

**PLANNING AND MANAGING
FORESTRY RESEARCH:
A SELF-LEARNING COURSE**

Developed at the University of Minnesota
College of Natural Resources, Department of Forest Resources
St. Paul, Minnesota, U.S.A.

In Collaboration With
The International Union of Forestry Research Organizations
Special Programme For Developing Countries
Vienna, Austria

September 1994

**MODULE 11
DEVELOPING RESEARCH LINKAGES:
LEARNING FROM OTHERS**

Table of Contents

	<u>Page</u>
MODULE 11 - DEVELOPING RESEARCH LINKAGES: LEARNING FROM OTHERS	1
Introduction to the Module	1
Initial Skill and Knowledge Assessment	3
Study Unit 11.1 - Facilitating Research Networking	5
The Role of Research Networking	6
Importance of Research Networking	8
Functions of Research Networking	9
Types of Research Networking	10
Networking with Nonforestry Research Organizations	14
Linkages Between Researchers and Educators/Trainers	14
Facilitating and Encouraging Networking	15
Disadvantages of Research Networking	16
Activities - Study Unit 11.1	17
Summary	21
Study Unit 11.2 - Utilizing Computer Networks	23
Computer Networks, Databases, and Management	
Information Systems	25
Forestry Databases	25
International Computer Networks	29
Management Information Systems	30
Computer Technology Changes Rapidly	31
Activities - Study Unit 11.2	33
Summary	37
Final Skill and Knowledge Assessment	39
Literature Cited	41
Readings for Module 11	43

MODULE 11

DEVELOPING RESEARCH LINKAGES: LEARNING FROM OTHERS

Introduction to the Module

*"No man is an island, entire of itself;
every man is a piece of the continent,
a part of the main;..."*

John Donne [1573-1631] *Devotions, XII*

Individual scientists can conduct research by themselves, in isolation from their peers and other scientists. Research organizations can carry out their research programs with little interaction with outside organizations or people. However, all of us can learn from others. Scientists and organizations are likely to be more effective if they are in contact with and can exchange information with other scientists and/or other research organizations. Some large-scale problems at the regional or global level may require joint collaborative research by a number of different scientists working at different locations and often for different organizations. As a research manager you can enhance your research program by promoting and facilitating the networking of people on your staff with those of other organizations in other countries, and promoting the exchange of information.

In this module we will help you, as a research manager, evaluate the potential for networking among researchers and research organizations to produce benefits to your research organization, and suggest ways to facilitate research networking when it appears to be desirable. We'll review the rapidly expanding potential for utilizing computerized information networks to gain access to major sources of information around the world that may be helpful to you and your scientists in planning, managing, and conducting your forestry research program.

List of study units covered in this module

- | | |
|------------------|----------------------------------|
| Study Unit 11.1. | Facilitating research networking |
| Study Unit 11.2. | Utilizing computer networks |

Initial Skill and Knowledge Assessment

Module 11 - Developing Research Linkages: Learning from Others

If you would like to find out how much you improve your skills and knowledge by studying this module, we suggest that you complete the exercise on the next page **before** you begin this module. This will establish your current level of skills and knowledge about the topics covered in this module. At the end of the module there is an identical skill and knowledge assessment form which you can complete once you have finished the module. By completing and comparing the before and after assessments, you can determine the extent to which you have improved your skills and knowledge.

Below are listed a number of skill and knowledge statements derived from the objectives of the study units in module 11. These are identical to those listed for this module in Study Unit 0.3 - Self-assessment of Training Needs, which you may have completed initially to guide your course of study. *Please read each statement carefully and indicate with a checkmark the level that best describes your current skill or knowledge, from 1 to 5, using the following descriptions:*

- 1 I cannot perform this skill, or I have not been exposed to the information.
- 2 I cannot perform this skill, but have observed the skill or have been exposed to the information.
- 3 I can perform the skill or express the knowledge with assistance from others.
- 4 I can perform the skill or express the knowledge without assistance from others.
- 5 I can perform the skill or express the knowledge well enough to instruct others.

Skill or Knowledge Statement	Your Level of Skill or Knowledge				
	1	2	3	4	5
a) Describe the various types of research networking used in your organization.					
b) Suggest ways in which your organization could strengthen and expand its research networking.					
c) Describe the benefits of establishing a management information system in your organization.					
d) Describe the benefits of linking your organization to international computer networks such as Internet.					

Study Unit 11.1

Facilitating Research Networking

Science is a social activity. As manager of research, you must be aware that scientists need to communicate with other scientists. Frequent contact between scientists is essential for the progress of science. In this unit we'll explore with you the various ways that scientists interact. You'll learn about formal approaches to research networking, and some of the effective nonformal means of interaction often used by scientists worldwide. We'll then help you take an in-depth look at the way researchers in your own organization network with other researchers. Lastly, we'll help you to envision ways your organization can assist your scientists to improve their networking capability.

Objectives

When you have completed this study unit you should be better able to:

- describe the various types of research networking used in your research organization;
- identify potential organizations and individuals with which your organization might establish research networks; and
- suggest ways in which your organization could strengthen and expand its research networking.

The Role of Research Networking

Networking refers to the formal and informal ways in which scientists and research organizations contact one another and develop working relationships to exchange information, cooperate in research studies, and coordinate research programs and projects.

One of the chief ways of learning is through direct contacts with other people. People learn from other people. This is as true within the scientific community as it is in society at large. Scientists learn and exchange information through contacts with other people. Moravcsik (1986) states that most of the important communication among scientists takes place through person-to-person contact, and by written forms of communication.

Science is a social activity. Frequent contact among scientists is essential for the progress of science. Through contacts with other researchers and organizations, scientists exchange ideas and information, collaborate on research studies, validate scientific discoveries, and disseminate research results. Organizations work with each other to coordinate research programs and to facilitate the sharing of expertise, equipment, and facilities. Contacts among scientists are stimulated through the development of informal and formal networks of scientists and organizations.

Lack of interaction among researchers can result in inefficiencies, unneeded duplication of efforts, and waste of resources. Experience indicates that having a critical mass of researchers in an area can help in achieving significant progress in a reasonable time. This critical mass is not available in most developing countries.

A survey of forestry research organizations in developing countries (39 respondents) indicated (table 11.1.1) that from 40 to 60 percent of the organizations never formally interact with other research or educational institutions in their own country in cooperative research or training and staff exchange (Bengston, Xu, and Gregersen 1988). Interestingly, formal interaction with agricultural research organizations in cooperative research is almost as frequent as with other forestry research organizations. Informal interaction in the form of information exchange is more frequent, as might be expected. Similar results were obtained in a survey of forestry research organizations in 85 countries (ITFFR 1988). Only 55 percent of the respondents reported having any cooperative arrangements with either domestic or foreign research organizations.

As indicated in table 11.1.1, formal interaction between countries is almost as frequent as intracountry interaction. The interaction with international institutions occurs mainly through FAO, World Bank, and other projects.

The lack of coordination and communication among research organizations in developing countries is discouraging in many cases. Mechanisms need to be developed for expanding and improving the interactions among researchers themselves. This can partly be achieved through effective research networks, but there also are other things which need to be done, such as increasing the funding available for exchanges of scientists, attendance at scientific meetings, and so forth.

To make effective use of the available human and other resources, managers of forestry research organizations should encourage, facilitate, and promote research networking.

Importance of Research Networking

Communication and exchange of information among scientists is essential for the functioning of scientific research. Modern science would not have developed as it has without communication among research scientists. To be effective, scientists must make their work known and seek constructive peer review to establish a mutual consensus regarding scientific knowledge. Exchanging ideas and information while research is in progress, and collaborating with other scientists, can greatly speed up the process of finding solutions to the complex critical problems currently facing science and society.

Many of the forestry research problems facing the world today go far beyond the administrative boundaries of any national forestry research institute and exceed its financial and human resources. Modern science is truly international. Much can be gained by cooperative research among forestry research institutes in several countries, and by sharing expertise and exchanging information among scientists working on common problems in many different areas of the world. No single research institution has a monopoly on research expertise for all fields of forestry. Each can gain by interchanges of information among scientists, and by fostering some form of research collaboration through research networking. Organized collaborative research often can produce far more than the sum of what would be produced by individuals working in isolation.

Most of the major problems in the world relating to the management and use of forest and related resources cut across many disciplines, often involving the physical, biological, and social sciences. Work on such problems requires the exchange of information and cooperation of scientists from many disciplines. Yet much of science is organized by scientific disciplines. Universities are organized by scientific disciplines, with departments of botany, soils, forestry, economics, etc. Forestry research organizations have a similar organization, with research units in forest hydrology, genetics, entomology, silviculture, wood technology, and others. This type of organization, built around scientific disciplines, facilitates work within disciplines to advance the frontiers of science. However, to address major problems in forestry, there is a need to encourage multidisciplinary research. The development of problem-centered research networks can facilitate the interaction of scientists from many disciplines and many organizations.

Functions of Research Networking

Scientists form professional organizations to facilitate the exchange of information and contacts among scientists. They collaborate with other scientists to enhance their research programs. Research organizations coordinate research, develop working relationships, and share equipment and expertise with other organizations. Voluntary organizations promote the exchange of information and experimental materials, such as seeds, for special areas of research. These and other types of social relationships among scientists and research organizations are examples of research networking.

Research networking:

- promotes the sharing of scientific information and expertise;
- provides opportunities for developing staff skills and exchanging technologies;
- provides access to knowledge and skills outside of forestry research organizations;
- reduces research costs and makes more effective use of scarce research talents and skills;
- reduces unnecessary duplication of research effort;
- coordinates research programs for a more effective problem-solving approach; and
- links researchers and educators and trainers to facilitate the transfer of updated information in the classroom and the field.

Although research networking includes the development of common research designs and the pooling of research data, it encompasses far more activities and interests. Moravcsik (1986) points out that sharing facts is a relatively unimportant part of communication among scientists, and thus computerized information bases play a relatively unimportant role. He states that scientists in the Third World need to share not only technical information, but also information about scientific methods, the management of science, and the philosophy of science.

Types of Research Networking

Research networking can be done informally, through infrequent, casual, spontaneous contact with other scientists or organizations, without any formal agreement among those who participate. It also can be done more formally, under the sponsorship of some organization which has networking as one of its functions. Or, it can be conducted through formally approved agreements drawn up between research organizations, that spell out the terms of cooperation.

Networking can be done by individual scientists, who participate in networks on an individual basis. Networking also can be done by organizations, where the networking is carried out among organizations through their designated representatives.

There are many ways in which networking of individual scientists and research organizations can be carried out:

- "INVISIBLE COLLEGES."—Scientists develop many informal contacts with their peers as a means of keeping abreast of the latest work in the field, and to exchange ideas with each other. Linked together by an interest in a common research area, these informal, loose-knit groups of people are said to form an invisible college (Ziman 1976). Scientists visit each other, seek each other out at scientific meetings, communicate by telephone, letter, or other means. These invisible college networks are not organizations, have no officers, no charter, no set meeting time, publish no newsletter. They simply consist of a number of scientists who are bound together by an interest in communicating with one another in order to further their research in some particular field. The motivating force behind such networks is the initiative of individual scientists who want to be on top of things in their chosen field of research.

Many of the latest developments of science, and much of the technology transfers among scientists, take place through such informal contacts among individuals. Because these loose-knit associations of individual scientists lack a sharply defined identity, and are not easily seen, they tend to be overlooked in considering research networking. Nevertheless, they can be one of the most effective forms of research networking, and deserve the strong support and encouragement of research managers and funding organizations.

- PROFESSIONAL SOCIETIES.—Scientists join national and international professional scientific societies, and participate in the activities of these societies, to meet other scientists and exchange information. Membership and participation in a scientific society is a form of research networking.

By attending and presenting papers at meetings and conferences sponsored by the society, scientists are assured of meeting many other scientists who share a similar interest. A scientist who serves on committees or becomes an officer in such a society often develops close working relationships with fellow members. Scientists should be encouraged to participate in professional scientific societies, and be supported with some travel funds to the extent possible so as to make active participation possible.

- **INFORMATION NETWORKS.**—Information networks are set up to facilitate exchanges of information among scientists and practitioners with a common interest, typically through newsletters. These networks often are supported as part of some other ongoing program, or are funded by a special grant. Typically, they publish and distribute newsletters to those interested in being on the mailing list. Many of these are free. Examples of such networks include: *Rural Development Forestry Network* (formerly Social Forestry Network); *Forest, Trees and People Newsletter* (International Rural Development Centre, Swedish University of Agricultural Sciences); and *Agroforestry Today* (newsletter from ICRAF, the International Centre for Research on Agroforestry). Others, such as the International Society of Tropical Foresters and the Nitrogen Fixing Tree Association, may require a modest membership fee. Becoming a member of such a network ensures the scientist of keeping abreast of new developments in a particular field of interest, at little or no cost to the individual scientist. Some networks maintain and publish a list of members and their addresses, to facilitate members getting in touch with one another. Research managers should ensure that the research scientists on their staff are familiar with the various information networks that exist.
- **RESEARCH PROJECT NETWORKS.**—Networks are set up to coordinate research efforts in a particular problem area. Research project networks may: develop, publicize, and provide training in a commonly accepted research design; develop and provide a centralized data processing and analysis service; maintain an aggregate data bank to be shared among members; publish newsletters; hold periodic workshops and meetings to exchange information and develop plans for future activities; and secure and distribute research funds. Not every network engages in all of these activities, and some have other activities. Most research networks are set up at the initiative of some outside funding agency that wishes to initiate and coordinate research activities on a relatively large regional or international scale. Establishing and maintaining such research networks requires considerable funds to support networking activities over a relatively long period of time.

Scientists and research institutions who become members of such networks may gain access to special expertise, training, funding, information, and special services that otherwise would not be available. To gain these advantages they must commit personnel and resources for research studies that are strongly influenced and/or controlled by outside sponsors and members of the network. Membership in research networks usually means making a commitment to support some part of the network research program, often for a period of several years.

Examples of research project networks include: Nitrogen Fixing Tree Association; Oxford Forestry Institute Tropical Pine Provenance Research Network; Central American and Mexican Cooperative in Conifer Resources; Madeleña regional network of Centro Agronomico Tropical de Investigacion y Enseñanza (CATIE); International Development Research Centre of Canada bamboo/rattan network; World Wildlife Fund Network; and Forestry/Fuelwood Research and Development (F/FRED) project.

- **ORGANIZATIONAL NETWORKS.**—Forestry research organizations maintain informal contacts with other research and nonresearch organizations, both inside and outside of forestry, to become better informed about activities that may influence forestry research. They also may develop formal agreements with other institutions to promote the interchange of information, exchange of personnel, sharing of equipment and facilities, research collaboration, and coordination of research programs. They may participate in formal research networks among forestry research institutions to coordinate research projects. Most are members of the International Union of Forestry Research Organizations (IUFRO) which provides research scientists and managers with the opportunity of joining one or more of the many subject working groups of IUFRO and engage in worldwide networking with scientists of similar interests. Some enter into formal twinning arrangements with other research organizations in order to facilitate the exchange of information and personnel. All of these are examples of organizational networking to further the objectives of a forestry research organization.
- **COMMUNICATION NETWORKS.**—A rapidly growing type of network is the use of electronic mail, through the use of INTERNET or other global information network facilities. This permits the rapid and relatively inexpensive exchange of messages, data, and information among personal computers. Research scientists at one location can have rapid and direct contact with researchers in other locations, including other countries around the world. For more information about such networks, see Study Unit 11.2.

Salleh (1992) has reviewed some of the many forestry research networks that currently exist in the Asian-Pacific region (see box 11.1.1).

Box 11.1.1. Examples of forestry research networks in the Asia-Pacific region.

ASEAN programs:

1. Asean-Australia Cooperative Program on Living Coastal Resources, with emphasis on mangrove and coastal reef ecosystems.
2. Asean-Canada Forest Tree Seed Centre, Mauk-Lek, Thailand.
3. Asean-New Zealand Afforestation Project, Tarlac Province, Philippines.
4. Proposed Asean-Australia Forest Tree Improvement Program, Thailand.
5. Asean Timber Technology Centre, Kuala Lumpur, Malaysia.
6. Asean Institute of Forest Management, Kuala Lumpur, Malaysia.

UNESCO-UNDP Programs:

1. Demographic Study on Lowland Dipterocarp Forest in Pasoh, Malaysia.

IDRC Programs:

1. Rattan Forestry Research Network, Malaysia.
2. Regional Mangrove Information Network, Philippines.
3. Bamboo Network, Beijing.
4. Palm Wood Research Network.

Royal Society (UK) Southeast Asia Rainforest Research Program, Sabah, Malaysia.

Forestry/Fuelwood Research and Development Project (F/FRED) MPTS Network, Bangkok, Thailand.

International Tropical Timber Organization (ITTO), Yokohama, Japan.

TROPENBOS (research in the humid tropics), Indonesia

IUFRO-SPDC

Plant Resources of South East Asia (PROSEA), Indonesia, Malaysia, Philippines, Thailand.

FAO Projects (many different networking research topics)

Adapted from: Salleh 1992, pages 31-33.

Active scientists in any field of research often belong simultaneously to several different scientific networks, both informal and formal. They may have informal contacts with peers in their discipline, be active in special interest groups or as officers of one or more professional societies, and be on the mailing list for one or more networks publishing newsletters. They may take part in some form of research project network. They also may have contacts with other scientists through networks linking their own research organization and other organizations. All of these networking activities can have an important influence on a scientist's work and on the professional and peer recognition given to that work.

Networking among forestry research organizations can influence program direction and enhance research accomplishments of the member organizations. But unless organizational networking is actively supported by research management and the scientists involved, it can become just a paper network, with little activity or influence on actual research activities. There is little reason to establish a research network among forestry research organizations unless it will have an influence on the kind of research being done and on research accomplishments.

Networking with Nonforestry Research Organizations

A substantial amount of research directly related to forestry is conducted by agricultural and other nonforestry research organizations (see Bengston et al. 1988, for examples from the Asia-Pacific region). Research in watershed management, hydrology, and soils is conducted by university departments of agronomy, soils, and engineering, and by government agencies representing agriculture, water resource development, and other nonforestry programs. Much basic biological research related to forestry is conducted by university departments of botany, ecology, genetics, zoology, and other biological sciences. Much of the research related to agroforestry is conducted by university departments of agronomy, animal husbandry, soil science, and others, and by special agricultural and other institutes. Much of the social science research related to forestry development is conducted by anthropologists, geographers, sociologists, and other social scientists outside of forestry research organizations. Research directly related to forest products is conducted by forest products industries, other industries, and by engineering and other university departments, among others.

Nonforestry research organizations throughout the world possess considerable knowledge and expertise and conduct research that is directly relevant to forestry research. Managers of forestry research seek to develop close working relationships with those nonforestry research organizations that are most relevant to their research programs. By encouraging and supporting the establishment of

research networks with such nonforestry research organizations, forestry research managers can more effectively utilize available scientific expertise and coordinate research programs to make more efficient use of their research funds.

Linkages Between Researchers and Educators/Trainers

Educators and trainers utilize basic and applied knowledge about science and technology in their education and training activities. Many educators and trainers are themselves researchers, and keep abreast of current developments in their field. However, some simply do not have the time or resources to conduct research on their own. Because educators and trainers are the ones who train the scientists and resource managers for the future, it is important to encourage close contact between research scientists, educators, and trainers. By sharing information and ideas, all can have the benefit of the most recent knowledge of science and technology, and ensure that this is passed along to young professionals in the field.

Networks that facilitate the interaction of scientists, educators, trainers, and field professionals should be strongly encouraged and supported by research managers in forestry. It is the educators and trainers who will produce the research scientists of tomorrow. It is in the self-interest of research managers to ensure that the information on which the training of future scientists will be based is the best available. Further, such networks provide access to a considerable pool of scientific expertise and managerial knowledge that can benefit research programs of the forestry research organization.

Facilitating and Encouraging Networking

Burley (1986, 1989) suggests several principles for success in research networking related to research projects:

- The problem should be:
 - clearly defined with a specified research agenda; and
 - common to several countries.

- Participants and collaborators should:
 - have a strong self-interest in participating;
 - contribute some resources to networking activities;
 - be sufficiently trained and have expertise to make significant contributions to networking efforts;
 - be willing to share results of activities with other participants through a variety of activities; and
 - develop mechanisms for the extension of research results to intended users.

- Networks should:
 - be guided by strong leaders who have the confidence of the participants;
 - acquire outside funding to facilitate the birth and early functioning of the network;
 - not be considered permanent institutions, but be flexible in adapting to the skills and requirements of participants; and
 - have local institutional continuity and commitment.

Burley identified a number of problems that have been experienced in existing networks. These include:

- Disagreements and/or competition among participants as to:
 - topic or species;
 - appropriate experimental design;
 - comparable assessments and appropriate analysis; and
 - leadership.
- Inadequate:
 - activity and resources;
 - amounts of test materials;
 - communications and feedback; and
 - national government commitment.
- Difficulties experienced in:
 - identifying participants;
 - exchanging plant material because of international controls and lack of facilities;
 - identifying and preparing adequate documentation for donors; and
 - obtaining finance for coordination and supporting activities.

If research networking is to succeed, it must have the support of those who manage and fund research programs. Every effort should be made to ensure that those who fund research are aware of the importance of networking in scientific research, so that adequate funding to support this activity will be provided.

Disadvantages of Research Networking

Although there are many advantages to research networking, there are costs involved in taking part in them. Those who participate in research networks, particularly collaborative research networks, are expected to contribute time and

other resources to the network. For smaller research organizations, with limited personnel and resources, participation in too many regional and other research networks may become a management problem (Eyzaguirre 1992). Excessive participation could divert a sizeable amount of scarce resources from national research needs to meeting the goals of the regional networks. Research managers need to weigh the potential costs and gains of participation, and carefully control commitment of resources to research networking.

Activities - Study Unit 11.1

Activity 1

Considering your own research organization, what type of research networking (formal or informal) is more commonly used, and which is more important? *Also describe how your organization goes about networking with other organizations and/or scientists, and what benefits it derives from research networking.*

Activity 2

List below what you believe to be the primary advantages to your research organization that result from its various networking activities.

Comment 1

Most organizations utilize a number of means to network with other scientists and their organizations. Perhaps you mentioned invisible colleges, the informal contacts that scientists use to stay abreast of the latest work in the field, and to exchange ideas with each other. Professional societies, information networks, research project networks, and organizational networks are all ways scientists and their research organizations formally network. Each type of networking provides different benefits to the participating scientists or their organizations.

Comment 2

Given the many advantages from successful networking, we hope you could list many new ways of networking that could improve the performance of individual scientists, managers, and administrators, and the organization as a whole. If you had trouble thinking of specific advantages, please review the text in this unit.

Activity 3

What difficulties has your organization experienced when attempting to network? *Once you've thought about this for a while, write down your response. Then review Burley's (1986, 1989) listing of principles for networking success, and commonly occurring problems. Perhaps you now have more ideas to add to your original response. If so, add them in the space below.*

Activity 4

With your previous response in mind (#3), do any opportunities exist to improve your organization's research networking activities? As research manager, what can you do to overcome existing problems and make the networking process more efficient? These questions are important, so think about your response carefully.

Comment 3

According to Burley (1986, 1989) existing networks have experienced a number of problems, including:

- a. Disagreements and/or competition among participants as to:
 - topic or species;
 - appropriate experimental design;
 - comparable assessments and appropriate analysis; and
 - leadership.

- b. Inadequate:
 - activity and resources;
 - amount of test materials;
 - communications and feedback; and
 - national government commitment.

- c. Difficulties experienced in:
 - identifying participants;
 - exchanging plant material because of international controls and lack of facilities;
 - identifying and preparing adequate documentation for donors; and
 - obtaining finance for coordination and supporting activities.

More than likely your own organization has experienced at least some of these problems (or perhaps others not mentioned).

Comment 4

This is the heart of this study unit: *What can you do as research manager to improve your organization's networking efficiency and effectiveness?* We hope you carefully considered the problems your organization or its scientists have experienced when networking, and then proceeded to conceive of reasonable steps to take to improve the situation. If you did so, **Congratulations!**, as your organization is well on its way towards improving its overall effectiveness through the benefits of networking.

Summary - Study Unit 11.1

Research networking refers to the formal and informal ways in which scientists and research organizations contact one another and develop working relationships to exchange information, cooperate in research studies, and coordinate research programs and projects. Many of the complex natural resources problems facing the world today cut across many disciplines, and go far beyond the administrative boundaries of individual research organizations. Efforts to solve these problems are likely to require far more financial and human resources than are likely to be available in any one country. Modern science is truly international and interdependent. Science is a social activity, thus frequent contacts among scientists is essential for science to progress. Research organizations have much to gain by exchanging information among scientists and fostering research collaboration and the sharing of resources through networking.

This unit is intended to help you gain a better understanding of the role and importance of research networking, and of the many ways in which this can take place. We hope that by completing the activities, you more clearly understand how your own organization goes about networking with other scientists and organizations. By completing the unit, you have identified some problems commonly encountered by your organization in its networking efforts, and suggested realistic measures to improve your organization's networking success.

For further information about research networking, we encourage you to read the article by J. Burley (1989), "Options for forestry research networking," which is reprinted in the readings section at the end of the module. Other references that may be of interest are listed at the end of this module.

Study Unit 11.2

Utilizing Computer Networks

International computer networks, such as Internet, are expanding and installing new nodes around the world. In the near future, most research and extension institutes in developing countries will have access to such networks, as many do today. These networks will soon become popular scientific communication media for accessing central data bases, exchanging information, sharing research data, transmitting publications, training, and a variety of other purposes. As research institutions develop their computer facilities, including local area networks and databases, one important issue that comes to the forefront is the potential for research institutions to share research data.

This study unit presents an overview of computer networks, databases and management information systems. It provides essential information that may help you, as a research manager, improve your computer information systems.

You will learn about the importance and availability of forestry databases and decision support systems. You also will learn about management information systems devoted to the management of research. This includes the use of computers for sponsored project administration and monitoring issues. Finally, an overview of the services provided by international computer networks and its use in the communication of research results is given.

Objectives

When you have completed this unit you should be able to:

- identify some of the important forestry scientific and bibliographic databases and decision support systems available in the world;
- describe the benefits of establishing a management information system in your organization;
- describe the benefits of linking your organization to international computer networks such as Internet; and
- discuss the benefits of developing scientific and bibliographic databases within your organization.

Computer Networks, Databases, and Management Information Systems

The revolutionary advances of computer information technology are well known, but the real change is still ahead. This change, whose impact will be clearly appraised by the year 2000, is related to efforts which do not solely depend on computer experts. In fact, the information revolution involves a high component of work by experts in different fields learning about new information technologies and building databases and information systems. It also involves strong efforts in diffusion and training.

Private and public organizations, including research and extension organizations, will develop *applications*, i.e. decision management support routines, with different target groups, going from the farmer to the researcher and the research manager.

Information systems will allow the farmer, the extensionist, the researcher and the planner to make guided decisions, based on information gathered from databases, expert systems and models. Research results will provide the basic information to support recommendations.

The planning of research will take into account the new philosophy of transference through information systems, considering experimental and survey data as inputs to models and expert systems. Networks of experiments, instead of nonrelated experiments, will be favored. Gathering specified site information from different studies will make it possible to establish links among different experiments.

The current growth of computer networks, satellite-based and cellular communication facilities, fiber-optic cables and digital telephone systems should provide the basis for a global communication web. This web is the media that will be used to offer electronic services such as teleconferencing, mail, telecommuting, electronic education and consulting services.

As the trend of prices of computer equipment goes down and routine services, such as library services, are more conveniently provided by computer networks, more institutions will access computer network services. These services will provide less expensive communication channels and an outstanding opportunity to get first class information on line. As more and more institutions join the networks, individual connection costs will diminish.

Forestry Databases

Sophisticated scientific information systems are being developed and already are in use in most of the technologically advanced countries. Less developed countries will join this effort during the next decade, building their own databases and information systems. International and regional research centers are making efforts to build and offer user-friendly information services.

A number of forestry databases contain information about tree growth, distribution, climatic and site requirements. Some of those databases contain field trial and yield plot numerical data or summaries of these data. Other databases contain environmental data.

Bibliographic databases are also common, some in the form of reference lists or aids, and some in the form of tabular or text information.

Some of these databases are combined with decision support systems, modelling tree growth, considering site indexes and offering bio-economic analyses.

Table 11.2.1 provides a partial list of computerized forestry databases, and specifies the type and availability status of each (as of mid-1994).

Table 11.2.1. Selected list of computerized forestry databases and decision support systems.

Name	Owner	Type	Availability
BRAHMS	OFI	10	limited availability
CABIKEY	CABI	1	development version, available on request
COMPENDIUM	CABI	1,3,10	under development
CABI Key	CABI	10	commercially accessible
DATACHAIN	ICRAF	10	available (US\$ 70)
FORNIS	CIFOR	1	under development
GROMAP	CSIRO	7	available (US\$ 100)
INSPIRE	OFI	3	available (US\$ 60)
MIRA	CATIE	1,2,4,5,8,9,10	limited availability
MPTDAT	CSIRO/F/FRED	4	available on request
MPTS	ICRAF	3	available (US\$ 250)
MPTSys	F/FRED	1,2,3,4,6,8,10	available on request
	WINROCK		
MULBUD	ANU	9	available (US\$ 200)
INFORAT	CATIE	1	limited availability
PLANTGRO	CSIRO	6	commercially accessible
PROSPECT	OFI	3	limited availability
SESAME	CIRAD	1	commercially accessible
SISTEM +	OFI	2,10	limited availability
TREECD	CABI	1	commercially accessible
TREEDAT	QFS	4	limited availability
TRESOURCE	IPGRI	11	under development
TROFIS	CSIRO	7	under development
TROPIS	CIFOR	12	under development

Type	Description
1	bibliographic database
2	field trial and yield plot
3	summary database - species descriptive information
4	summary database - field trial treatment mean
5	site index model
6	tree performance model
7	spatial model
8	integrated decision support system
9	bioeconomic analysis
10	utilities
11	germplasm resources information system
12	linkage software to access various databases

ACRONYMS

- ANU Australian National University
 CABI CAB International (formerly Commonwealth Agric. Bureau, UK)
 CATIE Tropical Agriculture Research and Training Center, Costa Rica.
 CIFOR Center for International Forestry Research, Indonesia.
 CIRAD Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement, France.
 CSIRO Commonwealth Scientific and Industrial Research Organization, Australia
 F/FRED Forestry and Fuelwood Research and Development Project, USA.
 ICRAF International Center for Research in Agroforestry, Kenya.

IPGRI International Plant Genetic Resources Institute, Italy.
OFI Oxford Forestry Institute, UK

International Computer Networks

The rapid development of electronic information technology is being stimulated by improvements in computer programs to access worldwide information networks. Some important access programs for research scientists all around the world are GOPHER, WAIS (Wide Area Information Server), MOSAIC, and WWW (World-Wide-Web). For example, WAIS is a set of programs that allow a user to search and access many distant locations on many different computer systems. This information can be transferred by means of files from the host computer system to your own computer system, so they become available to you. These programs allow you to gain access to global information networks such as INTERNET or BITNET (which may have different names in different countries, e.g. NETNORTH, EARN, ASIANET).

INTERNET is an electronic communication system consisting of a large number (more than 34,000 in 1993) of interconnected smaller public and private computer networks around the world (Stecklow 1993). Each of these smaller networks is maintained independently by its own organization, such as a university or government agency. Each has its own data bases and programs developed and maintained by the organization that are made accessible to outside users through INTERNET connections. These individual networks pay a fee to be connected to INTERNET, but then users within the individual networks generally can use the larger network at no extra charge, and with no limit on the amount of use. The overall network (INTERNET) was begun by the U.S. government in 1973, which continues to contribute to its support (Stecklow 1993). However, INTERNET has no owner. It is run by volunteers with additional funding derived from the connection fees charged to individual computer networks.

Many research organizations or university departments have established and maintain specialized data bases that pertain to their particular fields of interest, together with programs to access and utilize these databases. For example, there are network sites that provide information and applications software related to ecology, biodiversity, fire management, fisheries, water resources, environmental law, hydrology, environmental engineering, environmental policy and economics, social sciences related to forestry, and tropical forestry, to name only a few. With access to the appropriate network, you can easily search, find, and retrieve publicly available information stored on many of the confederated computers within the network.

Among other things, INTERNET provides access to specialized bibliographies (including tropical forestry), and to computerized indexes (computerized card catalogs) for many major university and other libraries around the world. Most of these contain simple instructions for accessing the stored information. Often, one can browse through a hierarchy of documents, or search for documents that contain certain words or phrases.

Also, pictures, images, sounds, maps, and almost any form of publication can be stored or retrieved across the network with some of these programs.

Electronic networks, such as INTERNET, provide a fast and relatively cheap means of international communication and transfer of information through electronic mail (e-mail). Messages can be sent easily from one personal computer user to another, instantaneously at no charge, once you are connected to the system through one of the local computer networks.

If you have a personal computer, modem, communications software and a telephone, you have the basic equipment you need to get connected to the Internet network. However, in some developing countries where no nodes of this system are available, this implies international phone calls and high costs for the user.

In most developed countries, and in some developing ones, however, costs of joining the network are affordable. For example, in Costa Rica, a research institute should pay 500 dollars a month for a 32 Kbps channel with access to a 64 Kbps link to the PAS-1 satellite.

This implies having access to all the services including electronic mail, file transference, connection to remote servers, teleconferencing, etc. Some specific services of the Internet network deserve special attention.

The Gopher servers, some 500 around the world, offer files containing information about a variety of topics. They also offer access to databases, announcement of conferences, access to famous libraries, etc. Your institute might easily build a Gopher service offering information about your research activities, workshops and other events, and providing access to databases, etc.

The Talk and Chat services of Internet enable you to participate or organize a conference with two or more people around the world.

The WAIS (Wide Area Information System of Internet) allows you to search information about a specific subject in different servers around the world. Using several key words to search for information, a list of documents and servers containing the information is provided to the user.

Management Information Systems

Research managers and administrators know that having up-to-date information about their operations is important to do an effective job. Managers need to monitor the planned activities of the institute. In particular they need to know what experiments are under way, which scientists are involved, what facilities are used and what are the budgetary constraints, i.e. what funds are available.

Even in a small organization, keeping track of present and past activities and producing reports for different purposes is time consuming.

Good computer software should be useful in the planning stage and in the execution of the project, to monitor and evaluate different activities and to produce reports for different audiences.

Reports are produced by the computer and are tailored to the needs of different users. They might be consulted on line, on the screen of a microcomputer or terminal, or might be printed on paper. Specific reports to donor institutions might be produced following specific norms and requirements.

A variety of software are available for these purposes. For example, ISNAR (International Service for National Agricultural Research, the Netherlands, distributes INFORM (Information for Agricultural Research Managers), an information management system, developed by Barry Nestel. CATIE (Tropical Agriculture Research and Training Center, Costa Rica) distributes SAP (Sponsored Projects Administration system), which runs under FOX or under ORACLE.

Computer Technology Changes Rapidly

Computer technology, and the hardware and software that is available commercially, changes rapidly. Each year brings major advances in computers and their accessories, in software programs, in data and information availability, and in means of access to international information networks. Undoubtedly, what has been written here will be out of date within a short time after publication. The discussion of this important topic here has attempted to point out the potential usefulness of this emerging technology, and its implications to the planning and management of forestry research. As a manager, you should be aware of the potential for computers to help you and your scientists and administrative staff, carry out their work. It is important that you, or one or more of your staff, keep informed of new developments in this rapidly changing field, and explore its potential for helping you achieve the goals of your research program.

Activities - Study Unit 11.2

Activity 1

What are some of the most important types of forestry databases and computer systems available in the world? List them below:

- 1.
- 2.
- 3.
- 4.
- 5.

Activity 2

What are the most important databases and computer systems that your institute should start to develop or continue to maintain? List them below and analyze their relative importance and degrees of effort needed:

- 1.
- 2.
- 3.
- 4.
- 5.

Comment 1

Some of the possible answers you may have given are:

1. Bibliographic databases
2. Germplasm databases
3. Species descriptive summary databases
4. Field trial databases
5. Decision support systems

Comment 2

Some of the possible answers you may have listed include:

1. Bibliographic databases
2. Scientific databases containing field data
3. Species descriptive databases devoted to specific species of your interest
4. Economic analysis systems
5. Decision support systems based on tree growth models and site index information.

Since we are not familiar with your own particular situation, we cannot estimate what relative importance you may have assigned to your answers, or what degree of effort might be required to develop each. The last two cases listed above are more difficult to develop and usually need several years of continuous effort.

Activity 3

List below some of the most important services provided by the Internet network, and analyze their relative importance to your institute:

- 1.
- 2.
- 3.
- 4.
- 5.

Activity 4

What information would you expect to obtain from a management information system? List below some of the types of information that would be useful to your organization:

- 1.
- 2.
- 3.
- 4.
- 5.

Comment 3

We hope that your list include some of the following:

1. Electronic mail
2. Teleconferencing
3. Access to remote servers, databases and gophers
4. Search of information sources through key words
5. Access to remote libraries

Of course, we cannot know how you might rank the relative importance of each of these or other services you may have listed to your organization. We would expect that you would have ranked at least some of them as being relatively important.

Comment 4

Although we cannot know your particular information needs, we suspect that you might have listed some of the following types of information:

1. Expected products and milestones of a specific project
2. Human resources available
3. Funds expended and balances available for a specific project or activity
4. Monitoring information about the execution of activities
5. Due dates for reports to donor institutions

Summary - Study Unit 11.2

Computer networks are expanding rapidly. At present they are available in developed countries and in many developing ones, providing an affordable media for communication and dissemination of research results and activities.

In particular, the Internet network offers a number of important services to research organizations, such as electronic mail, discussion forums, teleconferencing, access to libraries and information services.

Different forestry databases are available for different purposes including: bibliographic, field trial and yield plot, field trial-treatment mean and germplasm databases, among others. Some decision support systems based on databases and tree growth models have been developed. Recently a proposal to integrate information from different databases has been presented (TROPIS) and is under analysis by CIFOR.

Management information systems help managers to plan and monitor research activities and sponsored projects. These systems produce reports tailored to different audiences. Several alternatives are available in the world, INFORM from ISNAR is a well known and thoroughly tested one.

Although computer networking is changing rapidly, we hope that this unit has at least made you aware of the potential usefulness of computer networks in forestry research. We strongly urge you to keep informed of new developments in this rapidly emerging field.

Final Skill and Knowledge Assessment

Module 11 - Developing Research Linkages: Learning from Others

On the following page are listed a number of skill and knowledge statements derived from the objectives of the study units in module 11. These are identical to those listed in the initial skill and knowledge assessment at the beginning of the module.

Now that you have completed module 11, please read each statement carefully and indicate with a checkmark the level that best describes your current skill or knowledge, from 1 to 5, using the following descriptions:

- 1 I cannot perform this skill, or I have not been exposed to the information.
- 2 I cannot perform this skill, but have observed the skill or have been exposed to the information.
- 3 I can perform the skill or express the knowledge with assistance from others.
- 4 I can perform the skill or express the knowledge without assistance from others.
- 5 I can perform the skill or express the knowledge well enough to instruct others.

Skill or Knowledge Statement	Your Level of Skill or Knowledge				
	1	2	3	4	5
a) Describe the various types of research networking used in your organization.					
b) Suggest ways in which your organization could strengthen and expand its research networking.					
c) Describe the benefits of establishing a management information system in your organization.					
d) Describe the benefits of linking your organization to international computer networks such as Internet.					

Literature Cited - Module 11

- Bengston, D. N., et al. 1988. *Forestry research capacity in the Asia-Pacific region*. East-West Environment and Policy Institute Occasional Paper no. 6. Honolulu, HI: East-West Center. 96p.
- Bengston, D. N., Z. Xu, and H. M. Gregersen. 1988. *Key factors in strengthening forestry research capacity in developing countries*. Working Paper 5. St. Paul, MN: University of Minnesota, Department of Forest Resources, Center for Natural Resource Policy and Management Studies. 28 p.
- Burley, J. 1986. Forestry research networks—objectives, problems and management. In *Increasing productivity of multipurpose lands*, comp., L. W. Carlson and K. R. Shea, 319-27. IUFRO Research Planning Workshop for Africa, Sahelian and North Sudanian Zones, Nairobi, Kenya, 9-15 January 1986. Ottawa: Canadian Forestry Service. 333p.
- Burley, J. 1989. Options for forestry research networking. In *The management of large-scale forestry research programs and projects*, ed. A. L. Lundgren. General Technical Report NE-130. Broomall, PA: USDA Forest Service, Northeastern Forest Experiment Station. 236 pp.
- Eyzaguirre, P. B. 1992. *The role of agricultural research networks in small countries*. Background paper prepared for the international workshop on management strategies and policies for agricultural research in small countries. Réduit, Mauritius, 20 April - 2 May 1992. The Hague, Netherlands: International Service for National Agricultural Research. 7p.
- International Task Force on Forestry Research. 1988. *A global research strategy for tropical forestry*. New York: United Nations Development Programme. 88pp.
- Moravcsik, M. J. 1986. Two perceptions of science development. *Research Policy* 15(1):1-11.
- Salleh, Mohd. N. 1992. *Forestry research in the Asia-Pacific*. FORSPA Publication 1. Bangkok, Thailand: Forestry Research Support Programme for Asia and the Pacific, Food and Agriculture Organization of the United Nations. 54p.
- Stecklow, S. 1993. Internet becomes road more traveled as e-mail users discover no usage fees. *The Wall Street Journal* 74(226):B1. September 2.

Ziman, J. 1976. *The force of knowledge; the scientific dimensions of society*.
London: Cambridge University Press. 374p.

Readings for Module 11

The following readings have been selected to provide you with additional information related to the material covered in Module 11. We hope you will find them of interest.

Burley, J. 1989. Options for forestry research networking. In *The management of large-scale forestry research programs and projects*, ed. A. L. Lundgren. General Technical Report NE-130. Broomall, PA: USDA Forest Service, Northeastern Forest Experiment Station. 236 pp.