in 1957, Brookland listed telephone calls to government offices, learned societies, manufacturers' associations, newspapers, the Commonwealth

Bureaux, university departments, foreign embassies, and other firms as important resources for an agricultural firm's information service (p. 100).

There are numerous examples in agriculture of databanks and specialized information services for which people contacts are considered key components. The Pacific Coast Forest Research Information Network (PACFORNET, now FS Info—Forest Service Information) regards "linking users to subject specialists" as a vital part of reference service (Yerke, 1976). The Aquatic Sciences and Fisheries Information System (ASFIS) has a register of experts—700 individuals whose expertise may be valuable to aquaculture—and institutions (Caponio, 1977; Dopkowski, 1981). The Postharvest Institute for Perishables Information Center (established at the University of Idaho with support from the U.S. Agency for International Development), whose primary goal is to reduce crop losses in developing nations, maintains an extensive online listing of experts (George, 1981). A number of electronic systems have shown that using personal contacts is an important benefit. Both the ARS electronic publishing experiment and the development of the Nebraska databank AGNET (AGricultural Computing NETwork, a network which contains 200 computer programs and gateways to other information sources) resulted in facilitating contacts between people.

Contacts between users can be enhanced in more informal ways as well. A strong relationship between a librarian and an organization's "gatekeepers" may in fact disseminate information farther than several library-patron contacts. As Cooney and Allen (1976) exhort, information specialists should play a role in supporting the gatekeepers, in bringing other scientists into contact with them, and in facilitating information transfer between them (p. 111). Librarians can and should play a valuable part in enhancing relationships between formal and informal information channels.

The bewildering profusion of both scientific-technical literature and technology suggests a second, increasingly important role for librarians and information services. This role is played out in a variety of ways—i.e., by sifting the literature, managing electronic technologies, and instructing users in doing the same. Sifting the literature is a traditional activity, but its importance is progressively magnified by the growth of science. As Jennings (1957) noted in describing the New York State Agricultural Experiment Station Library, the culling of literature as it arrives for material pertinent to researchers was one of her most important tasks. Today there are many tools to assist with that task, but it has been nearly abandoned in many libraries with large and diverse clienteles. Subject knowledge on the part of information professionals may be increasingly important because in some settings such culling may involve selecting material applicable only to local soil, climate, and economic conditions.

There is a need to index and control not only literature, but also software, databanks, and even people contacts. Librarians have focused

tremendous energy on library technologies but much less on user-oriented technologies. A librarian or information professional must have expertise in the management of information systems and be as conversant with a whole panoply of hardware, software, and databanks as with books and journals. A librarian must be familiar with large numbers of databanks and specialized information services and be able to advise users in accessing them. These have clearly come to play a central role in agricultural information and, for the most part, they have been developed outside the library milieu to handle vast amounts of factual data—for example, data regarding pesticides (NPIRS—National Pesticide Information Retrieval System) and germplasms (GRIN—Germplasm Resources Information Network) (see *Factual Databanks,* 1978; Porta, 1986). Decentralization of information delivery directly to users does not mean that the librarian's role is diminished. Instead, librarians need to facilitate end user access by advising on the array of commercial services available to users as well as on hardware and software. They need to take on "information counseling" roles as championed by Horton (1982). Frank (1987) even suggests a new professional—a "farm computer consultant"—with skills in finance, marketing, and management (p. 310).

Finally, the information professional's role in response to the explosive growth of scientific-technical literature and technology includes providing end user instruction and assisting users directly to access the assemblage of databanks and services and this role will surely increase in importance. The complexity of the information world requires a trained user and there is a need for users to exploit better existing resources. Especially in circumstances with limited information personnel, the user should not have to be dependent on the librarian. At the same time it is essential to remember that time is a valuable commodity. The goal of user education programs should be to decrease, not increase, the time a user has to spend gathering information.

Another major goal for all information professionals and organizations worldwide is providing fast document delivery by utilizing modern telecommunications capabilities. Like any other tool, information is not useful if it is not available when it is needed.

Information professionals also must develop services that help meet both very general and highly specialized information needs. Buntrock (1980) predicted that the European Community would emphasize promotion of so-called "value added" information systems—systems which combine information analysis and factual databanks to answer all kinds of online and offline queries from all kinds of users. Indeed, the success of all-encompassing information services regarding particular commodities or activities suggests the need for this kind of vertically integrated information service in a more general setting. An excellent example is the databank AGNET. Created with regular user feedback, it grew as a result of user needs with no type of information considered out

of its scope. FS Info, referred to earlier, was the result of an effort to change the way of thinking about information services. Its "beauty is that it creates a web by linking librarians, information centers, researchers, practitioners, and editors within the U.S. Forest Service" (Rutherford, 1987, p. 1). There are many other examples of vertical integration, or comprehensive information services, including the USDA Information Center for Animal Disease Emergencies in Hyattsville, Maryland (Pilchard, 1978); a USAID sponsored workshop for development of an international sorghum information network (Olsen, 1975); and the clearinghouse at BIOTROP—Regional Centre for Tropical Biology located in Bogor, West Java, Indonesia, which combines scientific information, publications, and public relations functions (Sahertian-Bakhoven & Soedojo, 1983).

The importance of convenience and the growing universe of information suggest that more personalized, specialized information services are also needed. Drake (1982) provides a particularly helpful description of such a special librarianship model. It calls for information management which combines a gathering function with analysis, synthesis, and delivery in a usable form (p. 227). It also requires a marketing approach that begins with customer needs, wants, and expectations (Drake, 1982, p. 231). This marketing approach, which has been the hallmark of special librarianship, focuses on developing appropriate services and products for each segment of the clientele and continually assessing satisfaction of both users and potential users. Not only is each segment important, but it is increasingly possible to tailor services to individual needs and modi operandi. Another illustration is provided by Lancaster and Smith (1979) who define the special library model as: (1) using all forms of recorded information as practical tools; (2) limiting of materials to those related to the work of the parent organization; and (3) expanding and extending reference services as a principal function. This special library model has already been adopted by numerous international agricultural information networks. User needs in agriculture suggest the necessity to extend models of this kind. From the user's point of view, information services should concentrate on answers and delivery and less on materials per se.

In order to accomplish this, however, users must play a role in the design of services. Ensuring that they do is another important role for librarians. There are some excellent examples in agricultural librarianship of services and networks which have actively involved users in their development and changed and enhanced services in response to them. Many have been mentioned in this article. The National Pesticide Information Retrieval System regularly involves users in annual user conferences. In assessing ten years of AGNET, the University of Nebraska founders James G. Kendrick and Thomas L. Thompson conclude that the main reason for AGNET's popularity and growth was "strict adherence to the policy of responsiveness to our users" (Murray,

1985, p. 110). AGNET's "library" of services was not the result of a theory or a design. Its staff simply listened to users and made every effort to supply what they needed.

Managers and providers of an information service—be it a secondary literature service, a library, or a specialized information center—must understand its particular clientele and its requirements. The importance of this cannot be overstated. The literature provides some useful reviews of user studies and other formal ways to gain understanding of users (e.g., Dervin & Nilan, 1986; Lancaster & Smith, 1979; Martin, 1976; and Powell, 1988). Cronin (1981) provides some general guidelines to follow in pursuing this objective. Cronin recommends that the aims in studying users should be to establish the precise size and character of the actual user population, to profile its information requirements in a systematic fashion, to attempt to match resources to needs, and to monitor effectiveness by encouraging user feedback. The important point, simply put, is that to gain sympathy for, and understanding of, users and to see the potential for services through users' eyes, one must go out and ask them what they need. Only market research will inform the interested librarian who is faced with a distinctive clientele of their special and no doubt highly individualized needs.

The danger of not investigating user needs is that users generally accept what is offered. Agriculturists are not considered to be particularly demanding (R. Farley, personal communication). However, the lack of criticism should never be interpreted as satisfaction by users. In fact, Oldman and Wills (1977) concluded from a study of business libraries that the more a library does for its patrons the more critical they are of it; however, the less it does for users the less critical they are (p. 122).

In order to learn first-hand about their users' needs and frustrations, librarians must move even further beyond traditional warehousing functions and take a proactive public relations role. Chen's study (1974) of 500 scientists found that the majority do not consult a librarian when in need of information. The proactive study at Cornell University's Mann Library seemed to break down barriers to the "awareness of information sources and services more than it affected physical or bibliographic barriers to information" (Coons et al., 1985). Another example of an assertive, public relations role for a library was that created by Drake (1978) following a survey which showed that Indiana veterinarians relied almost entirely on their own books and journals for information. She established and publicized a Veterinary Medicine Information Center at Purdue University which resulted in daily inquiries from the veterinary sector at large. In agriculture there has been a proliferation of services which can concentrate on providing service rather than on processing and maintaining collections. The success of these services has implications for the self-service library. As White (1979) notes, there are now commercial services whose purpose is

to analyze and digest information in libraries and information centers. If librarians are truly concerned with users they must examine and perform this role.

The present survey makes it clear that agricultural librarians have a special pivotal role to play in the rapidly changing, increasingly important, and information-dependent agricultural sector of our society. To play this role, they must look in two directions at once—to their users for guidance and for a statement of needs, problems, and priorities; and to the world of information and technology for solutions and resources. It is their special responsibility to bring the two together. The task is challenging in its scope, urgency, and open-endedness, but what is known about agriculturists and about current trends can help focus their efforts.

REFERENCES

Agar, J. R.; Volans, J. K. S.; & Runcie, K. V. (1984). Managing information to fit the need. *Journal of Information Science, 8*(5), 225-227.

Allen, T. J.; Piepmeier, J. M.; & Cooney, S. (1971). The international technological gatekeeper. *Technology Review, 73*(5), 37-44.

Bernardo, F. A. (1981). Catering to the information needs of extension workers. In *Agricultural information to hasten development* (proceedings of the VIth World Congress of the International Association of Agricultural Librarians and Documentalists, 3-7 March 1980) (pp. 13-17). Los Banos, Philippines: Agricultural Libraries Association of the Philippines & Agricultural Information Bank for Asia.

BLDSC tests delivery: Delivery from CD-ROM. (1989). *IAALD Quarterly Bulletin, 34*(1), 34.

Brennen, P. W. (1975). International flow in American agricultural literature. *IAALD Quarterly Bulletin, 20*(2), 86-93.

British library report claims online searches ineffective. (1988). *On-Line Review, 12*(4), 234-235.

Broadbent, K. P. (1977). Agricultural information services in developed countries and their contribution to agricultural research. In *Scientific literature service workshop* (11-13 April 1977) (pp. 8-23). Paranaque, Rizal, Philippines: Philippine Council for Agriculture and Resources Research in cooperation with Agricultural Libraries Association of the Philippines.

Brookland, K. E., & Watson, E. M. (1957). Agricultural library work in an industrial company. *IAALD Quarterly Bulletin, 2*(3), 99-104.

Buntrock, H. (1980). Agricultural information in the European Community: Achievements, problems and prospects. *International Forum on Information and Documentation, 5*(3), 7-14.

Buntrock, H. (1981). Summary report. In *Agricultural information to hasten development* (proceedings of the VIth World Congress of the International Association of Agricultural Librarians and Documentalists, 3-7 March 1980) (pp. 329-38). Los Banos, Laguna, Philippines: Agricultural Libraries Association of the Philippines and Agricultural Information Bank for Asia.

Burton, H. D. (1976). Current awareness literature services. *Agricultural Libraries Information Notes,* 2(3), 1-2.

Busch, L., & Lacy, W. B. (1983). *Science, agriculture, and the politics of research.* Boulder, CO: Westview Press.

Caponio, J. F. (1977). The Aquatic Sciences and Fisheries Information System—an international exchange. *Agricultural Libraries Information Notes, 3*(4), 1-2.

Case, D., & Rogers, E. (1987). The adoption and social impacts of information technology in U.S. agriculture. *The Information Society, 5*(2), 57-66.

Chartrand, R. T.; Carr, A. B.; & Miller, N. R. (1983). Getting information to the farms. *Bulletin of the American Society for Information Science, 9*(3), 10-12.

Chen, C. C. (1974). How do scientists meet their information needs? *Special Libraries, 65*(7), 272-280.

Consumer Dynamics, Inc. (1980). *Conclusions on the effects of decisionmaking behavior on the use of information: Final phase I report.* Rockville, MD: Author.

Cooney, S., & Allen, T. J. (1974). The technological gatekeeper and policies for national and international transfer of information. *R & D Management, 5*(1), 29-33.

Cooney, S., & Allen, T. J. (1976). Users' behaviour and communication networks: Widening the scope of information science. *IAALD Quarterly Bulletin, 21*(3/4), 110-112.

Coons, B.; Olsen, J. K.; Lippincott, J. K.; & Mann, A. R. (1985). Information resources in agricultural research: Project overview. *Agricultural Libraries Information Notes, 11*(8), 1-4.

Crane, D. (1972). *Invisible colleges: Diffusion of knowledge in scientific communities.* Chicago: University of Chicago Press.

Cronin, B. (1981). Assessing user needs. *Aslib Proceedings, 33*(2), 37-47.

Dagnelie, P. (1978). Some comments on agricultural databanks: The user's viewpoint. In *Factual data banks in agriculture* (proceedings of the symposium organized by the Commission of the European Communities, July 12-13, 1977) (pp. 62-64). Wageningen, The Netherlands: Centre for Agricultural Publishing and Documentation.

Deang, R. T. (1977). Agricultural information needs in experiment stations. In *Scientific literature service workshop, 11-13 April 1977* (pp. 27-29). Paranaque, Rizal, Philippines: Philippine Council for Agriculture and Resources Research in cooperation with Agricultural Libraries Association of the Philippines.

Deirg, I. O. (1973). User aspects: An Irish view. In *Progress and prospects in agricultural librarianship and documentation* (papers presented at the Regional European Symposium of the International Association of Agricultural Librarians and Documentalists, 14-18 May 1973) (pp. 64-76). Wageningen, The Netherlands: Centre for Agricultural Publishing and Documentation.

Dervin, B., & Nilan, M. (1986). Information needs and uses. *Annual Review of Information Science and Technology, 21,* 3-33.

Dewey, H. (1981). AID—update service to developing countries. *Agricultural Libraries Information Notes, 7*(1), 1-3.

Dopkowski, P. (1981). Aquaculture information: A challenge for the eighties. *Agricultural Libraries Information Notes, 7*(4), 1-4.

Drake, M. A. (1978). Creating demand for information: A case study of veterinarians. In E. H. Brenner (Comp.), *The information age in perspective* (proceedings of the 41st ASIS Annual Meeting, November 13-17, 1978, Vol. 15) (pp. 110-11). White Plains, NY: Knowledge Industry Publications for American Society for Information Science.

Drake, M. A. (1982). Information management and special librarianship. *Special Libraries, 73*(4), 225-237.

Drucker, P. F. (1976). Managing the public service institution. *College & Research Libraries, 37*(1), 4-14.

Duces, B., & Strawhorn, J. M. (1981). Information use in decisions to adopt agricultural innovations: Theoretical implications. *Agricultural Libraries Information Notes, 7*(11), 1-4.

Factual data banks in agriculture. (1978). (proceedings of the symposium organized by the Commission of the European Communities, July 12-13, 1977). Wageningen, The Netherlands: Centre for Agricultural Publishing and Documentation.

Frank, R. C. (1987). Agricultural information systems and services. *Annual Review of Information Science and Technology, 22,* 293-334.

Garfield, E. (1978). What is the literature cited by agricultural scientists? A case study in literature dispersion. In P. Velasquez & R. Nadurille (Eds.), *Proceedings of the Fifth World Congress of the International Association of Agricultural Librarians and Documentalists, April 14-18, 1975* (pp. 125-38). Mexico: Instituto Nacional de Investigaciones Agricolas.

George, P. F. (1981). Postharvest Institute for Perishables Information Center. *Agricultural Libraries Information Notes, 7*(12), 1-4.

Gilman, H. (1947). What the scientist expects of the librarian. *College and Research Libraries, 8*(July), 329-332.

Gregorio, L. B., & Sison, J. C. (1989). Agricultural information provision in developing countries. *IAALD Quarterly Bulletin, 34*(1), 7-11.

Hálaszi, J. (1970). *Lees- en zoekgewoonten van landbouwkundige onderzoekers en studenten en motieven voor aankoop van wetenschappelijke literatuur van landbouwkundige onderzoekers.* (Reading and searching habits of agricultural scientists

and students and motivation of agricultural scientists for buying scientific literature). Wageningen, The Netherlands: Centrum voor Landbouwpublikaties en Landbouwdocumentatie.

Hansen, I. B. (1981). Use of the Danish Veterinary and Agricultural Library by direct library users and users of an online documentation service. *IAALD Quarterly Bulletin, 26*(3), 89-96.

Horton, F. W., Jr. (1982). The emerging information counselor: A new career path in need of a champion. *Bulletin of the American Society for Information Science, 8*(June), 16-19.

Ikpaahindi, L. (1985). Information gathering methods of Nigerian veterinary scientists. *Library and Information Science Research, 7*(2), 145-157.

Information management: Symposium on the transfer and interpretation of scientific and technical information in agriculture, 2-3 February 1977. (1978). Organized by Directorate-General, Scientific and Technical Information and Information Management, in cooperation with Directorate-General, Agriculture. Luxembourg: Commission of the European Communities.

Information technology for agricultural America. (1983). Prepared by the Congressional Research Service, Library of Congress for the Subcommittee on Department Operations, Research, and Foreign Agriculture of the Committee on Agriculture, U.S. House of Representatives, December 1982, 97th Cong., 2d session. Washington, DC: USGPO.

Interagency Panel on the NAL. (1982). *Assessment of the National Agricultural Library–Final report to the Secretary.* Beltsville, MD: USDA Science and Education.

Jennings, P. (1957). The library of the New York State Agricultural Experiment Station at Geneva, New York. *IAALD Quarterly Bulletin, 2*(4), 137-139.

Joint Council on Food and Agricultural Sciences. (1988). *Accomplishments for research, extension and higher education, a report to the Secretary of Agriculture.* Washington, DC: USDA Joint Council on Food and Agricultural Sciences.

Jones, G. E. (1978). Anticipating information needs of tomorrow's farmers. In *Information management: Symposium on the transfer and interpretation of scientific and technical information in agriculture, 2-3 February 1977* (pp. 103-21). Luxembourg: Commission of the European Communities.

Kinney, J. (1988). Starting from scratch: Building library systems and a network in Malawi. *Agricultural Libraries Information Notes, 14*(6/7), 1-3.

Koster, G. (1971). Practical experience with the tools of agricultural information for the benefit of extension services and agricultural business. In *Acquisition and exploitation of information in the field of food and agriculture: Modern technics and international cooperation* (World Congress of Agricultural Librarians and Documentalists, 4th, 20-25 April 1970) (pp. 263-66). Paris: Institut National de la Recherche Agronomique.

Kranich, N. C. (1989). Information drought: Next crisis for the American farmer? *Library Journal, 114*(11), 22-27.

Lancaster, F. W., & Beecher, J. W. (1981). Agricultural librarianship and documentation as a profession. In *Agricultural information to hasten development* (proceedings of the VIth World Congress of the International Association of Agricultural Librarians and Documentalists, 3-7 March 1980) (pp. 197-210). Los Banos, Laguna, Philippines: Agricultural Libraries Association of the Philippines and Agricultural Information Bank for Asia.

Lancaster, F. W., & Smith, L. C. (1979). Science, scholarship and the communication of knowledge. *Library Trends, 27*(3), 367-388.

Laux, W. (1973). Obstacles to the use of scientific documentation. In *Progress and prospects in agricultural librarianship and documentation* (papers presented at the Regional European Symposium of the International Association of Agricultural Librarians and Documentalists, 14-18 May 1973) (pp. 91-99). Wageningen, The Netherlands: Centre for Agricultural Publishing and Documentation.

Laux, W. (1978). User requirements. In P. Velasquez & R. Nadurille (Eds.), *Proceedings of the Fifth World Congress of the International Association of Agricultural Librarians and Documentalists, April 14-18, 1975* (pp. 27-35). Mexico: Instituto Nacional de Investigaciones Agricolas.

Maciuszko, K. L. (1989). The case for coexistence: Hardcopy and online searching. *Library Journal, 114*(6), 55-57.

Maltha, D. J. (1971). Feasibility of international co-operation in agricultural documentation and information. In *Acquisition and exploitation of information in the field of food and agriculture: Modern technics and international cooperation* (World Congress of Agricultural Librarians and Documentalists, 4th, 20-25 April 1970) (pp. 271-76). Paris: Institut National de la Recherche Agronomique.

Maltha, D. J. (1972). Information needs in agriculture. *IAALD Quarterly Bulletin, 17*(3), 170-177.

Marshall, J. G. (1989). Characteristics of early adopters of end-user online searching in the health professions. *Bulletin of the Medical Library Association, 77*(1), 48-55.

Martin, J. K. (1977). Online bibliographic search services at the Russell Research Center. *Agricultural Libraries Information Notes, 3*(3), 1-5.

Martin, L. A. (1976). User studies and library planning. *Library Trends, 24*(3), 483-496.

Martin, S. K. (1989). Information technology and libraries: Toward the year 2000. *College and Research Libraries, 50*(4), 397-405.

Metcalfe, J. R. (1981). International collaboration: A means to an end or an end in itself? In *Agricultural information to hasten development* (proceedings of the VIth World Congress of the International Association of Agricultural Librarians and Documentalists, 3-7 March 1980) (pp. 115-21). Los Banos, Laguna, Philippines: Agricultural Libraries Association of the Philippines and Agricultural Information Bank for Asia.

Müller, E., & Friis, T. (1980). Execution and evaluation of an AGREP user study. *IAALD Quarterly Bulletin, 25*(4), 54-58.

Murray, P. J. (1985). AGNET: After a decade...Different clientele and enhanced services. *Online, 9*(6), 109-117.

National Academy of Sciences, National Academy of Engineering, Institute of Medicine, Committee on Science, Engineering and Public Policy. *Information technology and the conduct of research: The user's view. Report of the Panel on Information Technology and the Conduct of Research.* (1989). Washington, DC: National Academy Press.

National Agricultural Library. Project Review Team. (1988). *ARS/NAL review of library operations: A summary of findings and recommendations.* Beltsville, MD: National Agricultural Library: Author.

Oldman, C. M., & Wills, G. (1977). *The beneficial library.* Bradford, England: MCB Books.

Olsen, J. K.; Lippincott, J. K.; & Coons, B. (1985). *Appropriate public services for agricultural research faculty: Final report from the public services research projects, Cornell University.* Washington, DC: Association of Research Libraries, Office of Management Studies (ERIC Document Reproduction Service No. ED 255 220).

Olsen, W. C. (1975). Workshop for development of an International Sorghum Network. *Agricultural Libraries Information Notes, 1*(6/7), 4.

Olsen, W. C. (1979). Management in agricultural research libraries: The next thirty years. In A. Fusonie & L. Moran (Eds.), *International agricultural librarianship: Continuity and change* (proceedings of an international symposium held at the National Agricultural Library, November 4, 1977) (pp. 113-19). Westport, CT: Greenwood Press.

Olsen, W. C. (1982). OATS tested by NAL. *Agricultural Libraries Information Notes, 8*(11/12), 6.

Oyler, D. (1975). CAIN on-line at the University of Wisconsin. *Agricultural Libraries Information Notes, 1*(1), 1-2.

Palmer, J. (1986). Information services in a beleaguered agricultural industry. *Aslib Proceedings, 38*(4), 101-113.

Peart, B. (1977). Priority sources of information currently available to the Official Advisory Service in England and Wales. In *Information management: Symposium on the transfer and interpretation of scientific and technical information in agriculture, 2-3 February 1977* (pp. 74-89). Luxembourg: Commission of the European Communities.

Pilchard, E. I. (1978). An information center for animal disease emergencies. *Agricultural Libraries Information Notes, 4*(12), 1-3.

Porta, M. A. (1986). Selected agricultural databases and computerized systems. *Computers and Electronics in Agriculture, 1,* 289-297.

Powell, R. R. (1988). *The relationship of library user studies to performance measures: A review of the literature* (Occasional Papers Series No. 181). Urbana-Champaign, IL: University of Illinois, Graduate School of Library and Information Science.

Price, D. J. de Solla. (1986). *Little science, big science...and beyond.* New York: Columbia University Press.

Pritchard, W. R. (Ed.). (1989). *Future directions for veterinary medicine.* Durham, NC: Duke University, Pew National Veterinary Education Program, Institute of Policy Sciences and Public Affairs.

Project at Cornell to identify the core literature of the agricultural sciences for distribution to the third world. (1989). *IAALD Quarterly Bulletin, 34*(1), 32-33.

Read, N. (1987). The advisory role and changes in agricultural information. *Aslib Proceedings, 39*(1), 33-38.

Reddy, D. B. (1987). Agricultural information transfer in India. *Information Development, 3*(3), 167-170.

Richardson, J. G., & Mustian, R. D. (1988a). *Perceived capacity of the North Carolina Agricultural Service to deliver technological information: Reactions of agricultural producers who use Extension information.* Paper presented to the Southern Rural Sociological Association at the Southern Association of Agricultural Scientists, 85th, January 31-February 3, 1988 (ERIC Document Reproduction Service No. ED 293 673).

Richardson, J. G., & Mustian, R. D. (1988b). *Preferred methods for delivery of technological information by the North Carolina Agricultural Extension Service: Opinions of agricultural producers who use Extension information* (Paper presented to the Agricultural Communications section, Southern Association of Agricultural Scientists, 85th, January 31-February 3, 1988) (ERIC Document Reproduction Service No. ED 293 672).

Russell, H. M. (1983). Agricultural user populations and their information needs in the industrialized world. *IAALD Quarterly Bulletin, 28*(2), 40-52.

Russell, H. M. (1984). Agricultural user populations and their information needs in the industrialized world. In H. A. Liyai, B. N. Ayaka & R. Thomas (Eds.), *Proceedings of the International Conference on Education and Training for Agricultural Library and Information Work, 7-12 March 1983* (pp. 55-69). Nairobi: Kenya Library Association.

Rutherford, G. (1987). Networking forestry information and services. *Agricultural Libraries Information Notes, 13*(4), 1-3.

Sahertian-Bakhoven, P., & Soedojo, S. S. (1983). Library and information needs of end users in the agro-biological sciences. In *The library in the information revolution* (proceedings of the sixth Congress of Southeast Asian Librarians, 30 May-3 June 1983) (pp. 463-65). Singapore: Maruzen Asia for CONSAL VI.

Samaha, E. K. (1984). Document delivery: An AGRIS co-operative approach. In H. A. Liyai, B. N. Ayaka, & R. Thomas (Eds.), *Proceedings of the International Conference on Education and Training for Agricultural Library and Information Work, 7-12 March 1983* (pp. 309-18). Nairobi: Kenya Library Association.

Science for agriculture: Report of a workshop on critical issues in American agricultural research, June 14-15, 1982. (1982). New York: Rockefeller Foundation.

Sophar, G., & Murphy, P. V. (1981). Information use in decisions to adopt agricultural innovations: Practical applications. *Agricultural Libraries Information Notes, 7*(11), 5-7.

Storm, B. L. (1982). Information and rural development: From Bangladesh to Guatemala, audio and video tapes deliver important messages. *Bulletin of the American Society for Information Science, 8*(4), 25-29.

Survey of individual users of MEDLINE on the NLM system. (1989). *NLM Technical Bulletin,* (February) (Suppl. no. 1, special issue), 48-49.

Torricelli, Robert G. (1984). The research accountability act (HR 5098, a bill to promote dissemination of biomedical information). *Congressional Record:* Extensions of remarks (proceedings and debates of the 98th Congress, 2nd Session, March 8), *130*(27), E881-E882.

Trueswell, R. L. (1969). Some behavioral patterns of library users: The 80/20 rule. *Wilson Library Bulletin, 43*(5), 458-461.

Van Styvendaele, B. J. H. (1977). University scientists as seekers of information: Sources of references to periodical literature. *Journal of Librarianship, 9*(4), 270-277.

Van Styvendaele, B. J. H. (1981). University scientists as seekers of information: Sources of references to books and their first use versus date of publication. *Journal of Librarianship, 13*(2), 83-92.

von Frauendorfer, S. (1959). World agricultural economics and Rural Sociology Abstracts: Analysis of a questionnaire. *IAALD Quarterly Bulletin, 4*(4), 211-216.

Voss, N., & Wiedeman, W. (1981). Literature requirements and informative behaviour of scientists in grassland management and related fields. In *Agricultural information to hasten development* (proceedings of the VIth World Congress of the International Association of Agricultural Librarians and Documentalists, 3-7 March 1980) (pp. 277-85). Los Banos, Laguna, Philippines: Agricultural Libraries Association of the Philippines and Agricultural Information Bank for Asia.

Warmann, G. W. (1988). *The market for extension information in Virginia* (Paper presented at the Annual meeting of the Southern Association of Agricultural Scientists, 85th, January 31-February 3, 1988) (ERIC Document Reproduction Service No. ED 293 676).

White, H. S. (1979). Growing user information dependence and its impact on the library field. *Aslib Proceedings, 31*(2), 74-87.

Williams, C. E., & Williams, S. K. T. (1984). Agricultural user populations and their information needs: A case study of Badeku pilot rural development project in Nigeria. In H. A. Liyai, B. N. Ayaka, & R. Thomas (Eds.), *Proceedings of the International Conference on Education and Training for Agricultural Library and Information Work, 7-12 March 1983* (pp. 36-54). Nairobi: Kenya Library Association.

Yerke, T. B. (1976). Pacific Coast Forest Research Information Network (PACFORNET). *Agricultural Libraries Information Notes, 2*(12), 5-7,3.