The initial version of this self-learning course was developed by Dr. Allen L. Lundgren, Mr. Scott J. Josiah, Dr. Hans M. Gregersen, and Dr. David N. Bengston at the University of Minnesota, College of Natural Resources, Department of Forest Resources, in collaboration with the International Union of Forestry Research Organizations (IUFRO), Special Programme for Developing Countries (SPDC), and with the advice and assistance of experienced forestry research managers around the world (see the course guide for more detail on the course development).

The course is available from:

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Complete List of Modules

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

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Forestry Research Planning and Management: An Introduction

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Initial Steps in Strategic Planning

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# Module 10 - Monitoring and Evaluating Research Programs

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Monitoring and Evaluating Research Programs

One of your major responsibilities as a research manager is to ensure that the research proceeds in a timely manner and within budget, addresses priority research topics, meets standards of scientific excellence, and is properly reported in appropriate publications. In addition, you also must satisfy the administrative reporting demands of your superiors, and those of external funding and regulatory entities. To do this properly, you need to keep informed about the current status of research activities and accomplishments, and how they are related to the goals and objectives of your organization. An appropriate system for monitoring and evaluating your research programs can provide the information you need to evaluate both research quality and impacts on science and society.

Horton et al. (1993) defined monitoring and evaluation as follows:

- **Monitoring** is observing or checking on research activities and on their context, results, and impact. Its goals are to ensure that implementation is proceeding according to plan; to provide a record of input use, activities, and results; and to warn of deviations from initial goals and expected outcomes.

- **Evaluation** is judging, appraising, or determining the worth, value, or quality of proposed, on-going, or completed research, generally in terms of its relevance, effectiveness, efficiency, and impact.

Monitoring provides information needed for evaluating the quality or value of research. Monitoring systems should be designed to provide the information required by the types of evaluation being undertaken.

Research evaluations can be made of either the research process itself, or the impacts of the research (figure 10.1). Evaluations of the research process provide information that will help the manager improve the way in which the research is being carried out, and the quality and quantity of the outputs produced. Such
evaluations provide information that can be used by managers, administrators, and policy makers to judge and improve the effectiveness and efficiency of an organization's performance.

![Diagram of Process Evaluations and Impact Evaluations]

**Figure 10.1.** Evaluations of forestry research can be made of the research process itself, or of the impacts (costs and benefits) of the inputs used and the outputs produced.

Evaluations also can be made of the impacts of research on science and society of specific research projects, programs, or activities. Here, the objective is to increase understanding of how research affects the real world, to evaluate the costs and benefits (both market and nonmarket) of research and its impacts on science (contributions to knowledge), society (economic, social, cultural), or the natural world (environmental, resource).

Both process and impact evaluations are needed to provide managers with the information they need to plan and manage forestry research activities.

Since monitoring and evaluating research programs is such an important topic to research managers, we have devoted an entire module to help you to better understand the process. In the first study unit you’ll learn of some of the important principles in designing monitoring and evaluation systems for research management. Next, we’ll show you how monitoring can assist you in assessing research progress towards your organization’s objectives. Then you’ll explore ways to evaluate research that will help your organization produce research of consistently high quality. Finally, you’ll learn how to evaluate the impacts of your research programs, information needed by donors and funding agencies to make decisions about funding forestry research.
Below are listed a number of skill and knowledge statements derived from the objectives of the study units in this module. These are identical to those listed 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.

If you would like to find out how much you improve your skills and knowledge by studying this module, we suggest that you complete this exercise before beginning the module. This will establish your current level of skill 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.

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<td>a) Specify the purposes of your organization's monitoring and evaluation system.</td>
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<td>b) Identify the potential users of the information provided by your monitoring and evaluation system.</td>
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<tr>
<td>c) State and use six basic questions that help to focus and make more meaningful the results of monitoring and evaluation activities.</td>
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<td>d) Describe the primary uses of monitoring in research management.</td>
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<td>e) List three types or levels of monitoring, and describe their functions.</td>
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<td>f) List a number of methods or mechanisms which can be used to monitor forestry research activities.</td>
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<tr>
<td>g) Describe three criteria for evaluating the quality of research produced by your organization.</td>
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<tr>
<td>h) Describe several review mechanisms that ensure the production of research of acceptable quality.</td>
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<td>i) Describe the difference between ex ante and ex post impact evaluations.</td>
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<td>j) Identify the various types of impact evaluations used to determine research impacts.</td>
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Objectives
When you have completed this unit, you should be better able to:
- specify the purposes to be served by your organization's monitoring and evaluation system;
- identify the potential users of the information provided by your monitoring and evaluation system;
- state and use six basic questions that help to focus and make more meaningful the results of monitoring and evaluation activities; and
- evaluate your own organization's monitoring and evaluation system for its utility and relevance to user needs.

Data collected from monitoring and evaluating research can represent a significant investment of your organization's resources. But without a clear idea of how and by whom this data will be used, the time, effort, and expense expended in collecting the information may be wasted. Thus, research managers must carefully design their monitoring and evaluation activities to ensure that they will be useful as a management tool. Unfortunately, instead of looking at monitoring and evaluation as valuable management tools that gage the organization's progress toward its objectives, many research organizations view these activities as unnecessary burdens, implemented largely to satisfy funding or regulatory requirements.

In this introductory study unit of this module, you'll learn how you or other stakeholder groups can use the results of monitoring and evaluation activities in guiding the management of your forestry research organization. You'll learn how monitoring and evaluation (M&E) activities must be designed from their very inception to be relevant and useful to those who will ultimately use the information they produce. We'll also provide some common examples of mistakes in monitoring that render the results unusable to groups needing the information. And we'll present six basic questions you can ask that will help make your M&E activities more relevant and useful to managers and other users of the information.

Importance of Monitoring and Evaluation in Research Management
Funding for forestry research has never been abundant. A major challenge to forestry research administrators, managers, and researchers is to ensure that the limited funds they have for conducting research are used to produce high-quality research that is both scientifically sound and useful to prospective users. Sound evaluations can help the
research manager better achieve desired goals and objectives, and can promote accountability for the resources used in the research. Improved evaluations of forestry research options can help make research programs more effective and efficient. Such evaluations need information that can be produced only by effective monitoring of research activities and accomplishments.

Evaluation can be defined as the act of determining the value or worth of something. To evaluate research means to determine its value. But such a definition says nothing about what aspect of research is to be valued, what value system is to be used, or whose value system is to be used in the process of evaluation. As we shall see, determining what is to be valued and how it is to be valued depends to a large extent on the purpose of the evaluation. Each organization tends to develop its own special system of monitoring and evaluating research to provide the information needed to effectively manage its research program so as to achieve the objectives and goals of the organization.

Research evaluation is not new. Administrators, managers, and researchers always have had to evaluate proposed research programs, projects, activities, and methods. To manage research effectively, they have had to gather information about research activities. However, in recent years considerable attention has been focused on developing better ways to evaluate research and improve the research evaluation process to make research planning and management more effective. Considerable work has been done on evaluating research in agriculture, and there is a large literature on the subject. A recent working paper by ISNAR (International Service for National Agricultural Research), The Hague, Netherlands, provides an overview of the role of monitoring and evaluation in the management of agricultural research (McLean 1988).

More recently, new research programs in several countries have produced a substantial and growing literature on the evaluation of forestry research (cf. Bengston, Gregersen, and Lundgren 1987). Studies of forestry research in developed and developing countries around the world have been conducted in cooperation with IUFRO (Bengston and Gregersen 1988). At the IUFRO Research Planning Workshop for Africa, Sahelian and North Sudanian Zones, held in Nairobi in January 1986, Armstrong (1986) presented some general guidelines for effective evaluation of forestry research programs.

**Internal vs. External Reviews**

Research evaluations can be conducted by both internal and external reviews. Internal reviews are those that are initiated and conducted within the research organization itself as a means of
evaluating its research strategies, plans, and achievements. The reviews may be of the organization as a whole, of research units within the organization, or of individual researchers within the organization. External reviews may be initiated and conducted by agencies outside of the research organization, or they may be initiated and managed by the organization itself. For example, funding agencies or organizations may impose external reviews as a reality check on expenditures of the funds allocated to the research organization. Or, the research organization itself may seek outside help in evaluating its own research program, to obtain a more independent check on its program and a broader perspective on issues and problems to be addressed. Such outside reviews also can identify potential areas of duplication or complementarity with research being conducted by other organizations.

Fuglie and Ruttan (1988) suggest that strong internal review mechanisms are necessary (and if well done, perhaps sufficient) for providing the information needed for research planning and management. However, external reviews provide an outsider perspective on the research program, and lend more credibility to the research program in the eyes of those funding the programs.

Fuglie and Ruttan (1988) suggest that external program reviews are best suited for assessing research program priorities and strategies, rather than assessing the scientific quality of the research work being conducted. External program reviews should:

- Evaluate goals and strategies, focusing on:
  - appropriateness of the research objectives set by the organization;
  - reasonableness of the schedule of anticipated research accomplishments; and
  - adequacy of the staff, facilities, funding, and other resources required to conduct the scheduled work.

- Evaluate research management, focusing on:
  - institutional environments within which research takes place;
  - management strategies used in implementing research programs;
  - comparisons of planned and actual accomplishments; and
  - general effectiveness in achieving objectives, goals, and mission.

- Review outreach programs (technology transfer and extension), focusing on:
  - the scope and mix of outreach programs; and
  - obtaining outside input into the outreach review process.
A Framework for Evaluation
Gregersen and Lundgren (1986) have suggested a simple, useful framework for conducting an evaluation of forestry research. It is based on the following steps (figure 10.1.1):

**Evaluation Steps**

1. Specify the objectives of the evaluation.
2. Identify the measures and criteria to be used in the evaluation.
3. Choose model and conduct evaluation.
4. Interpret and present results.

**Factors**

- Intended use for the evaluation
- Evaluation questions to be answered
- Available models, date, time funds: credibility and relevance factors
- Audience

*Figure 10.1.1. A framework for evaluating research: critical steps in the evaluation process, and factors affecting each step. (Source: Gregersen and Lundgren 1986.)*

**Step 1. Specify the objectives of the evaluation.** Before an evaluation can be conducted, there must be some agreement on what information the evaluation is to produce, the objectives of the evaluation. The objectives of the evaluation depend upon the uses to which the results are to be put, which in turn depend upon who will use the results. Thus, in order to specify the objectives of the evaluation, it is first necessary to determine who the clients for the evaluation are, and what questions they want answered by the evaluation. Both the uses and users of forestry research evaluations are discussed later in this study unit.

**Step 2. Identify the measures and criteria to be used in the evaluation.** Once the objectives of the evaluation are specified, the next step is to identify the measures and criteria that will be used in the evaluation. Some of these criteria may be economic, some may be noneconomic. The exact nature of these criteria depends
upon the questions that the evaluation’s clients want answered. Some of the criteria that may be used in evaluating forestry research are discussed in study units 10.2, 10.3, and 10.4.

Step 3. Choose the evaluation model or approach, and conduct the evaluation. A large number of evaluation techniques have been developed and used for evaluating research in forestry (for example, see Jakes and Leatherberry 1986, Lundgren 1986, Grayson 1987, McDaniels 1988). In selecting an evaluation model, both technical and user considerations should be kept in mind (figure 10.1.2). Technical considerations focus on two factors: (1) the constraints imposed by the client or evaluation situation, principally dollars, time, and data availability; and (2) characteristics of the analytical technique, including reliability, relevance, relative cost, and data needs. User considerations focus on two factors: (1) the objectives of the evaluation, which are determined by the use and purpose of the evaluation by the client; and (2) the criteria to be used in the evaluation, which include both relevance and credibility of the evaluation method selected.

Step 4. Interpret and present the results of the evaluation. The fourth step in evaluation is to interpret the results in terms that are meaningful to the client and that can be used to answer the questions posed, and present that information to the client in an understandable, useful, and timely manner.

Useful Principles in Monitoring and Evaluating Forestry Research

There are several useful principles that can help develop more effective strategies for monitoring and evaluating forestry research (Lundgren 1989).

Evaluations should:
- be user-driven;
- recognize the fundamental difference between basic and applied research;
- consider both the effectiveness (concerned with doing the right things) and efficiency (concerned with doing things right) of research;
- use research evaluation methods and criteria appropriate to the user and uses of the evaluation results;
- recognize the basic uncertainties and risks inherent in scientific research; and
- be used as an aid to decision making, not as a decision maker.
Figure 10.1.2. Factors affecting the choice of an evaluation approach. 

Particular emphasis should be given to defining the purpose for which monitoring and evaluation is being done, and to identifying and involving the people who ultimately will use the information produced by the monitoring and evaluation system once it is functioning.
Purposes of Research Evaluation

In general, evaluations of forestry research can help forestry research managers:

• strengthen the planning and management of forestry research by providing information about the research process itself, and the production, dissemination, and utilization of research results;

• ensure that research programs are relevant to national development goals by providing information about the costs and benefits, both market and nonmarket, and social and environmental impacts of forestry research;

• strengthen political support for forestry research by providing information about the potential contributions of forestry research programs to national development goals; and

• identify future promising directions for research.

More specifically, research evaluations can be made for several purposes (Lundgren 1989). They can help:

Establish research program direction. Evaluations can be made to help establish research program direction by appraising the potential impacts of proposed research programs on national development goals to ensure the relevance of research programs to a sustainable national development strategy.

Determine funding priorities. The forestry sector must compete against the other economic sectors in society for scarce funds to support its program of forestry activities. Forestry research must likewise compete for funds with other areas of research, and with other forestry program priorities. Evaluations of forestry research benefits and costs, and of potential contributions to national economic development, can help establish funding priorities among competing research programs or projects.

Justify funding requests. Evaluations of potential research projects and past research accomplishments provide information useful in justifying funding requests to legislative bodies and other funding agencies. Such evaluations may pay particular attention to research contributions to national goals, and to its impacts on society, resources, and the environment.

Evaluate research proposals. Evaluations can be used to systematically estimate the costs and benefits of potential research proposals to assist in choosing the most appropriate proposals.

Evaluate performance of people or units. The performance of people or of research units can be evaluated to determine to what extent they are accomplishing planned targets, and their general
effectiveness and efficiency in reaching goals and objectives. Such performance evaluations are commonly used by research managers to determine what, if any, corrective action is needed in program direction, how funds and other resources are to be allocated, and whether promotions or salary increases are warranted.

**Ensure scientific soundness of research and results.** An important part of research evaluation is evaluating the scientific soundness of proposed and completed research. This is of particular and immediate concern to scientists, who often are called upon to evaluate research proposals and publications. But it also is of concern to all others in the research process, because the successful application of scientific results in practice depends upon sound science. The organization of science into narrow disciplines encourages the systematic and sound development of scientific knowledge within those disciplines. It is scientists within these “invisible colleges” that must judge the scientific soundness of research proposals and accomplishments.

**Evaluate usefulness of research results.** Even though research is scientifically sound, it may not be useful if it does not meet the needs of research users. Science judges research results on their potential or actual contribution to current knowledge. Potential users evaluate research on the basis of its potential usefulness in practice. The general public, politicians, policy makers, and others judge research by its potential usefulness to themselves or to society. Ultimately, the value of research is determined by the actual or potential usefulness of its results to either science or society. Developing a system to monitor and evaluate the usefulness of research results can strengthen linkages between researchers and research users (see module 12).

**Meet documentation requirements of donors, funding agencies, and others.** All donors and funding agencies are likely to require detailed reports of expenditures and accomplishments for the projects or other activities they are funding. To meet these requirements, research managers must keep record of receipts, expenditures, activities, and accomplishments, and prepare periodic reports on these.

Before undertaking any evaluation of forestry research activities, it is important to clearly outline the purposes of that evaluation, because the purpose helps determine the type of information that the evaluation will be required to produce.

**Users of Research Evaluations**
Several different groups of people (stakeholders) participate in the research process. Each group has different responsibilities and
interests. Each group views research from a somewhat different perspective, and requires different evaluations to meet their information needs. If an evaluation is to be useful, and actually be used, it must clearly address specific needs of specific users. Thus, the first task of any research evaluation is to clearly identify the potential user of the evaluation results, and to work closely with that user to determine just what questions the evaluation is to answer, how the information produced by the evaluation is to be presented in order to be useful to the user, and when the information is needed. Because the choice of evaluation approach is strongly influenced by the particular needs of those who will use the evaluation results, evaluations of forestry research should be user-driven. That is, they should be designed to provide specific kinds of information to meet the information needs of specific groups of stakeholders. Some of these stakeholder groups, and their needs, include (Lundgren 1989):

**Funders and legislators** who provide funds to support forestry research programs are interested in evaluating how research contributes to the broader goals of society. They must decide how to allocate a limited amount of funds among competing priority needs in every sector of the economy. They must be convinced of the value of the potential contributions that forestry research could make in meeting national needs.

**Higher-level administrators** within the forestry research organization, and within governmental agencies responsible for forestry research, must develop budget requests for funding to support forestry research. They must justify planned research programs to legislators and others who provide funding. They want evaluations to address the broader impacts of research programs on society or the environment, and in the contributions of forestry research to economic development.

**Research managers** of the various research programs and units within an organization, need evaluation results to: justify research projects and programs to higher-level administrators in their organizations; develop budgets; allocate appropriated funds and other resources among various research projects and researchers; and assess the performance of people in their organization.

**Research scientists** who actually carry out the research, are responsible for assuring the scientific soundness of research, and are interested in using scientific criteria for evaluating research projects and results. They also are interested in having their research findings contribute to solving problems of society. Their knowledge, skill, and experience strongly influence what research will be done by an organization. Research scientists can use evaluations of research to help develop budgets for research.
proposals, decide on research priorities within a given budget, and convince research managers and administrators of the value of their research.

Disseminators of research findings also have an interest in evaluating research. Those who publish scientific journals seek independent peer review of manuscripts to evaluate their soundness. Extension agents and others who disseminate research results to potential users in the field through simplified handouts, training sessions, demonstration areas, and other means, must appraise the potential usefulness of research results to client groups.

Research users who adopt and use research results also evaluate research for its potential usefulness in their activities. Although users are interested in how new technologies or information will help them do their immediate job better, they also may be concerned about some of the more indirect impacts on society and the environment that could result from their adoption of the new technology.

The general public can be affected directly and indirectly by the adoption and use of forestry research results. Special interest groups within the general public may become involved in evaluating the direct and indirect and short- and long-term impacts of the adoption and application of new technologies created by research. These groups, and the public at large, may evaluate specific research projects or programs in their own terms. They often exert strong political influence on funding and legislative groups to influence the appropriation of funds for forestry research.

All of these groups, and others could be added, make judgements about forestry research, and thus have an interest in some sort of evaluation of forestry research. Because of their interest, these potential users of evaluation results should play a strong role in planning the evaluation from the very beginning, to ensure that any evaluations conducted produce the kinds of information that are needed to answer their questions.

### Guidelines for Establishing Monitoring and Evaluation Systems

Six basic guidelines, expressed as questions, can help research managers focus their monitoring and evaluation activities:

1. Who needs the information/data to be collected? That is, who will be the primary users of the information?

2. How will the information obtained from monitoring and evaluation activities be used?
3. Are you asking the most important questions? That is, do your monitoring and evaluation systems address the key questions asked and key information needs of the primary users?

4. What do you need to do to obtain an answer? How will the M&E process be structured to enable the efficient collection of the required data?

5. What methods can be used to find out what you want to know? How will the data be collected? How will the monitoring and evaluation system be integrated into the ongoing activities of the various research programs?

6. How will the data be analyzed and presented to the final user?
Activities

Please read the situation described below and answer the questions that follow.

Situation Analysis

Victor was the manager of forestry research for a large national research organization for nearly 10 years before retiring. During his tenure as manager, the organization became well known for its superior performance, particularly for its elaborate and useful user-focused monitoring and evaluation systems that are integrated into all aspects of the unit’s activities. Because of his reputation as a top manager, Victor is often requested by other national forestry research organizations to provide advice and expertise regarding the establishment of similar monitoring and evaluation systems.

His current consulting assignment is particularly challenging. The monitoring and evaluation systems of this organization are in a state of complete confusion. The current manager lacks a clear idea of the reasons for establishing user-focused M&E systems, which is reflected in the hodgepodge of approaches currently being used. It is difficult to judge the performance of some research units because they lack an M&E system. As a result, requests for information are completed late or not at all. Other research units seem to have elaborate monitoring systems that produce mountains of data, but with little interpretation or evaluation which would make the information more useful. For instance, one research unit leader has instituted a monitoring system that seems to measure everything going on, requiring huge amounts of researcher and staff time. Another research manager strongly prefers monitoring by walking around and talking with people, and doesn’t stress reporting or integrated monitoring systems. As a result of these disparate approaches to M&E, it is extremely difficult for administrators, funders, regulators, other scientists, disseminators of research results, and other users of the research to obtain a clear picture of the performance of the organization, its personnel, or the quality of its research activities.

Victor has been asked to evaluate the current M&E system(s) and to make recommendations for improvement.
As Victor conducts his evaluation of this organization’s M&E system(s), what problems should he identify as needing correction? Write your responses in the spaces provided below.

1. 

2. 

3. 

4. 

5. 

As part of his recommendations, Victor is planning to include some basic guidelines, expressed as questions, for the research manager to use to help him focus his M&E activities. What are these five questions? (If you have trouble with this question, reread the text, then write your response in the space provided).

1. 

2. 

3. 

4. 

5. 
There are a number of problems in this organization's M&E system:

1. The manager does not understand the need for comprehensive monitoring.
2. There is no well-organized, systematic approach to M&E which spans all research units.
3. The M&E systems are not user focused, with little to no thought given to eventual use of the information collected.
4. Some units ignore M&E altogether.
5. Other units produce voluminous amounts of data that is nearly useless, since data interpretation or evaluation is not conducted.
6. The research manager relies on informal monitoring techniques. While these techniques can compliment other systematic approaches to monitoring, solely relying on the "monitoring by walking around" method will lead to inadequate monitoring.

Five basic guidelines, expressed as questions, which can help research managers focus their M&E activities are:

1. Who needs the information/data to be collected? That is, who will be the primary users of the information?
2. How will the information obtained from M&E activities be used?
3. Are you asking the most important questions? That is, do your monitoring systems address the key questions asked and key information needs of the primary users?
4. What do you need to do to obtain an answer? How will the M&E process be structured to enable the efficient collection of the required data?
5. What methods can be used to find out what you want to know? How will the data be collected? How will the M&E system be integrated into the ongoing activities of the various research programs?
Activity 3

In your own organization, who are the primary users of M&E data? List these individuals or groups in the spaces provided below.

1. 
2. 
3. 
4. 
5. 
6. 
7.
Since we're not familiar with your own organization, we can't list
the primary users of M&E data for your organization. We can
however, list individuals or groups that may potentially use
information gained from M&E activities.

1. **Funders and legislators** who provide support for forestry
research activities, and regulators who have oversight
responsibilities.

2. **Administrators** within the forestry research organization, and
within government agencies responsible for forestry research.

3. **Research managers** who manage the various research
programs and units within the organization, evaluate results to
justify research projects and programs to higher level
administrators, develop budgets, allocate funds, and assess
personnel performance.

4. **Research scientists** who are responsible for assuring scientific
soundness of the research conducted, tracking expenditures,
developing budgets for research proposals, deciding on
research priorities, and convincing research managers and
administrators of the value of their research.

5. **Disseminators** of research findings are interested in M&E
results. Research journals want to be assured that the research
is of acceptable scientific quality. Extensionists need research
results that are accurate, reliable, and relevant to their clients’
needs.

6. **Users** of your organization’s research results, including other
scientists who build on these results or who use them to
develop new technologies, and those who apply your research
results to change the way things are done in practice.

7. **The general public**, particularly special interest groups, are
also potential users of research results. They pay taxes that
fund research activities, and are thus interested in evaluations
that evaluate the efficacy of how those funds were used, and
the usefulness of the results. They also are affected in many
different ways by the use and application of those research
results.
Is your organization’s M&E system relevant and usable to the people or groups you listed above? Use the table below to determine how useful you think the information generated by your M&E systems is to the users. In the first column (M&E Information User) list the users you identified above in Activity 3. Then rate the relevance and utility of M&E information for each user by checking the appropriate column.

<table>
<thead>
<tr>
<th>M&amp;E Information User</th>
<th>Highly Useful to User</th>
<th>Somewhat Useful to User</th>
<th>Not Useful to User, Needs Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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<td>5.</td>
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<td></td>
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<tr>
<td>6.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are several purposes for instituting and maintaining user-focused M&E systems in forestry research organizations. Please list five of these purposes below.

1. 

2. 

3. 

4. 

5. 


Since we're not familiar with your organization, we can only hope that your M&E system addresses the needs of all key users. But if your organization is like most others, there is nearly always some room for improvement! This table can help you isolate and identify these weak spots in your M&E system, and can serve as a basis to develop strategies for improvement.

Some of the purposes for forestry research organizations to institute and maintain user-focused M&E systems include:

1. Establish research program direction.
2. Determine funding priorities.
3. Justify requests for continued funding to donors, legislative bodies, etc.
4. Evaluate costs and benefits of research proposals.
5. Evaluate the performance of people working for the organization.
6. Evaluate the performance of individual research programs or units in meeting their goals and objectives.
7. Evaluate the performance of the research organization in meeting its goals and objectives.
8. Assess the quality and scientific soundness of research conducted.
9. Evaluate usefulness relevance of research results.
10. Meet documentation requirements of donors, funding and regulatory agencies regarding expenditure of funds, and the achievement of goals, objectives, and targets.

If you have worked through some of the other modules, you have probably noticed the repeated emphasis on ensuring that all research activities focus on the user. M&E activities are yet another example of the importance of maintaining close ties with your organization's key stakeholders.
In order to obtain a clear idea of how their organization is performing, managers of forestry research must establish and maintain an M&E system that is integrated with their organization’s daily operations. M&E activities should generate information that is usable to managers and other persons or groups. That is, the monitoring and evaluation activities must be user-focused.

This study unit explored problems commonly experienced when designing and implementing M&E systems in forestry research organizations. We stressed the importance of incorporating M&E activities into all of your organization’s activities. We emphasized the need to make M&E user-focused by involving users in the design of these systems from the very beginning, in order to ensure their needs for information will be addressed. You learned how the results of M&E activities can be used by managers in the daily management of their forestry research organizations, and by other stakeholder groups important to the research organization. Thus, by completing this unit, you now have a better grasp of a powerful management tool that can help you significantly improve your organization’s performance.

If you would like more information about using M&E results in research management, we encourage you to obtain and review the interesting articles identified in the literature cited and other references listed at the end of the module. Two key articles directly related to the topics covered in the module, and cited in the text, are reprinted for your use in the section on readings at the end of the module.
Monitoring Research Progress Towards Objectives

Objectives
When you have completed this unit, you should be better able to:
- describe the primary uses of monitoring in research management;
- list three types or levels of monitoring, and describe their functions;
- list a number of methods or mechanisms which can be used to monitor forestry research activities;
- describe a number of ways to improve the monitoring of forestry research activities; and
- meet reporting standards and timetables required by your superiors, funding organizations, and governmental agencies.

The objectives of forestry research programs and studies are determined in large part by the interaction of the organization's mandates and mission, its linkages and relationships with users, and the results of its strategic, operational, and annual planning. Specific studies are designed and implemented to address these organizational objectives. An equally important component of the research process is to accurately monitor and assess the organization's progress toward meeting those objectives. Unfortunately, all too often monitoring is considered to be an afterthought, an activity tacked on to the existing research activities, often at the request of donors, funding, or regulatory agencies. Yet monitoring is an essential activity of research management; without it managers cannot achieve a clear picture of their organization's performance and effectiveness, and cannot make midcourse corrections to improve research quality and effectiveness.

In this study unit, you'll learn of the importance of integrating monitoring into all phases of the research process. We'll show you a number of practical, time-tested mechanisms that you can use to successfully track your organization's research progress. You'll also use several structured formats to help you monitor your own research program. These interesting and stimulating exercises can help you to better understand and master the monitoring process.

Uses of Monitoring in Research Management
Managers of forestry research are concerned not only with planning research, but also with ensuring that the plans are implemented, and that the research is being carried out in such a way as to achieve the planned objectives of the organization. To do this they must keep informed about the progress of the various research activities under their jurisdiction, and check that progress against the goals and objectives that were established...
for each major activity. In other words, they must monitor research activities and assess progress towards stated goals.

The term *monitor* is derived from the Latin term *monere*, which means to warn. Monitoring of research has been defined as,

"... observing or checking on research activities and on their context, results, and impact. Its goals are to ensure that implementation is proceeding according to plan; to provide a record of input use, activities, and results; and to warn of deviations from initial goals and expected outcomes" (Horton, Peterson, and Ballantyne 1993).

A systematic program to monitor research progress provides the manager with information needed to assess the performance of research groups and individuals within a group, to prepare required progress and other reports on research activities and accomplishments, and to modify existing plans. Such a monitoring system may be formal, requiring periodic reports and other data-gathering mechanisms, documenting activities and accomplishments; it may be informal, relying on close personal contact and frequent observation of the work that is going on; or (more likely) it may be a combination of the two approaches.

Monitoring serves two major uses in research management: (1) *accountability*, which refers to the responsibility of individuals or organizations to account for the proper use of resources; and (2) *decision making* by research managers in planning, implementing, and reporting on research activities (Horton, Peterson, and Ballantyne 1993). Both uses are closely linked. Information about accountability is useful in making decisions about research plans and activities and in reporting research activities and accomplishments.

**1. Monitoring for accountability.** Most research management and funding organizations require periodic reports on research expenditures, activities, and accomplishments. To obtain the information required for such reports, it is necessary to closely monitor research activities and outputs. Each organization usually has its own particular guidelines and formats for such reports. Any system for monitoring research should be matched to the information requirements of such reports, to ensure that the necessary data and information is collected in the form required for the report.

Research managers also need information about research activities and progress, and about the use and application of research results, in order to assess the impact that research is having on the broad goals and objectives of society, as a means of justifying the research program to those providing the funding. This includes
justifying the research program to potential groups who have supported past funding requests, or who may be called upon to fund future requests.

2. Monitoring for decision making. Having current information about research activities and accomplishments helps managers spot potential problems that are emerging in carrying out scheduled activities. The sooner that one can discover difficulties that are arising in implementing research studies, the sooner one can take corrective action to alleviate the problem. This may involve trying to change the ways in which research activities are being carried out, or it may involve changing the plan to more realistically reflect actual operating conditions.

Monitoring also provides information that is useful in periodic reviews of research programs and projects, to determine if strategic research directions and objectives need to be modified to better meet society's goals. Based on this information, it may be decided to terminate, continue, expand, or change the existing research activity.

The Role of Monitoring in Research Management

Forestry research studies, projects, and programs typically go through three major stages that are relevant to the management of research: planning, implementation, and review. At each stage of the management cycle, monitoring plays different roles (see box 10.2.1), and will be conducted differently and provide different types of information.

In designing a system for monitoring and evaluating forestry research programs, projects, and activities, the differing needs of all three stages of the management cycle should be taken into account. At any one time, the research manager is likely to have several ongoing research activities at various stages in the management cycle, and thus be concerned with monitoring all three stages of the management cycle simultaneously.
### Box 10.2.1. Changing roles of monitoring during various stages of the project management cycle.

<table>
<thead>
<tr>
<th>Stage in the Management Cycle</th>
<th>Roles For Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Assess the socioeconomic context of proposed research;</td>
</tr>
<tr>
<td></td>
<td>Determine research needs of clients;</td>
</tr>
<tr>
<td></td>
<td>Devise research strategies;</td>
</tr>
<tr>
<td></td>
<td>Set research goals;</td>
</tr>
<tr>
<td></td>
<td>Review goals of proposed research in relation to needs;</td>
</tr>
<tr>
<td></td>
<td>Prepare research plans;</td>
</tr>
<tr>
<td></td>
<td>Evaluate research proposals.</td>
</tr>
<tr>
<td>Implementation</td>
<td>Check input use against budgets;</td>
</tr>
<tr>
<td></td>
<td>Check activities against plans;</td>
</tr>
<tr>
<td></td>
<td>Check progress against milestones;</td>
</tr>
<tr>
<td></td>
<td>Document input use, activities, and progress for future evaluation.</td>
</tr>
<tr>
<td>Review</td>
<td>Review whole management cycle: context, needs, goals, strategies, plans, implementation procedures, resource use, activities, progress, outputs, impact; and</td>
</tr>
<tr>
<td></td>
<td>Assess proposals for improvement.</td>
</tr>
</tbody>
</table>

*Source: Adapted from Horton, Peterson, and Ballatyne 1993.*

### Types of Monitoring

Avers (1990) suggests that there are three types or levels of project and program monitoring:

- implementation monitoring;
- effectiveness monitoring; and
- validation monitoring.

**Implementation monitoring** is conducted to determine if planned activities are being carried out as laid out in the plan, and if the expected outputs and results are being achieved. This documents whether or not we actually did what we said we would do. This is the most common and widely used type of monitoring. It is concerned with how well planned activities are carried out, but is not concerned with whether or not the planned activities should have been carried out, or whether better plans could have been developed to accomplish the intended results. Implementation monitoring seeks to answer the question, “Were the activities carried out as planned, and the stated goals achieved?”

**Effectiveness monitoring** is conducted if there is concern about how effective existing plans are in achieving the objectives and
goals of the organization. It is conducted to determine if plans should be and can be redesigned to better reach the organization’s stated objectives and goals. Effectiveness monitoring seeks to answer the question, “What is the best plan for achieving the organization’s stated objectives and goals?”

Validation monitoring is conducted when there is a need to determine if the basic assumptions that were made in developing the plans are correct. It collects the information needed to verify the assumptions and information used in developing plans. Validation monitoring seeks to answer the question, “Is the information and assumptions we use in developing plans correct and accurate enough for our planning needs?”

### Mechanisms for Monitoring Research

There are several mechanisms that can be used to monitor activities in forestry research organizations, including:

1. periodic progress reports of activities and accomplishments for each research study currently underway;
2. periodic internal reports written by researchers which sum up their individual research activities and accomplishments;
3. short-term studies/evaluations (internal or external) to determine the effectiveness and usefulness of the organization’s research program;
4. internal group reviews through periodic meetings or retreats;
5. incorporate into all research study plans objectives, and milestones for achievement that specify targets and their expected completion dates;
6. annual internal program reviews; and
7. periodic reports to donors, upper level management, and the general public.

### Determining What is to be Measured

In order to evaluate and justify research projects and programs, managers need to monitor the inputs used in the project/program, its accomplishments and the outputs produced, and the use and impact of the research results (see box 10.2.2). In evaluation, these actual accomplishments, outputs, and impacts will be compared to those planned and intended. In managing the organization’s human resources, the performance of individual researchers, staff members, and other employees is monitored and compared against expected levels of performance. In managing the organization’s property, including facilities, equipment, and
supplies, observations would be made and records kept of the location, condition, and use of each major item, and of new items acquired and old items disposed of during a particular period of time. Detailed records of the flows of incomes received and of expenditures are needed to properly manage finances.

**Box 10.2.2. Examples of attributes to be monitored for various management activities (adapted from Gijsbers 1993).**

<table>
<thead>
<tr>
<th>Management Activities</th>
<th>Attributes to be Monitored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research projects, programs</td>
<td>Inputs, accomplishments, outputs, impacts</td>
</tr>
<tr>
<td>Human resources</td>
<td>Performance, job satisfaction</td>
</tr>
<tr>
<td>Property, facilities, equipment, supplies</td>
<td>Location, condition, amounts acquired and dispersed</td>
</tr>
<tr>
<td>Finances</td>
<td>Flow of incomes, expenditures</td>
</tr>
</tbody>
</table>

In developing a monitoring system, a useful tool is the Logical Framework, discussed in study unit 5.3 (see figure 5.3.2). The Logical Framework requires you to produce, for each activity or element of a research project or program: a narrative summary of that activity or element be produced; a description of the verifiable indicators that are to be used to monitor that activity or element, those things that are to be measured to demonstrate that the desired results are being accomplished; a description of the means by which that indicator will be verified, including where the evidence can be obtained and how it can be measured; and a brief description of the important assumptions that underlie the use of the indicators.

**Applying the Results of Monitoring**

There is little reason to develop an elaborate monitoring system for a forestry research organization unless the results of that monitoring are actually used in planning and decisionmaking. Thus, in designing a monitoring system, considerable care should be given to ensuring that the results produced by the monitoring will actually be useful to the intended users, that the results will be delivered to the intended users in a convenient and useful form and in time to be of use, and that the cost in time and funds of carrying out the monitoring can be justified in terms of the net gains produced by having that information. Perhaps the most important consideration in planning an effective monitoring system is to clearly identify prospective users and accurately specify their needs for information to be derived from the monitoring system. Any monitoring system should be user-focused, targeting specific users and their needs (Patton 1986).
Horton, Peterson, and Ballantyne (1993) outline ten guidelines for improving the design and implementation of M&E systems (box 10.2.3).

**Box 10.2.3. Ten guidelines for improving M&E.**

- Focus on key management and accountability needs.
- Avoid overambitious M&E objectives.
- Think of M&E as a process that integrates decisionmaking, planning, and implementation, not as a series of disconnected activities.
- Assign responsibilities for M&E and for follow-up action.
- Inform all levels of management and staff of the purposes, principles, and uses of M&E.
- Plan an M&E system that fits the organization's resources and needs.
- Jointly plan, coordinate, and facilitate donor M&E activities to satisfy their requirements and minimize disruption of research.
- Use simple, practical methods to minimize time, cost, and paperwork.
- Provide information on a timely basis for decisionmaking.
- Summarize M&E results for managers and present options for action.

*Source: Horton, Peterson, and Ballantyne 1993.*
Please read the situation described below and answer the questions that follow:

**Situation Analysis**

Malendra Sahl, Manager of Research for the Ghosa Forestry Research Division for the past seven years, has just finished reading an external evaluation of his organization conducted by his division's most important bilateral donor. The evaluation is not flattering, and points out a number of deficiencies in the research unit's program and activities. According to the report, research projects were completed late or were never completed at all. And the evaluators indicated they had great difficulty determining current research progress. Being ultimately responsible for his research organization's performance, Malendra is predictably upset, as well as puzzled. This critical evaluation comes to him as almost a complete surprise, and reflects negatively on his own managerial competence.

To be sure, he is aware that many of the division's research activities have proceeded more slowly than anticipated. But he disputes the finding that some research projects were never completed. It only appears that way because several researchers left the organization prior to writing their final reports. And it bothers Malendra that the evaluators depended so much on internal documents such as quarterly, semi-annual, and annual reports, which are admittedly incomplete. Malendra's management style is based on the conviction that scientists' creative energies should not be hindered by onerous reporting and monitoring requirements. Thus, he's never insisted on careful adherence to policies requiring timely submission of reports, making him a popular manager among his research staff. In Malenda's view, if the evaluators wanted information regarding research progress, they should have asked the researchers. That's what he does! Further, Malendra feels that donors require too much performance data, placing an unnecessary burden on research organizations and reducing the division's productivity and researcher effectiveness. It's bad enough that he has to provide excessive amounts of detailed financial information regarding expenditures, an activity that takes an enormous amount of time to assemble.

Malendra also disputes a finding by the evaluators that a number of studies could have benefited from a midterm review. He feels his researchers are competent enough to proceed on a research project once the concept and initial design have been approved. His division has a lot of research projects operating simultaneously, and he simply doesn't have the time to continually implement formal midterm reviews and constantly reevaluate his division's research programs.

The evaluators have also recommended that milestones and measurable indicators be incorporated into each research project and study design, and that these milestones and indicators be monitored to help gauge research progress toward the stated objectives. Malendra feels this is rather unrealistic and unworkable. He is appalled by the amount of work he feels this will require, as well as the commitment of scarce resources to monitoring activities his research organization is going to have to make to address these recommendations.
There clearly is a difference of opinion between Malendra and the evaluators regarding the relative amount of organizational resources which should be committed to monitoring activities. Who do you think is right, and why? Write your response in the space provided below.
We hope it is clear that the evaluators are correct; Malendra needs to improve his organization’s M&E mechanisms. To some, M&E systems may seem to be an unnecessary use of scarce resources that could be better used to support research activities. Yet for a variety of reasons, research managers such as Malendra who oversee complex forestry research programs must have some means to monitor the progress and quality of research activities.

M&E systems are necessary complements to strategic and operational plans. Without such information, how can the manager determine whether the organization’s goals and objectives are being met, or if the strategic and operational plans are being fulfilled? Donors, superiors, and regulatory agencies also want to know if funds are being spent properly and effectively. The only way to obtain this information is through M&E.
Malendra’s forestry research unit seems to lack some important components of a monitoring system. In the spaces provided below, list 5 monitoring mechanisms that could be instituted by Malendra to improve his unit’s monitoring capacity.

1. 

2. 

3. 

4. 

5. 

By using an informal and rather incomplete approach to monitoring research progress, Malendra is ignoring a basic principle essential to the effective management and monitoring of forestry research organizations. What is this principle?

(Reread the text if you’re not sure, then write your response in the space provided below.)
Mechanisms or means to conduct monitoring activities in forestry research organizations include:

1. Periodic internal reports written by researchers which detail progress on current research activities and accomplishments.

2. Short-term studies/evaluations (internal or external) to determine the effectiveness and usefulness of the research program.

3. Internal group reviews through periodic meetings or retreats.

4. Incorporate into all research study plans objectives and milestones for achievement that specify targets and their expected completion dates.

5. Annual internal program reviews.

6. Periodic reports to donors, upper level management, and the general public.

A basic principle essential to the effective management of forestry research organizations is that M&E must be incorporated into all activities of the research organization. M&E functions should be automatic, systematized, and so well integrated into the research program that they are not considered separate from research, but are instead seen to be a fundamental component, indistinct from research implementation.
Ten guidelines have been suggested to improve monitoring and evaluation of research programs. List five of these guidelines in the spaces provided below. (If you're not sure, reread the text and then complete this activity.)

1. 
2. 
3. 
4. 
5. 

Ten guidelines for the improvement of research program M&E are:

- focus on key management and accountability needs;
- avoid overambitious M&E objectives;
- think of M&E as a process that integrates decision making, planning, and implementation, not as a series of disconnected activities;
- assign responsibilities for M&E and for follow-up action;
- inform all levels of management and staff of the purposes, principles, and uses of M&E;
- plan an M&E system that fits the organization's resources and needs;
- jointly plan, coordinate, and facilitate donor M&E activities to satisfy their requirements and minimize disruption of research;
- use simple, practical methods to minimize time, cost, and paperwork;
- provide information on a timely basis for decision making; and
- summarize M&E results for managers and present options for action.
Monitoring research is the observing or checking on research activities and on their context, results, and impacts. The goals of monitoring include: to ensure that implementation is proceeding according to plan; to provide a record of input use, activities, and results; and to warn of deviations from initial goals and expected outcomes. Monitoring is essential if the research manager is to successfully track the organization’s progress toward meeting those objectives. Without monitoring, managers cannot have a clear picture of their organization’s performance and effectiveness, and cannot make any midcourse corrections that may be needed to improve research quality and effectiveness.

In this study unit you learned of the importance of integrating monitoring into all phases of the research process. You learned why monitoring is a necessary part of research management, and reviewed several practical mechanisms you can use to successfully track your organization’s research progress.

If you would like more information about monitoring research progress toward objectives, we encourage you to obtain and review the interesting articles identified in the literature cited and other references listed at the end of the module. Two key articles directly related to the topics covered in the module, and cited in the text, are reprinted for your use in the section on readings at the end of the module.
Monitoring and Evaluating Research Quality

**Objectives**

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

- describe three key criteria for evaluating the quality of research produced by your organization;
- describe several review mechanisms that ensure the production of research of acceptable quality;
- explain the differences between evaluations of basic research and evaluations of applied research;
- evaluate how your own organization monitors the quality of research produced; and
- establish procedures to ensure that the research performed by your organization is of high quality and meets standards of scientific excellence and usefulness to potential users.

Forestry research must meet certain quality standards in order to be useful and acceptable to the scientific community and to society. Quality criteria depend in large part on the viewpoints of the groups or persons utilizing the research results. Scientists have established standards of scientific excellence by which all research is judged. Research that utilizes weak or erroneous methods, and produces erroneous results or interpretations, is of little use to either clients or the scientific community. In fact, it may be harmful if erroneous results are well publicized and are incorrectly perceived as being factual and of high quality. Those who use research results may be concerned with the scientific validity of the research, but will judge the quality of the research produced primarily on its applicability and usefulness to their own unique situations. An important responsibility of forestry research managers is to ensure that the research produced by their organization is both scientifically acceptable and useful to the clients of their research outputs.

A primary goal of forestry research managers is to develop and maintain a reputation for consistently producing high quality research that is recognized by both the scientific community and those who use research results for practical application. One of the neverending tasks of the research manager is to create an environment that encourages and facilitates the production of high quality research. An important component of this environment is a system for monitoring and evaluating the quality of research.

This study unit is designed to provide you with practical information which you can use to improve the quality of research produced by your organization. By completing this study unit, you’ll learn of a number of ways to monitor and evaluate the quality of research produced. You’ll discover that ensuring quality requires a commitment to monitoring throughout the research process, from initial plans to final dissemination of results. You’ll also examine your own organization’s performance in this important area, recommending changes than can improve the quality of research produced.
Useful Criteria for Evaluating Forestry Research Quality

In evaluating the quality of forestry research, three broad criteria are of particular importance. To be considered high quality, research should:

1. **Be scientifically sound.** Scientific soundness is an important and necessary criteria in evaluating research and its results. It is a question that only trained scientists can answer. The scientific soundness of research is usually judged through informal and formal peer review of research proposals and study plans prior to the research, and of manuscripts and other outputs prior to publication or release. It also is handled by challenges in the scientific literature following publication of results. Constructive critique by fellow scientists, a long-standing tradition in science, provides quality control from the scientific viewpoint. The results of research that are judged to be unsound from a scientific standpoint are not likely to be accepted by either science or society.

2. **Produce useful results.** In addition to being scientifically sound, research also should produce results that can be used by the intended audience. This is a key criteria for judging research quality, whether the results are to be used by scientists or by nonscientists. If research results are not used by either scientists or nonscientists, they meet the needs of neither science nor society, and the research may have wasted scarce resources. Two questions regarding the usefulness of research results might be asked:

   *Can the results actually be used by the intended user?* If so,

   *Are the results likely to be used?*

   These two questions are related, but are not asking the same thing.

   Answering the first question about the feasibility of using the results requires estimating the extent to which the results of the research could be used by the intended user. In the case of research results that will be used primarily by other scientists for further research, it often is difficult to foresee just to what extent and how those results could be used in the future. In the case of applied research, answering this question requires the evaluator to work closely with disseminators of research results, including extension agents and others who work directly with the final users, and with the intended final users of those results, to determine whether or not the research results actually could be used in their operations. Assumptions by researchers as to the potential usefulness of research
findings in practical application are frequently unreliable, because most researchers lack the detailed knowledge of the operational conditions under which the research results will be applied.

Answering the second question about the likelihood of use is more difficult. It requires working closely with intended users to: estimate the extent to which the research findings may have to be modified in order to be adopted; explore the likelihood of adoption; determine the likely rate and extent of adoption; and determine if there are any institutional or other barriers that may inhibit the adoption of the research results.

If the potential research results appear to be useful to intended users, but for one reason or another are not likely to be adopted by them, or if they are likely to be implemented by only a few users on a limited scale, then the research may produce relatively limited benefits to society.

3. **Address important problems.** The importance of the research problem and its proposed solution to science and/or society is a key criteria for judging research quality. It has been truthfully said:

   *There are many interesting research problems. Some of them are important.*

Scientists encounter an unending stream of interesting problems in the course of their work. A scientist can wander from one interesting problem to another for an entire career, keeping busy doing research and publishing the results, without asking whether the research problems being worked on are important ones, either from the standpoint of science or of society. Not all scientific research is equal. Some individuals, some research units, some laboratories, seem to have the knack for working on problems that are critically important to science or to society.

There is no easy way to determine if a problem is important, but an attempt should be made to do so. Peer scientists can help judge a problem's relative importance to science. Potential users can help judge a problem's relative importance to society. If a research problem and its solution are not important to either science or society, then even if the research is well-planned and carried out to perfection, by definition it is not important, and might just as well not have been carried out. Its successful completion will not change either science or society in any important way.
Considerations in Evaluating Basic Versus Applied Research

In evaluating research it is important to distinguish between basic and applied research, because the approach used to evaluate the quality of basic research is fundamentally different from the approach used to evaluate the quality of applied research. Although the distinction between basic and applied research is fuzzy, for the purposes of this discussion we will distinguish between basic and applied research on the basis of who uses the results, and for what purpose they are used.

Considerations in evaluating basic research

Research that produces results that are used primarily by other scientists to do more research will be called basic research. Basic research aims at improving our understanding of the natural world, or improving our ability to do research on the natural world. The users of basic research are other scientists. Appropriate criteria for judging basic research are its scientific soundness and its contribution to science. Only scientific peers, working actively in a scientific field, have enough knowledge of specific areas of science to judge the potential or actual contributions of any specific piece of research to that area of science. Of course, the judgement of whether or not basic research should be supported, and at what level, is a question that goes beyond science and must be answered by society.

The results of basic research:

• are used by other researchers within the research community; and
• affect primarily science.

Therefore, evaluations of basic research must:

• consider the extent to which the research findings are actually used by scientists;
• consider its impact on science;
• be done by professional peers; and
• involve value systems from within the scientific community.

Considerations in evaluating applied research

Research that produces results that are to be used primarily in the real world by land managers, farmers, resource users, and others to change the way things are done will be called applied research. Those who evaluate applied research must know how particular research findings will be applied in practice, and what the consequences of such applications will be. Such knowledge is likely to be gained only from those who use and apply the research results, and/or by studies of specific research applications and the
resulting impacts. It is difficult for scientists who are not directly involved in the practical application of research findings to evaluate applied research without the close involvement of potential users and those who ultimately are affected by the adoption and use of research findings.

In contrast to basic research, the results of applied research:
• are used by people outside of the research community; and
• affect people, society, natural resources, and the environment.

Therefore, evaluations of applied research:
• must consider the extent to which the research findings are actually adopted in practice and put into use;
• must consider the impacts on people, society, natural resources, and the environment that occur from the adoption and use of the research findings;
• require criteria and methods outside of the scientific disciplines represented in the research; and
• involve a multitude of value systems from outside of science.

Of course, much research often is a mixture of both basic and applied research. In such cases, it may be necessary to use both approaches in evaluating the research and its outputs.

**Implementing Research Quality Control**

Research monitoring and evaluation can be done internally or externally. Most forestry research organizations use some combination of both approaches to ensure the quality of their research programs and outputs. Internal reviews and evaluations are conducted by research managers and their subordinates at various levels within the organization, both formally and informally. Some are conducted at regularly scheduled intervals, such as an annual performance review. Others are conducted as needed, such as reviews of study plans or publication manuscripts. External expertise is often called upon to participate in these reviews.

External reviews of a research organization, its plans and performance, may be generated by factors outside the organization. Research funders may require an outside review of research plans and performance before, during, and after completion of a research project or program. Outside reviews of an entire organization or its organizational components may be carried out every few years as a means of checking on the quality of its performance.

Some of the mechanisms used for quality control in both internal and external reviews of forestry research include:
1. **Initial peer and client review of proposals or study plans before they are implemented.** Reviews of research proposals by outside peers and users is a time-tested way of detecting errors in data, assumptions, and interpretations that may have crept into the writing. Finding and correcting such errors before starting a costly research program is a cheap way to avoid wasting scarce resources, and improve the quality of the research being conducted.

2. **Statistical reviews of experimental designs and analysis procedures.** Reviews of research plans by qualified statistical expertise helps to ensure that the planned research will produce the data and information needed to draw sound conclusions.

3. **Internal midproject evaluation.** Research is a risky business. Plans for research studies, projects, and programs are based upon many assumptions that are not known with any degree of certainty. Periodic evaluations of research activities as they unfold can provide managers with information they need to correct problems as they emerge, and to make appropriate changes in the plans.

4. **Internal peer reviews of early draft results.** The quality of research reporting can be improved by having draft manuscripts submitted to peers within the organization for review. Such reviews often catch simple mistakes in computation and presentation so that they can be corrected before they become public, and generally improve the quality of the research outputs.

5. **Final draft reviews, including both internal and external peer reviews, prior to publishing, dissemination.** These evaluations include editing for presentation, language, grammar, appropriateness for audience, etc. Research results that are accepted by scientific peers, and that are well presented for the intended audience, will enhance the quality and usefulness of the results produced by the research program.

6. **External reviews of broad research strategies, program areas, and accomplishments.** Periodic reviews of the entire research program by people outside of the research organization can provide new perspectives on the applicability and usefulness of the current research program in meeting the needs of science and society, and suggest promising new directions for research. The use of external reviews also gives credibility to the research review process in the eyes of funding organizations (Fuglie and Ruttan 1988). More
frequent external reviews may be needed and desirable when establishing a major new research program or institution, until the unit has proved itself.

An important, but sometimes overlooked, component of quality control is that imparted by co-workers within the organization, and by informal reviews and discussions with scientific peers and others outside the organization. This type of informal, personal quality control is likely to be fostered where frequent contacts and discussion of ongoing work, problems, and procedures are encouraged. For example, informal seminars/discussion groups that meet regularly to discuss research plans, activities, and results of the various research projects can, if properly handled, provide informal *constructive* review and suggestions that will improve research quality.
Activities

Please read the situation analysis below and then complete the activities that follow.

Situation Analysis

Juan has the unfortunate distinction of being recently appointed to the position of research manager for the Department of Forestry Research in a tropical developing country. We say unfortunate because the department's research results are constantly being criticized for their low quality and utility. Other scientists, funders, and members of the extension service that use the results are clearly dissatisfied with the overall quality of the research. Thus, use of the research is low, and the credibility and reputation of the research organization is poor and getting worse. Field personnel with the extension service refuse to participate in field research studies, since they feel that the research will only be a waste of time, with few usable results. And external funding sources are drying up as the withering criticism continues from all quarters.

Scientists external to the organization criticize the research results primarily on technical grounds. Experimental designs are sloppy and lack statistical rigor, sample sizes are consistently too small to generate valid results, and experimental controls are inadequate. Research questions are too broad, lack focus, and often are confounded with other questions. Literature reviews are cursory and incomplete. Statistical analyses are performed or interpreted incorrectly. Conclusions don't always conform with the data presented in the results, with the result being incorrect interpretations and recommendations.

Because of the low rigor and often erroneous nature of the research results, users of the research, particularly those in the extension service, find the research results often conflict with what they see daily in the field. Faced with these contradictions, the extension personnel have learned to disregard most results disseminated by the research organization. Research results are not often published in a user-friendly format appropriate for extensionists, and are instead disseminated as long, complex documents filled with extensive tables of data. Further, many of the research projects are of low utility and relevance to the extensionists, regardless of the overall quality of the results. Extension personnel are generally not consulted in a formal way when the research agenda is being established. And they generally find that because the research takes so long to implement, more rapid solutions to important problems are determined by field extensionists through trial and error and multiple observations.

Morale is low within the department, and infighting between researchers for the increasing scarce resources is chronic. Internal peer reviews of proposed research, or of research results are virtually nonexistent. Much research proceeds from the initial idea to the final report with little input from other colleagues. Research study plans are usually not written in a formal, standardized manner. No one on the staff is considered to be highly knowledgeable of statistics or computers, and research support services, particularly regarding editing and the dissemination of results, are marginal.

Juan clearly has his hands full. The Minister of Natural Resources (Juan's direct superior) has given Juan a mandate to straighten up the department, and to do whatever is necessary to improve the department's image and quality of its work.
Based on this rather dismal description of Juan’s research organization, and keeping in mind the six mechanisms for quality control of research results described in the text, what factors do you think most contribute to the low quality of research produced?

1. 

2. 

3. 

4. 

5. 

6. 
Comment 1

There are a number of factors contributing to the poor quality of research produced. Juan's research organization is suffering from a lack of research planning, interdisciplinary collaboration, an absence of internal and external reviews, lack of research support services, lack of early and continual communication with users, and an overall commitment to quality by both scientists and management alike. Specifically, Juan's research organization lacks:

1. Initial peer and client review of proposals or study plans prior to study implementation. Study plans are discussed in more detail in Module 5.
2. Statistical reviews of experimental designs and analysis procedures.
3. Internal midproject evaluations.
4. Internal peer reviews of early draft results.
5. Final draft reviews, including both internal and external peer reviews, prior to publishing, dissemination. These evaluations include editing for presentation, language, grammar, appropriateness for audience, etc.
6. External reviews of broad research strategies, program areas, and accomplishments.

Incorporating monitoring activities throughout all phases of the research process is a primary responsibility of the research manager, and is essential if quality research that meets the goals and objectives of the organization and the needs of users, is to be consistently produced.
What steps should Juan immediately take to improve the quality of the research produced by his department? Please write your response in the space provided below.

Activity 3

We know that your organization functions far better than Juan's. Nevertheless, it may be helpful for you to review your organization's performance regarding the production of quality research. Use the format provided below to rate the quality control mechanisms in your organization.

<table>
<thead>
<tr>
<th>Quality Control Mechanism</th>
<th>Excellent</th>
<th>Good</th>
<th>Needs Improvement</th>
<th>Lacking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Initial peer and client review of protocols or study plans</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. Statistical reviews of experimental designs and analysis procedures</td>
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<tr>
<td>3. Internal midproject evaluations</td>
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<td>4. Internal peer reviews of early draft results</td>
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<td>5. Final draft reviews (internal and external peer reviews and editing)</td>
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<td></td>
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<tr>
<td>6. External reviews of research strategies, program areas, accomplishments</td>
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<tr>
<td>7. Other?</td>
<td></td>
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</table>
It should be fairly clear what Juan needs to do to improve the quality of research produced by his organization. First, he needs to make it clear to all scientists and researchers that quality is a primary goal of the organization, a goal which will be receiving much greater emphasis. Next, he needs to meet with both his scientists and external users of the research to clarify the problems and to generate solutions. Once the problems are well understood, and once his research staff appreciates the organization's commitment to quality, Juan can proceed to craft and implement solutions with his staff, probably incorporating the five mechanisms for quality control of research results described in the text and in the previous response. Most scientists will be eager to improve the quality and utility of their research, making Juan's task of quality improvement a little easier.

This exercise is a good way for you to systematically analyze your own organization's strengths and weaknesses in the production of high quality research. In addition to these considerations, think about how your organization approaches its research agenda. Does it take on too many research activities, spreading its resources and personnel so thinly that quality suffers? Do the organization's mission or mandates require a broad, multiple focus research agenda? If so, how can research quality be improved given this influential policy and institutional environment?
It should be clear that to produce high quality, useable research results in a consistent manner, the quest for quality needs to be built into all stages of the research process, starting with research study plan preparation. How can the preparation of study plans enhance research quality? Please write your response in the space below.
Comment 4

Requiring the preparation of study plans is one of the more important actions research managers can insist on to improve the quality of forestry research. Written study plans force researchers to sharpen their thinking regarding the proposed research. While viewed as a bureaucratic chore by some researchers, study plans are wonderful opportunities for creativity, allowing the researcher to assemble ideas for review by colleagues and peers. Suggestions supplied by peer review enhance the value of the study, and help to ensure its scientific validity. Study plans permit changes when alterations in study design and methods are easily and cheaply implemented. They also serve as the first draft of the final report, carefully detailing the research question(s), hypotheses, methods, etc. Further, many funding agencies and clients require study plans as part of the approval process. In long-term research which may continue for many years, study plans provide a kind of institutional memory, ensuring continuity over long periods regardless of researcher turnover.
The forestry research organization must make a firm and substantial commitment to the production of quality research. Quality control is a primary responsibility of the research manager. Incorporating monitoring and evaluation activities throughout all phases of the research process is essential to produce quality research that consistently meets the goals and objectives of the organization and the needs of users. Mechanisms research managers can institute to improve or maintain research quality include: initial peer and client review of study plans; statistical reviews of experimental designs and analysis procedures; internal midproject evaluations; internal peer reviews of early draft results; final draft reviews (internal and external peer reviews and editing) prior to publishing and dissemination; and external reviews of broad research strategies, program areas, and accomplishments.

By completing this study unit, you’ve learned of a number of ways to monitor and evaluate the quality research produced. Through improved monitoring and evaluation, you’ll be able to achieve a clearer picture of your own organization’s strengths and weaknesses regarding research quality, and you’ll be better able to improve your own organization’s performance in this important area.

If you would like more information about monitoring and evaluating research quality, we encourage you to obtain and review the interesting articles identified in the literature cited and other references listed at the end of the module. Two key articles directly related to the topics covered in the module, and cited in the text, are reprinted for your use in the section on readings at the end of the module.
**Objectives**

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

- describe the difference between ex ante and ex post impact evaluations;
- identify the various types of impact evaluations used to determine research impacts; and
- list the uses of impact evaluations to your forestry research organization.

**Monitoring and Evaluating the Impacts of Forestry Research**

An important goal of forestry research is to produce research results that will advance scientific knowledge and help society utilize and develop its forest and related resources in a sustainable manner. Organizations that fund forestry research want to see how the results of this research can be and are being used to improve science and society in general, both now and in the future. They want hard evidence of the impacts and current and future benefits of that research presented in terms they understand.

We created this unit to help you to better evaluate how forestry research contributes to science and to society, and to improve your ability to describe the potential benefits of your research. By completing this unit, you’ll learn ways to document and communicate the full impacts of your research program to funders, and significantly improve your success at securing new and continuing funding.

**The Role of Impact Evaluation**

Forestry research is conducted and supported by society for two primary reasons: (1) to increase our knowledge and understanding of the management and use of forest and related resources, and (2) to change the ways in which we manage or use those resources so as to improve the living standards of people now and in the future. Impact evaluations of forestry research consider the benefits and costs of outputs produced by that research (figure 10.1), and the costs of the inputs used to produce those outputs. They are particularly concerned with the ultimate use of the results produced by research, and the benefits and costs that use may have on science, society, and/or the environment. Although evaluations can be made to determine the contributions of research to the advancement of scientific knowledge (impacts on science), this study unit is concerned primarily with the impacts of forestry research on society, the natural resources base, and the environment.
Types of Impact Evaluations

Three major classes of impacts are often used in evaluating forestry research:

• **The economic impacts** of research can be evaluated to determine if the benefits from using the research results exceed the costs of doing the research. This involves documenting the inputs used in producing, disseminating, and adapting the research results for practical application, and the changes brought about by the use of those results. The process is easy to describe, but often difficult to carry out in practice for several reasons. Information on research costs may not be in a form that can be used to determine the costs of a particular piece of research. Research programs that produced a particular result may be conducted over a period of several years and, in the process, produce a whole series of outputs. It is difficult (if not impossible) to accurately assign portions of the program costs to any one particular output of that program. A particular research result may be only one part of a complex new technological innovation, and thus it is difficult (if not impossible) to assign the benefits of the entire innovation to any one particular part of that innovation. Benefits that result from research may take place over a long period of time, and often cannot be estimated with any degree of precision at the time when an impact evaluation is to be made.

• **The social/cultural impacts** of research can be evaluated to determine how people may be affected by the adoption and use of particular research results. This includes determining changes in: the knowledge and skill levels of people; the number and types of jobs created and/or destroyed and labor relationships changed by the innovation and work assignments; the health of various groups of people; societal groups and institutions; and other social and cultural characteristics of society. Social/cultural impact evaluations are often concerned about the distribution of impacts among various groups of people on the basis of age, gender, race, income, location, or other societal distinctions or classifications.

• **The environmental impacts** of research can be evaluated to determine how environmental factors will be affected by a technological innovation stimulated by the research. This includes potential impacts on air and water pollution, hazardous waste disposal, soil erosion and sedimentation, changes in hydrologic regimes, contamination of soil and water by pesticide or herbicide residues, effects on the long-term functioning of the biosphere, potential climate change, and other factors.
Environmental impacts of forestry research also include evaluations to determine how the forest resources and related natural resources will be affected by a particular technological innovation. The particular technology affects how, to what extent, and for what purposes various forest resource units will be used by people. Each technology, when used in a given environmental and social setting, may have its own particular set of impacts on the resource, changing its composition and structure and thus affecting its future productivity for various goods and services. The intensity and extent to which a given technology is applied may determine whether or not the resource can be used on a sustainable basis.

Each of the three types of impact evaluation described above addresses a different type of impact that may result from utilizing new technologies derived from forestry research. Each is, in effect, answering a different question about the impacts of forestry research. All three types of evaluations are important to society. Any technological innovation is likely to generate all three types of impact, although the importance of the various types of impact may vary from one innovation to another. Thus, to fully address the impacts of forestry research there is a need to conduct all three types of impact analyses, carefully integrated to clearly show the multiple impacts of a proposed new technology. Each type of impact evaluation can be conducted at various levels of complexity, from broad qualitative descriptive surveys to detailed quantitative analyses. But regardless of the level of evaluation detail, all three types of impact evaluation should be considered to determine if they are applicable to the technological innovation being evaluated.

### Timing of Impact Evaluations

Evaluations of research impacts can be done at different times, depending on the purpose of the evaluation. Four common types of evaluations, based on when the evaluation is made, include:

**Ex ante.** Ex ante evaluations are those done before the research is conducted. Its purpose is to judge the value of and justify the proposed research. Evaluations done for the use of higher administrative levels are likely to address a broader range of societal concerns and issues than would evaluations done for lower administrative and management levels.

**Ongoing.** Evaluations made during a research project, while it is ongoing, provide information needed to manage the research project. Ongoing evaluations can help make decisions about changes in direction, expansion, or closing of research projects.
and programs. They also provide information about individual or group performance.

**Termination.** Evaluations of a research project or program made at the termination of the project or program provide information for the final report. Such evaluations of successful projects or programs often are used in justifying new research proposals for similar research. Evaluations of unsuccessful projects or programs can provide information helpful in designing new research projects.

**Ex post.** Ex post evaluations are those done after a research project or program has been terminated. It may be done immediately after, or it may be done several years later in order to better judge the long-term and indirect effects of a given research project. The information generated by an ex post evaluation can help in designing, appraising, and justifying new research proposals.

**Uses of Impact Evaluations**

If forest managers wish to plan and implement research programs that will contribute to sustainable development of their country, they need to know how their work is affecting that development. Impact evaluations of forestry research programs provide information to help research managers:

- improve the planning of research programs designed to accomplish specific goals and objectives;
- track the dissemination and use of research results;
- modify and redirect research programs to better achieve the organization’s goals and objectives;
- justify forestry research programs to policymakers, decisionmakers, and funders; and
- determine how specific research programs are contributing to economic and social development in society, and how they are affecting natural resources and the environment.

**Examples of Impact Evaluations of Forestry Research**

Relatively few quantitative evaluations have been made of the contributions of forestry research to development and conservation. This lack of solid evidence of such contributions probably hurts the funding potentials of many forestry research organizations. Although many countries do not currently have the expertise to undertake such evaluations, they often can put together some qualitative examples of specific contributions and
successes resulting from their own research programs. For additional support they can bring in quantitative and qualitative studies from other countries that indicate research successes in fields similar to the ones for which funding is being applied locally.

Some of the quantitative evidence that is available of positive economic impacts of forestry research was summarized in Study Unit 2.4 (see table 2.4.1). Examples of the potential contributions of forestry research to development were presented in Annex 2.4.2. A few of these examples are highlighted here (boxes 10.4.1 and 10.4.2).

Similar examples, developed and summarized for your own research organization, present concise evidence of the potential contributions by your research organization to national development.
Box 10.4.1. Examples of potential contributions of forestry and related research to development.

Benefits from Agroforestry and Watershed and Dryland Management Research

• Achilli (1984) reports 48, 20, and 17 percent reductions in peak monthly runoff, annual sediment transport, and peak monthly sediment transport, respectively, caused by improved farming, terracing, and tree planting in the Solo watershed on Java, Indonesia.

• Openshaw (World Bank 1986) summarizes the potential of improved management of natural savannah woodlands to contribute to tree fodder and fuelwood needs in the Sudan. Research has shown that, in many cases, application of simple management techniques, such as control of harvest and burning, can more than double sustainable outputs from less than one to two cubic metres per hectare per year (Winterbottom and Hazlewood 1987). Costs can be very low, creating cost-effective management opportunities. Similar results have been demonstrated for Niger and other countries.

Contributions of Research on Natural Tropical Forest Conservation and Management

• Winterbottom and Hazlewood (1987) have summarized research being undertaken in the Gusselbodi forest in Niger. This research has shown that simple, low-cost management techniques in the natural forest, such as early burning and careful timing of lopping and felling, can produce three cubic metres of fuelwood per hectare per year, or roughly six times the yield that is generally assumed for unmanaged forests. At the same time, a number of other products are produced (gums, fodder, medicines).

• Many otherwise obscure insect species in the tropics have major economic importance. For example, the oil palm (Elaeis guineensis) is pollinated in the wild in Africa by a weevil (Elaeidobius kamerunicus). The oil palm was introduced in what is now Malaysia in 1917 without the weevil and thus required costly, inefficient hand pollination. In 1980-81 the pollinator was collected from its native habitat in the forests of the Cameroon and brought to Malaysia after a six-month quarantine; significant improvement in pollination resulted, with the percentage of fruit set increasing by 8 to 28 percent. After considering other factors of production, it is estimated that the increase in national oil palm production could reach 12.3 percent (Salleh Mohd. Nor, personal communication). The improvement was worth some US$30 to US$60 million in foreign exchange in the first year alone (Goodland 1985).

Contributions of Research on Tree Improvement and Tree Breeding Research

• Research has shown that great gains in productivity can be made simply by identifying and selecting the seed source most adapted to planting locality. In provenance trials in Nigeria with E. camaldulensis, the best provenance had a mean annual increment of 17.3 cubic meters per hectare, while the poorest only had 5.1 cubic meters (FAO 1979). In the Congo and Brazil, the yield of eucalyptus plantations has been increased by up to 80 percent by selection of the best seed sources (Chaperon 1978; Brune and Zobel 1981). FAO, CTFT, DANIDA and other groups have established seed procurement systems around the world which aim at improved seed selection, exchange and distribution.

• Research has contributed in a major way to the fivefold increase in rubber yields achieved in Malaysia since 1920. The estimated rate of return on investment in rubber tree research in Malaysia is 22 percent (Pee 1977).
Box 10.4.2. Additional examples of potential contributions of forestry research to development.

Contributions of Utilization Research

- Research has permitted Malaysia to increase the number of species it uses commercially from 100 to more than 654 in 100 timber groups (Salleh Mohd. Nor, personal communication). Similar progress in species utilization has been made in Costa Rica and other countries. Research in the Philippines, Colombia, and several developed countries has vastly increased the range of species from the natural tropical forest which can be utilized in paper production, thus opening up opportunities for productive, sustainable use of previously unused resources.

- Research in six countries reported by Fisseha (1983) indicates that the contribution of forest-based small-scale enterprises (SSEs) to total SSE employment varies between 13 and 34 percent. Their contribution to total value added varies between 16 and 47 percent, and to total value of production from 14 to 49 percent. In all cases forest-based SSEs were one of the more important sectors.

Contributions of Policy and Socioeconomic Research

- Anderson (1987) carried out detailed research on the economics of multipurpose tree species in Nigeria. The results indicate that rates of return can increase from 7.4 to 16.9 percent when soil conservation benefits are included in addition to wood and fruit benefits in agroforestry components, and from 4.7 to 21.8 percent when shelterbelt soil conservation benefits are added to wood benefits (poles and fuelwood) alone.

- A recent study by the WRI (Repetto 1988) reveals that, in Indonesia, Sabah/Malaysia, Ghana, and the Philippines, government policies on forest revenue systems and wood-processing industries provided strong economic incentives, which led to accelerated rates of forest depletion and substantial losses of government revenue, due to lack of adequate rent capture from concessionaires. The economic losses due to these policies, in addition to other social and environmental impacts, are enormous.
Activities

Study Unit Activities

Activity 1

Research impact can be examined from two perspectives: during planning or implementation (ex ante), or after research is completed (ex post). We have listed below a number of characteristics of these two types of evaluations. In the space provided next to each characteristic, note whether it would be derived from an ex post or ex ante evaluation.

<table>
<thead>
<tr>
<th>Impact Evaluation Characteristics</th>
<th>Ex ante or ex post?</th>
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<tbody>
<tr>
<td>1. Conducted while research is planned or underway</td>
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<tr>
<td>2. Indicate magnitude of benefits that resulted from a research program</td>
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<tr>
<td>3. Extract lessons after the research is completed</td>
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<td>4. Identify future directions for forestry research</td>
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<td>5. Justify requests for continued funding support</td>
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<tr>
<td>6. Assist in priority setting</td>
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<tr>
<td>7. Estimate future benefits of planned or current research</td>
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</tbody>
</table>

There are three types of impact evaluations. What are they? List them below and include several examples of each in the spaces provided.

<table>
<thead>
<tr>
<th>Type of Impact Evaluation</th>
<th>Examples</th>
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<tbody>
<tr>
<td>1.</td>
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### Comment 1

<table>
<thead>
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<td>6. Assist in priority setting</td>
<td>ex ante</td>
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<tr>
<td>7. Estimate future benefits of planned or current research</td>
<td>ex ante</td>
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</tbody>
</table>

### Comment 2

<table>
<thead>
<tr>
<th>Type of Impact Evaluation</th>
<th>Examples</th>
</tr>
</thead>
</table>
| 1. Economic evaluations   | • changes in income  
                            | • changes in cash flow  
                            | • reduced risk  
                            | • increased diversity of income sources  
                            | • benefit/cost studies  
                            | • economic impacts |
| 2. Social impact evaluations | • changes in labor patterns  
                             | • changes in health  
                             | • changes in household income, cash flow  
                             | • changes in distribution of costs and benefits between genders  
                             | • changes in resource allocations  
                             | • changes in social status  
                             | • changes in resource availability and distribution |
| 3. Environmental impact evaluations | • increased productivity  
                                     | • reduced soil loss  
                                     | • increased fertility, yields  
                                     | • improved crop or tree genetic quality  
                                     | • hillside and hydrologic stabilization  
                                     | • protection/enhancement of biodiversity  
                                     | • higher seedling survival |
Impact evaluations of forestry research can be used in many important ways by the research organization, donors, science, and society. List as many uses of impact evaluations you can think of in the space below. Reread the text if you can't think of at least four uses.

Uses of Impact Evaluations

1. 

2. 

3. 

4. 

5. 
Some uses of impact evaluation are to:

1. improve the planning of research programs designed to accomplish specific goals and objectives;
2. track the dissemination and use of research results;
3. modify and redirect research programs to better achieve the organization’s goals and objectives;
4. justify forestry research programs to policymakers, decisionmakers, and funders; and
5. determine how specific research programs are contributing to economic and social development in society, and how they are affecting natural resources and the environment.
There is quite a difference, generally not well appreciated by many researchers, between the outputs of a research study or program and its impacts. Review the list of results below, and identify each as being an output or an impact. Note your response in the space provided next to each term.

<table>
<thead>
<tr>
<th>Result</th>
<th>Output or Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td></td>
</tr>
<tr>
<td>Number of sites planted</td>
<td></td>
</tr>
<tr>
<td>Number of trees planted</td>
<td></td>
</tr>
<tr>
<td>Improved survival of trees planted by farmers</td>
<td></td>
</tr>
<tr>
<td>Number of research person hours</td>
<td></td>
</tr>
<tr>
<td>Final report</td>
<td></td>
</tr>
<tr>
<td>Greater biodiversity of agroforestry systems</td>
<td></td>
</tr>
<tr>
<td>Increased employment</td>
<td></td>
</tr>
<tr>
<td>Improved sustainability of forest use</td>
<td></td>
</tr>
<tr>
<td>Kilometers of hedgerows installed</td>
<td></td>
</tr>
<tr>
<td>Rate at which funds were disbursed</td>
<td></td>
</tr>
<tr>
<td>Number of extension documents produced per year</td>
<td></td>
</tr>
<tr>
<td>Increased family income</td>
<td></td>
</tr>
<tr>
<td>Number of studies planned, in effect, or completed</td>
<td></td>
</tr>
<tr>
<td>Quarterly reports</td>
<td></td>
</tr>
<tr>
<td>Number of new wood products developed for market</td>
<td></td>
</tr>
<tr>
<td>Improved international markets for rainforest nuts</td>
<td></td>
</tr>
<tr>
<td>Result</td>
<td>Output or Impact</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Number of participants</td>
<td>output</td>
</tr>
<tr>
<td>Number of sites planted</td>
<td>output</td>
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<tr>
<td>Number of trees planted</td>
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</tr>
<tr>
<td>Improved international markets for rainforest nuts</td>
<td>impact</td>
</tr>
</tbody>
</table>
Impact evaluations attempt to estimate the past or future effects of research. Forestry research should produce research results that will advance scientific knowledge and help society utilize and develop its forest and related resources in a sustainable manner. Those who fund forestry research expect the research to result in future benefits of one kind or another. They want substantial evidence that the research is significantly contributing to advancement of science and the betterment of society.

Research managers have an important responsibility to implement programs that effectively document the impacts of their organization's research program. Two different perspectives for analyzing research impacts, *ex ante* and *ex post* evaluations can be used to determine future research directions, derive lessons from research already conducted, justify requests for continued funding support, and determine the magnitude of benefits derived from the research activities. Economic, social, environmental, or natural resources impact evaluations can be conducted for specific purposes.

This unit was designed to help you to better evaluate how forestry research contributes to science and to society, and to improve your ability to describe the potential benefits of your research. By learning how to document and communicate the full impacts of your research program to funders, you can significantly improve your organization's success at securing new and continuing funding.

If you would like more information about estimating the impact of forestry research, we encourage you to obtain and review the interesting articles identified in the literature cited and other references listed at the end of the module. Two key articles directly related to the topics covered in the module, and cited in the text, are reprinted for your use in the section on readings at the end of the module.
Below are listed a number of skill and knowledge statements derived from the objectives of the study units in module 10. These are identical to those listed in the initial skill and knowledge assessment at the beginning of the module. Now that you have completed all of the study units in the module, 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.

<table>
<thead>
<tr>
<th>Skill or Knowledge Statement</th>
<th>Your Level of Skill or Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Specify the purposes of your organization's monitoring and evaluation system.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>b) Identify the potential users of the information provided by your monitoring and evaluation system.</td>
<td></td>
</tr>
<tr>
<td>c) State and use six basic questions that help to focus and make more meaningful the results of monitoring and evaluation activities.</td>
<td></td>
</tr>
<tr>
<td>d) Describe the primary uses of monitoring in research management.</td>
<td></td>
</tr>
<tr>
<td>e) List three types or levels of monitoring, and describe their functions.</td>
<td></td>
</tr>
<tr>
<td>f) List a number of methods or mechanisms which can be used to monitor forestry research activities.</td>
<td></td>
</tr>
<tr>
<td>g) Describe three criteria for evaluating the quality of research produced by your organization.</td>
<td></td>
</tr>
<tr>
<td>h) Describe several review mechanisms that ensure the production of research of acceptable quality.</td>
<td></td>
</tr>
<tr>
<td>i) Describe the difference between ex ante and ex post impact evaluations.</td>
<td></td>
</tr>
<tr>
<td>j) Identify the various types of impact evaluations used to determine research impacts.</td>
<td></td>
</tr>
</tbody>
</table>
LITERATURE CITED - MODULE 10


ADDITIONAL SOURCES OF INFORMATION

READINGS FOR MODULE 10

The following readings have been selected to provide you with additional information related to the material covered in module 10. We hope you will find them of interest.


The problem in conducting this research was not one of finding enough evaluation material, but of digesting, organizing, and synthesizing it to make it relevant and useful for forestry policymakers, research administrators, and other potential users. The framework that follows should help the reader analyze the methods and case histories discussed later. Of many possible frameworks, we know that this one works, and that it will aid the user in developing a useful evaluation approach for a specific problem. It is based on the following steps (fig. 1): (1) establishing the evaluation objectives, (2) identifying the evaluation measures and criteria, (3) selecting an analytical model, and (4) interpreting and presenting the results. Each element is discussed in detail below.

### Establishing the Evaluation Objectives

Evaluations can be undertaken for a variety of reasons and with a variety of objectives—in most cases, one research evaluation can serve a number of objectives. However, when starting out it is important that the evaluator and client agree on the reasons for conducting the evaluation. In addition to the education, resource allocation, and policymaking uses discussed earlier, there may be another consideration: the client's "hidden agenda"—i.e., whether the evaluation will eventually be used in an advocacy or nonadvocacy situation. All considerations must be clear to the evaluator and client.

In addition to the objectives of the evaluation, the objectives of the research must be known, since they help determine relevant evaluation measures. The following research objectives might be encountered in applied forestry research (Fedkiw 1981, Callaham 1981):

- Reduce costs of production.
- Increase quality of goods or service.
- Reduce uncertainty in production or consumption.
- Increase quantity per unit time, resource, etc.
- Increase variety or opportunity access (e.g., new products).
- Prevent loss (maintenance research).
- Increase stability of production or consumption system.
- Redistribute costs or benefits of forestry activities.

Serious problems can arise if research objectives are defined too narrowly, since the evaluator cannot credit to the project benefits from accomplishments not identified in the objectives. The evaluation may indicate that the project was unsuccessful when in fact it was very successful. This point has been discussed by Pasella (1982) as the "Christopher Columbus effect." Columbus set off to find a new route to the Indies and failed; but one could hardly call the mission a failure. Evaluations need to be flexible, with objectives that encompass any byproducts of a research project.
Identifying the Evaluation Measures and Criteria

The next step is to formulate questions to be answered by the evaluation. These questions help determine evaluation methods and criteria. For example, a policymaker asks for information related to the economic efficiency of a project. Because the policymaker's questions deal with economic efficiency, the evaluation must include measures of economic worth. In this case, the evaluation questions can be translated quickly into appropriate evaluation measures.

Evaluators do, of course, ask many noneconomic questions. Patton (1982) has identified 33 sets of questions asked by evaluators (table 1). Only a few of them can be answered by strictly economic evaluations. Noneconomic evaluation questions are less easily associated with specific evaluation criteria and measures. The process of identifying noneconomic criteria and measures illustrates the iterative nature of the evaluation process and the fact that most evaluations involve a series of successive approximations.

Selecting an Analytical Model

Several sources list and describe evaluation techniques, including Porter et al. (1980), Schub and Tolinni (1979), and Salsain et al. (1980). But before an evaluator becomes immersed in the menu of potential evaluation models, it is important to remember that two actors are involved in choosing the evaluation technique: the evaluator and the client. The evaluator may be primarily concerned with the technical characteristics of the evaluation—data availability, reliability, reproducibility, etc., while the client, or decisionmaker, may be more concerned with relevance and credibility of results. These two main categories—technical considerations and client considerations—are in turn influenced by legal, political, and other constraints. They can be further subdivided as indicated in figure 2, which lays out the main factors affecting the choice of an evaluation approach.

Technical Considerations

Technical considerations focus on (1) constraints imposed by the client or evaluation situation, and (2) individual model characteristics. Constraints are principally dollars, time, and data availability. Four

Table 1.—Patton's (1982) evaluation question sets

<table>
<thead>
<tr>
<th>Question set</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the program meet minimum standards for accreditation or licensing?</td>
<td>(Accreditation evaluation)</td>
</tr>
<tr>
<td>What services should clients be receiving? To what extent are current services appropriate to client needs?</td>
<td>( Appropriateness evaluation)</td>
</tr>
<tr>
<td>Who knows about the programs? What do they know? ( Awareness focus)</td>
<td></td>
</tr>
<tr>
<td>What is the relationship between program costs and program outcomes (benefits) expressed in dollars?</td>
<td>(Cost/benefit analysis)</td>
</tr>
<tr>
<td>To what extent has a specific objective been attained at the desired level of attainment (the criteria)?</td>
<td>(Cost-effectiveness evaluation)</td>
</tr>
<tr>
<td>What information is needed to make a specific decision at a precise point in time?</td>
<td>(Decision-focused evaluation)</td>
</tr>
<tr>
<td>What happens in the program? (No &quot;why&quot; questions or cause-effect analyses.)</td>
<td>(Descriptive evaluation)</td>
</tr>
<tr>
<td>To what extent is the program effective in attaining its goals?</td>
<td>(Effectiveness evaluation)</td>
</tr>
<tr>
<td>Can inputs be reduced and still obtain the same level of output or can greater output be obtained with no increase in inputs?</td>
<td>(Efficiency evaluation)</td>
</tr>
<tr>
<td>What are the inputs into the program in terms of numbers of personnel, staff/client ratios, and other descriptors of levels of activity and effort in the program?</td>
<td>(Effort evaluation)</td>
</tr>
<tr>
<td>To what extent is this program able to deal with the total problem? How does the present level of services compare to the needed level of services?</td>
<td>(Extensiveness evaluation)</td>
</tr>
<tr>
<td>The evaluation is conducted by people outside the program in an effort to increase objectivity.</td>
<td>(External evaluation)</td>
</tr>
<tr>
<td>How can the program be improved?</td>
<td>(Formative evaluation)</td>
</tr>
<tr>
<td>To what extent do individual clients attain individual goals on a standardized measurement scale of 1 (low attainment) to 5 (high attainment)?</td>
<td>(Goal attainment scaling evaluation)</td>
</tr>
<tr>
<td>To what extent have program goals been attained?</td>
<td>(Goals-based evaluation)</td>
</tr>
<tr>
<td>What are the actual effects of the program on clients (without regard to what staff say they want to accomplish)?</td>
<td>(Goal-free evaluation)</td>
</tr>
<tr>
<td>What are the direct and indirect program effects on the larger community of which it is a part?</td>
<td>(Impact evaluation)</td>
</tr>
</tbody>
</table>

(Table 1 continued)
Table 1.—Continued

<table>
<thead>
<tr>
<th>Question set</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Program staff conduct the evaluation (Internal evaluation)</td>
<td></td>
</tr>
<tr>
<td>What happens is the program and to participants over time? (Longitudinal evaluation)</td>
<td></td>
</tr>
<tr>
<td>Was the evaluation well done? Is it worth using? (Meta-evaluation)</td>
<td></td>
</tr>
<tr>
<td>What do clients need and how can those needs be met? (Needs assessment)</td>
<td></td>
</tr>
<tr>
<td>How does the program population compare to some specific norm or reference group on selected variables? (Norm-referenced evaluation)</td>
<td></td>
</tr>
<tr>
<td>To what extent are desired client outcomes being attained? What are the effects of the program on clients? (Outcomes evaluation)</td>
<td></td>
</tr>
<tr>
<td>What are participants actually able to do as a result of participation in the program? (Performance evaluation)</td>
<td></td>
</tr>
<tr>
<td>How effective are staff in carrying out their assigned tasks and in accomplishing their individual goals? (Personnel evaluation)</td>
<td></td>
</tr>
<tr>
<td>What are the strengths and weaknesses of day-to-day operations? How are program processes perceived by staff, clients, and others? What are the basic program processes? How can these processes be improved? (Process evaluation)</td>
<td></td>
</tr>
<tr>
<td>What are the characteristics of specific and concrete products produced by or used in a program? What are the costs, benefits, and effects of those products? (Product evaluation)</td>
<td></td>
</tr>
<tr>
<td>Are minimum and accepted standards of care being routinely and systematically provided to patients and clients? How can quality of care be monitored and demonstrated? (Quality assurance)</td>
<td></td>
</tr>
<tr>
<td>What routine social and economic data should be monitored to assess the impacts of the program (e.g., health statistics, housing statistics, employment statistics)? (Social indicators)</td>
<td></td>
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<tr>
<td>Should the program be continued? If so, at what level? (Summative evaluation)</td>
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</tr>
<tr>
<td>What information is needed and wanted by decisionmakers, information users, and stakeholders that will actually be used for program improvement and to make decisions about the program? (Utilization-focused evaluation)</td>
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</tbody>
</table>

Characteristics of each model or technique are particularly important in the selection process: (1) reliability, (2) relevance, (3) relative cost, and (4) data requirements.

Reliability is determined by the theoretical soundness of the model, reproducibility of the results, objectivity, and acceptance by the scientific community. Model relevance is concerned with two factors: the extent to which the approach can generate results by the time they are needed, and the extent to which the model provides answers to the evaluation questions. Relative cost is the cost of using the model in relation to the available budget.

The question of data needs and availability is a critical one. Models differ dramatically in data needs. In the case of forestry, models that depend heavily on production and growth time series data, which are generally unavailable, may have to be discarded. Schuh and Tollini (1979) concludes that, "...simple approaches which are less demanding in terms of data are more useful than more complicated procedures which have to be based on more precarious data."

Client Considerations

As discussed earlier, the major impact of the client on the evaluation process is in determining objectives. We've discussed the three uses of research evaluation: (1) resource allocation, (2) policymaking, and (3) education. The evaluation technique is also affected by whether the evaluation will be used in an advocacy or nonadvocacy situation.

Another major consideration is the client's criteria for use. Although the relevance of the evaluation is important in determining whether an evaluation is used, some would argue that the overriding consideration is credibility. A 1976 report of the House Subcommittee on Oversight and Investigations states that the most significant factor in the acceptance of a benefit-cost study is the name of the sponsor (Anonymous 1980). Thus, the question of credibility is critical.

Credibility is influenced by four factors:

1. The perceived independence of the evaluator. For example, the research evaluation program of the Commission of the European Communities (CEC), stressed that "the independence of the assessments was considered essential to ensure objectivity and so to provide credibility" (Contzen et al. 1982).
2. The understandability of the evaluation approach.
3. The consistency of the evaluation results with other evaluations. However, too many favorable evaluations, with no negative ones, can decrease credibility.
4. The degree of agreement with the decisionmaker's intuitive judgment and beliefs. Along similar lines, the more the approach and results are accepted by the decisionmaker's trusted advisors or analysts, the more credible the evaluation.
Interpreting and Presenting the Results

Results of evaluations are often misinterpreted. Correct interpretations depend on good evaluations—i.e., those which consider the relevant dimensions of the situation. For example, the fact that a number of isolated research evaluations turn up with quite high rates of return to research does not mean that there is a general underinvestment of funds in this field of research. One can infer nothing about overall program funding from a review of a few isolated project evaluations. Further, most evaluations measure a very specific impact of a project along one narrow dimension (e.g., economic efficiency). One has to be careful not to broaden the interpretation to include dimensions not covered by the model.
RESEARCH EVALUATION: LESSONS FOR FORESTRY

Forestry research evaluators need not operate in a vacuum; there is a large body of literature in agricultural and industrial research evaluation, among other areas, to which they can turn for guidance. By studying examples from other fields, we can assess the potential usefulness of the various approaches or combinations of approaches for forestry research evaluation.

The point about combinations of approaches bears some emphasis. In most forestry research situations, some combination of quantitative and qualitative evaluation tools is needed, especially in research areas not dealing directly with market-priced products. As will be discussed later, 75 percent of agricultural research evaluations deal with a narrow range of commercial field crops. There are relatively few examples of quantitative evaluations that address other types of agricultural research.

This chapter, which covers a wide array of approaches to research evaluation, is arranged in three sections. It begins with a review of agricultural research evaluation, where efforts have focused heavily on methodology. This is followed by a review of industrial research evaluation, where the approach has been much more pragmatic. The final section of the chapter discusses other approaches to research evaluation not readily placed in disciplinary categories.
MONITORING AND EVALUATION IN THE MANAGEMENT OF AGRICULTURAL RESEARCH

Diana McLEAN

May 1988

International Service for National Agricultural Research
The ISNAR working papers series is a flexible instrument for sharing analysis and information about relevant organization and management problems of the agricultural research systems in developing countries.

In the course of its activities - direct assistance to national agricultural research systems, training, and research - ISNAR generates a broad range of information and materials which eventually become the formal products of its publication program. The working papers series enhances this program in several important ways:

1. These papers are intended to be a rapid means of presenting the results of work and experiences that are still in progress, but are already producing results that could be of use to others.

2. They are intended to be an effective vehicle for widening the discussion of continuing work, thereby increasing the quality of the final products. Critical comment is welcomed.

3. The series provides an outlet for diffusing materials and information which, because of their limited coverage, do not meet the requirements of "general audience" publication.

The series is intended mainly for diffusion of materials produced by ISNAR staff, but it is also available for the publication of documents produced by other institutions, should they wish to take advantage of the opportunity.
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This paper was prepared to introduce agricultural research managers to the basic concepts and approaches of monitoring and evaluation (M/E). It provides the framework for the development of a series of materials at ISNAR on the comprehensive topic of monitoring and evaluation. These subsequent papers will attempt to provide research managers with techniques of M/E for planning purposes (ex ante), ongoing project and program evaluation, final project evaluation, and impact evaluation.

This paper introduces the general topic of monitoring and evaluation, including a brief definition of terms, and the functional roles of different types of evaluation in research systems. The importance of expert or peer review is discussed as the most fundamental method of research evaluation at all stages of planning and implementation. The paper underlines the importance of integrating monitoring and evaluation into routine management practices, so that they are viewed by both those conducting evaluations and those being evaluated as tools for improving research. In addition to the main text there is an annex which more thoroughly discusses the evaluation of ongoing research, largely through annual reviews and comprehensive program reviews.

This paper discusses the distinct yet interrelated aspects of evaluating research performance, quality, and relevance. It does not attempt to cover the monitoring and evaluation procedures associated with personnel appraisal and financial and administrative management. These topics are considered in other ISNAR papers on human resource management and in general management literature.

It is necessary here to define the terms "program" and "project", since they have different meanings in different research organizations. Programs are coordinated research activities whose combined scientific output addresses national research objectives. Programs are long-term and somewhat continuous, and are composed, in some cases, of sub-programs, and of projects. Projects address specific research problems, and have explicitly defined timeframes, resources, and targets. Each project in turn comprises a number of specific operations or experiments.

Finally, I would like to acknowledge the contribution of ISNAR staff and others to this paper. Josette Murphy, formerly of ISNAR, made substantial progress on the topic, reflected in the draft publication Monitoring and Evaluation in Agricultural Research: Concepts, Organization, and Methods, and ISNAR Working Paper #2, Using Evaluations for Planning and Management: An Introduction. Matthew Dagg and Peter Goldsworthy have worked on integrating evaluation with planning, and have begun attacking the problem of identifying appropriate indicators at different levels of technical programs. Each has served as the ISNAR working group chairperson for monitoring and evaluation. Other ISNAR staff have offered valuable support, particularly Ghazi Hariri, Genevieve Michel, Dennis Wood, Paul Marcotte, and Rudolf Contant. In addition, I would like to offer deep gratitude to S.A. Adetunji, A.M. Masha, D.R.B. Manda, S.N. Maturi, J. Nya Ngatchou, B. Patel, E. Whingwiri, and Yohannes Kebede, who served as expert consultants on this topic.
INTRODUCTION

Information is the most valuable input for decision making. In national agricultural research systems information is needed at all levels of planning and implementation: by policymakers, national planners, and agricultural research leaders. Processes of monitoring and evaluation (M/E) are the primary means of collecting and analyzing information, and are thus intrinsic to good research management. Over the past decade, research managers have become increasingly aware of the importance of installing M/E procedures into their organizations, but the successfulness of these efforts has been mixed.

There are several reasons to integrate M/E into national agricultural research systems. One major reason is that since the economic recession of the 1970s research funds have been limited, and governments have required more justification for and controls over funds. In addition to the recession-induced constraints, the expanding fields of science and the growth of research institutes have created a greater demand for the existing resources. In order to remain productive in the increasingly more specialized areas of science, intellectual leadership is needed in each field, and funding must be available for the most promising and important research areas. It therefore becomes necessary to evaluate exploitable areas of science, the research most likely to provide new technologies to fuel national development, and to identify areas of investment. In addition, evaluation can improve ongoing research, through improved technical decision making and management.

Monitoring is essential for evaluation (Figure 1), and evaluation is used to assess:

- the potential impact of research in priority-setting and planning exercises;
- the performance and quality of research in progress;
- the successful completion and relevance of research projects;
- the ultimate impact of research results on the achievement of development objectives.

Monitoring includes the periodic recording, analysis, reporting, and storage of data on key research indicators. Monitoring primarily provides information on project performance, on whether an activity is proceeding according to plan. However, if ex post project evaluations or impact evaluations are to be held, it will also provide information on socioeconomic indicators for these purposes. For ongoing research, managers primarily monitor resources, such as the use of funds and personnel, and processes, such as the occurrence of annual review meetings or periodic seminars. This permits management to compare the progress of work against planned objectives, detect deviations, identify bottlenecks, and take corrective action while research is in progress.

The best key indicators of project performance are objective, quantifiable, and unambiguous. They can be verified if necessary. A good monitoring system is not more time consuming than the benefits justify, collects no superfluous data, is timely in data analysis, interpretation, and feedback, and is useful to researchers.
Evaluation is based on both qualitative and quantitative information, gathered through monitoring and from other sources. Whereas monitoring tracks research performance, whether progress is according to plan, evaluation analyzes issues of quality and relevance, and may even analyze the appropriateness of the plan itself. Evaluations result in a set of recommendations, which may address issues of planning, such as a shift in program objectives or content, or implementation, such as the need for more laboratory capacity.
Monitoring and evaluation are not new concepts. Yet research institutes have had little success in integrating effective M/E into their organizations. Why? Many professionals find it difficult to apply stricter management and control measures on what is essentially a creative process. They have come to accept that research has characteristics which distinguish it from most non-research activities, where M/E is more easily applied. Research is also intrinsically uncertain in its timing and its products, since progress depends on previous experimental results and breakthroughs made elsewhere.

The failure to conduct effective M/E can also be attributed to the attitudes of the researchers themselves. Monitoring and evaluation is regarded by many researchers as a burden inflicted upon them by bureaucrats, a process that leads from "analysis to paralysis". This attitude has been nurtured by the limited use of evaluation for inspection, auditing, or control purposes. In order for M/E to be used in a more positive manner, management and staff must have a common understanding of the importance of the processes involved, and of the contribution M/E can make to achieving the objectives of the research system. This requires that management fully support the integration of M/E into day-to-day operations.

Part of the problem also lies in the imprecise nature of the terms "monitoring" and "evaluation". The depth of analysis associated with each, their interdependence, and the use of the term evaluation to describe entirely different management processes have confused many managers. Any assessment, appraisal, analysis, or review is in the broader sense evaluative. However, in defining evaluation as a management tool, we have assumed that certain basic criteria exist:

1. There must be clearly defined targets and key indicators, and they must be determined in advance. This ideally occurs during ex ante evaluation, where baseline data and assumptions about project progress are explicitly laid out, and from which systematic monitoring procedures are set up. The data monitored often take the form of a time series of well-chosen observations.

2. The principal purpose for carrying out an evaluation needs to be clearly stated. It should be kept in mind that research does not function in isolation, and therefore evaluators must consider the political, institutional, social, and economic context in which research is conducted. Evaluation occurs at different management levels for different purposes, and can be concerned with such diverse factors as the use of institute resources, the scientific quality of research, the appropriateness of the technology, or national returns on investment in different sectors.

3. The scope of the evaluation must be clearly understood. When evaluating the impact of research, a differentiation must be made between research results and the contribution they make toward greater development objectives. Since this contribution is influenced by national infrastructure, economic parameters, extension possibilities, etc., successes or failures in agricultural development cannot be ascribed solely to technology generated from research. Research creates only the potential for development; whether or not this is realized depends on many other factors.
TYPES OF RESEARCH PROGRAM EVALUATION

Information from evaluations is used in different stages of research management (Table 1), by all levels of the management hierarchy. It is used in the management of technical programs, personnel, and financial resources. All research managers have participated in some monitoring and evaluation exercises, such as personnel appraisal, program planning, or end-of-project review of donor-funded activities. But most research institutes do not use M/E to maximum advantage. This section discusses the types of evaluations that are useful to managing the research program itself.

Part of the confusion surrounding the discipline of evaluation is an inconsistency in the terminology used. This becomes even less clear in the area of research evaluation, where little previous work has been done. In order to discuss the concepts, issues, and methods of the different types of evaluation, it is necessary to define a working vocabulary. Since there is no consensus on the terminology, ISNAR has accepted the following broad definitions.

Research evaluation: performance, quality, and relevance

The evaluation of technical research programs involves three important aspects. The performance of the research program compares achieved with expected outputs. It is primarily concerned with the use of resources, and the timeliness of the activity, and is determined mostly through monitoring and ongoing evaluation. Results from performance M/E are used to improve management procedures and increase productivity.

Assessing the success or failure of research, however, goes far beyond determining whether resources were used according to plan. Quality in research execution - the adherence to accepted standards of scientific work and precision - is essential. Evaluating quality in research poses serious problems for research organizations that lack experienced scientific expertise to cover all the disciplines and areas being researched. The quality of research is determined almost exclusively through some form of peer or expert review. Due to its importance and the problems encountered with peer review in many organizations, the topic will be covered in some detail in this paper.

Finally, research must be relevant. In most developing countries, research is "mission-oriented"; that is, it attempts to solve constraints or provide opportunities to national development. Evaluating the relevance of research involves relating each level of research objectives (from project to program to institute) to the next higher objectives, which ultimately reflect development objectives. Relevance, too, is primarily assessed through peer or expert review; in this case expanded from a more specific disciplinary focus to include experts in social, economic, and even political sciences. Determining the relevance of research often involves feedback from on-farm research and data collection through formal and informal surveys.

To discuss evaluation, it is necessary to distinguish between types of evaluation, since practitioners use terms inconsistently. Evaluations are most often categorized according to when they occur and their
<table>
<thead>
<tr>
<th>Level of management</th>
<th>Type</th>
<th>Methods</th>
<th>Frequency</th>
<th>Use</th>
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<tbody>
<tr>
<td>1. Cabinet Impact</td>
<td>Ex ante</td>
<td>Socioeconomic survey Technical &amp; socioeconomic analysis</td>
<td>10-15 yrs</td>
<td>Guide investment level to broad sectors</td>
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<td>2. Agriculture</td>
<td>Ex ante</td>
<td>Socioeconomic survey Technical and socioeconomic analysis, and review</td>
<td>10-15 yrs</td>
<td>Guide balance of investment in research/development institutions</td>
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<td>ministries Impact</td>
<td>Ex post</td>
<td></td>
<td>3-5 yrs</td>
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<td>3. National</td>
<td>Ex ante</td>
<td>Technical and socioeconomic analysis and review</td>
<td>3-5 yrs</td>
<td>Determine potential impact of research initiatives to guide allocations to research institutions</td>
</tr>
<tr>
<td>agricultural</td>
<td>Ex post</td>
<td></td>
<td></td>
<td>Verify original assumptions/lessons learned</td>
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<tr>
<td>research (council)</td>
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<tr>
<td>4. Research</td>
<td>Ex ante</td>
<td>Technical and socioeconomic analysis</td>
<td>3-5 yrs</td>
<td>Determine potential impact of research initiatives; justify/allocate resources to divisions/programs</td>
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<tr>
<td>institutions</td>
<td></td>
<td></td>
<td></td>
<td>Improve efficiency of management of research institution</td>
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<tr>
<td>Monitoring</td>
<td>Resource/process evaluation</td>
<td>periodic</td>
<td>Improve research implementation and planning</td>
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<tr>
<td>Ongoing</td>
<td>Peer/expert review</td>
<td>annual</td>
<td></td>
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<tr>
<td>5. Research</td>
<td>Monitoring</td>
<td>Resource/process evaluation</td>
<td>periodic</td>
<td>Improve station management</td>
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<td>stations</td>
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<tr>
<td>6. Programs</td>
<td>Ex ante</td>
<td>Technical &amp; socioeconomic analysis</td>
<td>3-5 yrs</td>
<td>Determine potential impact of different research approaches, projects</td>
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<tr>
<td>Monitoring</td>
<td>Resource/process evaluation</td>
<td>periodic</td>
<td>Improve program management</td>
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<tr>
<td>Ongoing</td>
<td>Peer/expert review</td>
<td>3-5 yrs</td>
<td>Guide short-term program planning</td>
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<tr>
<td>7. Projects</td>
<td>Monitoring</td>
<td>Resource/process evaluation</td>
<td>periodic</td>
<td>Improve project management</td>
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<tr>
<td>Ongoing</td>
<td>Peer/expert review</td>
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<td>Guide to modify projects in progress</td>
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<tr>
<td>Ex-post</td>
<td>Technical/socioeconomic review</td>
<td>3-5 yrs</td>
<td>Guide for future projects</td>
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<tr>
<td>8. Researchers</td>
<td>Monitoring</td>
<td>Resource/process evaluation</td>
<td>periodic</td>
<td>Improve activity management</td>
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<tr>
<td>Ongoing</td>
<td>Peer/expert review</td>
<td>annual</td>
<td>Guide research execution and planning</td>
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purposes. The evaluation of research occurs before (ex ante) to assess the potential impact of research, during (ongoing) to evaluate the performance and quality of research projects in progress, immediately after (ex post) to determine the successful completion and relevance of research projects, and 10-15 years after research results have been achieved (impact), to assess its ultimate impact on development.

**Ex ante evaluation**

Ex ante evaluation is a research planning process, which includes a comprehensive analysis of the potential impact of alternative activities before implementation. The primary method used in ex ante evaluation is peer or expert review, and the fundamental techniques are the same as those described in the paper "Priority Setting in Agricultural Research": primarily checklists, scoring models, and benefit/cost analysis. Many people associate the term "ex ante evaluation" with economic analyses, often at the national planning level. However, ex ante evaluation can occur at all levels, in institutes, programs, and even research projects, and the term is often used interchangeably with what different people call priority setting, planning, and program formulation.

Different evaluation criteria are considered at these various levels, depending upon the analysis being conducted. For instance, at higher levels, where planning takes into consideration the allocation of resources to different commodities, economic data would be more important than at the program level, where scientific and technical criteria become dominant. Some of these various criteria are potential economic impact, compatibility with development goals and research objectives, urgency for research, resource availability, the appropriateness of research results, including ease and cost of adoption by farmers, political influences, regional concerns, and contribution to technical programs and world knowledge.

The techniques also vary. Techniques of cost/benefit analysis, and econometric techniques using a production function approach are sometimes used at national or institute levels of decision making. While these techniques are theoretically applicable, it is often difficult to obtain the necessary personnel and data to conduct the analyses, and it is hard to identify and analyze the externalities arising from research which add benefits not captured in cost/benefit models. A possible exception is very specific research, such as the development of hybrids, where benefits can be captured by a single indicator, say improved yield.

At the project and program levels the techniques most often used are checklists and scoring models, with less emphasis on economic analysis. For these more subjective techniques, expert advice becomes extremely important. Research organizations differ in how researcher oriented they are; that is, how much individual judgement influences scientific priorities. In more project-oriented systems, the reviewers have more control over the development of the research program. A positive benefit of the project system is that researchers must clearly formulate objectives and workplans. This makes management-by-objective possible, which can economize on scarce resources. The project approach also encourages interaction between experienced and less experienced researchers in the planning of research proposals.
Ex ante evaluations are not always as comprehensive as they should be. As currently practiced, they tend to be restricted in their focus to particular disciplines. For instance, an economist might conduct an ex ante evaluation to look at potential returns to investment. A rural sociologist, through diagnostic surveys, would enlarge the criteria to include social benefits from research. A biological scientist might look only at scientific merit or the potential to make a technical breakthrough. To make ex ante evaluations more effective, there should be participation from different disciplines, and more comprehensive criteria should be applied. Thorough ex ante evaluation defines the baseline against which progress will be measured, sets targets, and states the assumptions used in making the projections. In addition, in order to tie ex ante evaluation to ex post evaluation, the indicators to be monitored during the course of the activity should be defined.

Even at the highest levels of management, effective ex ante evaluation depends on information from the researchers in the system. Management must assure mechanisms for conveying feedback from researchers on what they consider necessary or good opportunities for research investment, the potential contribution of different lines of research to development, and current or projected bottlenecks preventing the full adoption and use of research results. Likewise, management must communicate priorities and national objectives to researchers so operational planning can take place at the program and project levels.

Evaluation of ongoing research

The evaluation of ongoing research, also called ongoing or interim research evaluation, is the periodic review of research in progress. It is used to analyze not only the use of resources but also the quality of research, and the continuing relevance of research programs and projects. Ongoing evaluations can be annual in the case of project reviews, on demand in the case of suspected problems in implementation (such as unforeseen budget cuts or the departure of key staff), or every three to five years in the case of a comprehensive program review. Ongoing evaluations also consider program processes, by looking at such things as the occurrence and quality of the annual project proposal and review process, or the administration of research stations.

The most prevalent form of ongoing research evaluation looks at research performance, comparing achieved with expected activities, usually on an annual basis in the case of research projects. It indicates how efficiently resources are used and identifies implementation problems. It is important to note that efficient research is not necessarily successful. The effectiveness or relevance of the research conducted, as defined by its original objectives, is of greater importance.

Accordingly, recommendations from this level of ongoing evaluation mainly address problems associated with the day-to-day management of research, although they may also indicate the need for changes in project objectives and targets. Monitoring is fundamental to this type of evaluation. It primarily tracks the provision and delivery of inputs and services, and requires the generation of information on the availability and deployment of staff, infrastructure, equipment, supplies, services, and funds for projects within programs. While not necessarily the
responsibility of project leaders themselves, a lack of awareness of the availability and quality of resources can have negative effects on the research in progress. If reporting systems for personnel and supplies are functioning reasonably well, and a proper work plan with defined resources and benchmarks has been prepared in the research proposal, it is relatively easy to install an adequate monitoring system for performance evaluation.

Apart from the day-to-day monitoring of resources, a distinctly different monitoring process is used in the execution of applied and adaptive research; that is, receiving feedback from clients—farmers, extension services, and development organizations—during the course of the research. This is most often done through on-farm research. This feedback in the early stages of experimentation can save substantial resources and effort if a reorientation is required.

Ongoing research evaluation is also concerned with the quality of research, and to some degree its continuing relevance. This assessment is most often conducted through expert or peer review under the technical leadership of heads of institutes or programs, and assures the soundness of technical decisions at all levels in programs and projects. The adherence of scientists to accepted research standards should be an important part of the annual project review. This is not always the case, where either time constraints, lack of experienced researchers to serve as peers, or an over-emphasis on performance exists. The issue of continuing relevance of program and project objectives is most often included in comprehensive program evaluations.

Ex post evaluation

An ex post or final evaluation assesses project performance, quality, and relevance immediately after project completion. It attempts to measure the effectiveness and efficiency of a completed activity, and includes an analysis of the original assumptions used in planning. Ex post evaluation might be confusing to those research managers who, erroneously, establish no time frames for projects. Using established norms, the results which a project is expected to achieve in a given time can be specified. Estimating the time frame is part of the ex ante evaluation exercise. Good ex post evaluation is linked to ex ante evaluation, and can best be conducted where a baseline was originally defined, targets were projected, and data were collected on important indicators. Unfortunately, the link between ex ante and ex post evaluation is poor in many organizations, and the two are often even conducted by completely separate groups. Ex ante evaluation is most often conducted through expert consensus, while ex post evaluations are increasingly becoming the preserve of professional evaluators. Care must be taken to avoid this separation.

Ex post evaluation is more in-depth than the annual project evaluation, and analyzes the project from beginning to end, determining whether project objectives were attained, causes for discrepancies, costs, and the quality and relevance of the research. Ex post evaluation indicates which projects might be continued, expanded, reduced in scope, or terminated. Lessons learned from ex post evaluation are incorporated into subsequent project planning exercises. Due to the costs of conducting ex post evaluations, they are usually done only for the more important, innovative, or controversial projects.
Ex post evaluations often consider such aspects as the cost effectiveness of research; its potential relevance to national development goals; the response of research to an urgent and important problem; the acceptance of results by farmers, extension services, and development agencies; and the contribution of research to world knowledge. The aspects considered and the depth of the analysis will vary with the importance of the activity and the interests and values of the organization, such as those having economic, social, or nutrition biases.

While indicators for research performance are easily identifiable, much more work is needed to identify evaluation indicators which deal with research quality and relevance. In most developing countries research is meant to serve development objectives. The customary criteria for evaluating scientific research, most notably journal publications and instances of citation, are not comprehensive enough to consider the appropriateness of technology or its value to development. Research organizations must, therefore, broaden the classical criteria for evaluating research, and monitor these more comprehensive indicators. Some organizations are trying to evaluate user satisfaction as the major criterion of ex post evaluation. This can be difficult, as farmers may not be able to place a value on the research itself.

Advance preparations for ex post evaluation should include precise plans on documentation to obtain, people to interview, and sites to visit. Some supplemental information may need to be gathered through surveys or interviews. Most evaluation teams use a blend of interviews, field visits, observations, and report reading. Beyond a comparison of achieved and expected results, ex post evaluation tries to clarify the internal and external factors affecting these results.

Impact Evaluation

Impact evaluation, also referred to in some of the literature as ex post evaluation, attempts to determine the extent to which research programs have contributed to larger development goals, such as increased farm production or food self-sufficiency. Impact evaluations, which often indicate rates of return on the research investment, are primarily used to convince policymakers to allocate more resources to research. It has a time frame of ten or more years after research results have been released, making it less of a management tool than the other types of evaluation. As with other ex post evaluations, the baseline data, targets, and assumptions from ex ante evaluation are the basis for determining progress and ultimate impact.

An evaluation of the impact of research programs on development is greatly facilitated by prior evaluations of each project. If project and program evaluations are eventually to be used to support impact evaluations, this should be considered during ex ante evaluation and indicators chosen to serve this future purpose. For instance, if market prices need to be monitored periodically for use in a future impact evaluation, this must be identified at the ex ante stage of evaluation and monitored during the course of the activity.

Evaluating the contribution of research to economic development is complex, and there has been controversy over some of the techniques
used. Impact evaluations must distinguish between the contributions research makes to national development from the contributions made by other factors, such as the existence of a good extension service, agricultural inputs, adequate infrastructure, and favorable marketing and pricing policies. Whereas benefits have been relatively easy to attribute in the case of single-commodity technologies, such as high-yielding rice under irrigation in Asia, it has proved far more difficult to do this in more diverse and complex agricultural systems. As a consequence, input-output models which simply correlate investment levels in research with national productivity are not convincing.

Therefore, in addition to economic analysis, the case study approach has often been adopted, seeking the views of the users of the research where they can be identified. While this approach can give a more complete picture of the contribution of research to the client community and ultimately to national development, this approach requires extensive and often expensive data collection and a thorough analysis of socioeconomic factors. The results of impact evaluations can have broad implications for future priority setting, not only for research but also for development support services.

EVALUATION CRITERIA AND METHODS

It is useful in a discussion of monitoring and evaluation to distinguish between the terms criteria, indicators, methods, and techniques. Research evaluations are undertaken for many reasons and in many different contexts, and the evaluation criteria under investigation vary to some extent, depending on the type of research under investigation (e.g., basic, applied), the time frame of the evaluation (e.g., ex ante, ex post), and the aspects considered important (performance, quality, and relevance). Indicators are then selected to serve as a measurable means of determining whether the criteria are being met. They are usually quantifiable and can be verified. For instance, if a criterion for project selection (ex ante) is scientific merit, the indicator used might be demonstrated usefulness of the technology to an associated ongoing program, and the method used might be a form of peer review. The diversity of possible choices of criteria and of the methods used to evaluate them, makes the development of generalities difficult. For any given method, there might be several techniques, the use of which will depend on available data and personnel to conduct the analyses. This paper concentrates on general evaluation criteria and methods, and not on the specific indicators and techniques employed.

For project selection (ex ante evaluation at the project level) the criteria generally applied are technical and operational: scientific merit, the appropriateness of the resources required, and whether the project addresses larger program objectives. The need to demonstrate potential usefulness of research to greater social and economic goals is clearly strongest in mission-oriented research, but in recent years this criterion has also become important for strategic research. Strategic research targets are more difficult to define, and evaluation of strategic research tends to be more continuous and less product-oriented.
Ex ante evaluation criteria at the program level are expanded to accommodate an increasing emphasis on relevance and national returns on investment, and include scientific merit, relative opportunities for success from major thrusts within a commodity or among commodities, the allocation of resources to cover major program objectives, and the relationship between program objectives and national research objectives.

The criteria for ex post evaluation are related to those used in ex ante evaluation. However, they are most often conducted for large projects, programs, or institutes, and are not considered cost effective for all individual projects. The criterion of scientific merit remains important; this can be hard to assess because the component projects can be difficult to aggregate and analyze. Ex post evaluation criteria may differ from those originally defined in ex ante evaluation. Economic and social impact of a program may have become more important than originally assumed, or the objectives of the institute may have changed to reflect changes in policy or opportunities for development. Ex post evaluation may also be more concerned with efficiency. Evaluation criteria and what constitutes success usually differ from one project to another; this means that comparison with other projects is limited as an evaluation method.

Several general methods are used in research evaluation, depending on the criteria considered most important and the purpose of the evaluation. For instance, if performance is the primary concern and the purpose of the evaluation is to improve institute or program management, resources and processes will be monitored and evaluated in what is often called a "performance audit". If research quality is the primary concern, peer or expert review in some form will predominate. For relevance issues, the primary method is comprehensive evaluation based on technical and socioeconomic analyses, using experts from various disciplines. It is very important that those carrying out the evaluation and those being evaluated understand its purpose, and the intended use of the results.

Techniques refer to different tools used to supply evaluation teams with information, and these techniques are being continually refined and developed. It is important to note that while there is controversy over certain techniques, there is at present little disagreement about the fundamental soundness of methods of evaluating research based on a consensus of experts.

Currently, the predominant method employed in the evaluation of all three aspects of research is based to some degree on peer or expert review. Peer review is the process in which scientific merit is evaluated by other scientists working in or close to the field. The field must be sufficiently large for peers to be readily identified and there must have been time for the field to develop to the stage where a basis for agreement on what constitutes quality exists. By contrast, expert review involves the eminent specialists in a particular field, and is more often used when evaluating an entire program or a specialized institute.

There are numerous ways of conducting peer and expert review, and the method selected must take into consideration the organization and the culture it operates within. While some research organizations have had
negative experiences with peer review, there is no substitute for it in research evaluation. In these cases, the organization should attempt some modified peer review process. The Organisation for Economic Co-operation and Development (OECD) has identified the following types of peer review:

- **Direct peer review** is defined as a review by scientific peers which is confined to determining the scientific merit of an activity. Committee peer reviews are common, both for ex ante and ex post evaluation. Committee members may reach decisions individually, through a group consensus or in a phased combination of the two. Criticisms of the method arise when it is applied to multidisciplinary research, or in cases where resources are severely constrained and peers may be in competition with those being reviewed.

- **Modified peer review** is similar, but the criteria are broadened from scientific merit to cover the socioeconomic aspects of strategic and applied research. This requires integrating non-scientists into the direct peer review process. The most frequently used approach is to include users of research on committees and panels. A two-stage process is often used: one which looks at "good science" and the second which looks at relevance. Another approach is to supplement the conventional direct peer review with interviews and/or questionnaires to add more and different information to the evaluation. Many evaluators have suggested that this method is less reliable than open committee discussion in obtaining a balanced view. In any event, balanced judgements are necessary between specialists and generalists, and the management of the process becomes extremely important.

- **Indirect peer review** is based on information from peer reviews conducted for other purposes. Distinction in scientific performance is recognized in many ways: through the award of prizes, membership in prestigious societies, honorary degrees, etc. Other indications of scientific performance come from bibliometric analysis. Bibliometrics is founded upon the assumptions that the output of scientific research is consistently represented by articles appearing in scientific journals; that the number of citations to these articles is a legitimate indicator of their impact or quality; and that accurate data are available. It is questionable whether bibliometrics is relevant in developing countries. Some problems include the time and expense of conducting the analysis, a bias towards English-language journals, poor coverage in the data base of certain fields, and in applied and adaptive research.

There are many problems associated with peer review. Successful peer review depends on evaluator objectivity, true scientific expertise, and a common objective of improving research. In fact, this is often not achieved. Depending on the personalities, skills, conflicts, and competitiveness within the organization, peer review may be negatively applied. The inclusion of foreign experts can provide a means of achieving objectivity in peer review where competitiveness or lack of scientific expertise exists. The problem of scientific objectivity also becomes greater when the research is multidisciplinary or aims to achieve social or economic objectives. It then becomes necessary to broaden the
team of evaluators to include specialists from different disciplines, and perhaps representatives from development organizations, planning bodies, etc. The institute may need to develop team building and communication skills among the evaluators to do this effectively.

Attempts are being made to enhance peer review by introducing a broader base of information, such as through bibliometrics, but in no cases have these methods supplanted the need for peer or expert review of some kind. These methods, which rely heavily on publications and citation indices, are also considered less relevant to developing countries conducting applied and adaptive research. More significant is the growing use of methods such as questionnaires and structured interviews to gather information. These can reach large numbers of practicing scientists, development workers, extension services, etc., thus bringing more information to the traditional peer review process.

SETTING UP A MONITORING AND EVALUATION SYSTEM

What are your M/E requirements?

An M/E system is not an end in itself. It is successful only if it can be used to improve research. It costs money and time, and so each national research system or institute should determine its own requirements for M/E, and develop a system which responds to these needs. M/E are used at different levels of management for different purposes. In general, three important aspects of research are to be evaluated: performance, quality, and relevance. The following questions may serve as a guide to research organizations considering setting up or enlarging their M/E systems:

- **Which aspects of research are weakest in the organization — performance monitoring, quality control, or relevance of research?** The performance of research deals with the efficient use of resources and the achievement of stated outputs on schedule. The quality of research is concerned with the adherence of researchers to accepted standards of scientific work. The relevance of research has to do with the appropriateness of the original objectives and the potential of research to address important national objectives. Monitoring and evaluation have a role to play in all three aspects.

- **Is research planning at all levels sufficient to provide clear objectives and targets?** The relevance of research can only be determined if its objectives are clearly stated and relate to greater development objectives. Likewise, evaluation cannot check performance against objectives if these objectives are poorly defined. At each level of research management, objectives must be explicit. For instance, for long-term planning the stated objectives might include the preparation of a manpower training plan and an infrastructure development plan within certain defined budgetary limits, and the identification of researchable problems with targets in major commodities for the next 10 years. The need for a clear specification of shorter-term objectives and targets is also needed at the research project level, where both performance and quality are important elements.
- Are new M/E procedures necessary? Is the activity already assessed for performance, quality, and/or relevance? What are the shortcomings of the current process? Is a more formal approach needed? Sometimes the M/E system is not the problem; management may receive adequate information to apply remedial action, yet fail to act for lack of management skill, resources, authority, etc. In such cases, nothing is gained by installing a more elaborate M/E system.

- Who needs the information, for what purposes, and in what timeframe? It is essential when planning M/E activities to clearly determine who will use the results and for what purposes. The level of effort of M/E should be scaled to the expected use. Also, unless data gathering, analysis, reporting of information, and subsequent action are going to be timely, there is little point in setting up an M/E system at all. To assure this timeliness often requires that authority for corrective action be delegated to middle-level managers who are closest to the problem.

- What indicators are needed to do the job? Once objectives have been defined, verifiable indicators of achievement must be selected, and the methods of measurement determined. These provide the basis for monitoring, and systematic monitoring builds up the body of information for subsequent evaluation. The choice of indicators has implications on the type of people needed to monitor them, and the costs of M/E. While one might be tempted to assemble volumes of data, especially if a computer system has recently been installed, data are costly to collect, and irrelevant data will only complicate analysis later on.

- Are the data to be collected objective and verifiable? Objective in the sense that the same data collected by different people would be consistent; verifiable in that recorded data exist to back-up any conclusions made.

- Are personnel and funds available to do the M/E work? A commitment of resources is necessary at all levels to record and analyze data, report information, and carry out evaluations.

**Is a separate M/E unit needed?**

Many research organizations, having once made the commitment to do more thorough evaluations, decide to establish a separate monitoring and evaluation unit. The evaluation function is often combined with a responsibility for programming future activities, in a planning and evaluation unit. Whether a research organization needs a special unit for monitoring and evaluation depends on the types of evaluations deemed necessary, and the quantity and type of data required. For example, extensive and specialized data may be needed to perform detailed economic analyses, notably for impact evaluation. The complexity of the research organization — its size and structure — will also influence whether or not a special M/E unit is needed.

If a special unit is created, its staffing will obviously depend upon the functions assigned to it. Much of the information needed to monitor and evaluate research is obtained by research managers themselves, through
regular reporting. Unless very extensive data collection and analysis are undertaken, a specialist in evaluation should not be necessary. Some expertise, however, may be required on a consultancy basis to set up the unit. The unit should have a service orientation, and be staffed, at least in part, by former researchers. M/E will be better accepted by researchers if it is perceived as an internal activity, conducted by fellow researchers who are sympathetic to the special nature of research.

How much does M/E cost?

The costs of monitoring and evaluation depend upon the services required, the extensiveness of data collection and analysis, and whether external assistance is used. While much of M/E is done routinely by researchers, costs must be budgeted for the direct costs of the evaluation staff, for travel, for coordinating and tabulating data at the program and directorate level, and for preparing evaluation reports. There is also a less visible opportunity cost of the experts’ time, and the costs of disruption in the organization. Though costs vary considerably from one organization to the other, a range of 0.5 to 1.0% of the program budget is often cited for direct costs. These costs should be included as a separate budget line item for all major research programs.

The costs of evaluation, particularly of ex ante evaluation, should be balanced against the benefits to be gained from sound research planning. Evaluations can provide less obvious benefits also, such as an improved channel of communication within the organization, or an unexpected exchange of technical information. This is particularly so when evaluations are multi-disciplinary. In summary, while costs may vary, they should be proportionate to the importance of the program or institute being evaluated.

Guidelines for evaluations.

Regardless of the type of evaluation performed, general guidelines are available to make the process more efficient and effective. First, the objectives and boundaries of the evaluation must be outlined in advance, and should be agreed by both the evaluators and those being evaluated. For an annual review this is not complicated, but for more in-depth evaluations, a "scope of work" statement may be necessary. This statement lists the objectives of the evaluation, and the type of information to be obtained and analyzed during the evaluation. It is a statement of expected output, of questions to be answered. It does not usually specify the precise methods to be used.

The plans for a comprehensive evaluation indicate in advance the documentation needed, people to interview, and sites to visit. It will identify the supplemental information which may need to be gathered through surveys or interviews. Most evaluation teams use a blend of interviews, field visits, observations, and report reading. As research plays a role in national development, an evaluation must consider the institutional, political, social, and economic context in which it is conducted. Beyond a comparison of achieved and expected results, an evaluation should try to clarify the internal and external factors affecting these results.
For comprehensive program or institute evaluations it may be desirable to bring in expertise from outside of the organization. The objectivity and specialist skills of external evaluators can be an asset, especially for more complex or controversial research, for reviews of programs within institutes and their complementarity, and for suggesting major changes in the organization’s thrusts. The major disadvantage to external participation is the cost and a lack of familiarity with the country or the organization (Table 2). Regardless of the size and cost of the effort, evaluation should be considered part of research planning and implementation, and therefore incorporated as a regular research expense.

Table 2. Considerations for Using In-house Versus External Evaluators

<table>
<thead>
<tr>
<th>In-house Evaluators</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Familiarity with programs &amp; staff operations</td>
<td>* Objectivity and candor may be questioned</td>
</tr>
<tr>
<td>* Consistency assumed with national value system</td>
<td>* Possibility of organizational role conflict</td>
</tr>
<tr>
<td>* Less time required to schedule evaluations</td>
<td>* Difficulty of releasing staff from regular duties</td>
</tr>
<tr>
<td>* Less expensive</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External Evaluators</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>* Greater objectivity</td>
<td>* May be perceived as policeman and make staff anxious</td>
</tr>
<tr>
<td>* Free of organizational bias</td>
<td>* Requires time for contract negotiations and orientation</td>
</tr>
<tr>
<td>* Possibly greater access to decision-makers</td>
<td>* More expensive</td>
</tr>
<tr>
<td>* Time exclusively devoted to task</td>
<td></td>
</tr>
<tr>
<td>* Familiar with recent advances in technology</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collaborative Evaluators</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>* Advantages of both in-house and external evaluators; plus broader cultural and technical perspective</td>
<td>* Some candid discussion of sensitive national issues may be constrained</td>
</tr>
</tbody>
</table>

An evaluation culminates in recommendations to the appropriate level of management: for a research program this might be suggestions for the revision of its objectives, workplan and schedule, or the suggested termination of a project. At a higher level a recommendation might be made to provide emergency funds, change staff assignments and priorities, or radically modify or terminate a program. Those researchers most involved in the activity being evaluated should be given the opportunity to comment on the evaluation and the recommendations made. For any evaluation to be useful, feedback and corrective actions must be timely.

ISNAR'S APPROACH TO DEVELOPING M/E MATERIALS

Because of the diverse contributions monitoring and evaluation can make to research management, ISNAR cannot develop M/E materials in all areas at once, this all the more so because of the dearth of background materials from which to draw. One annex on monitoring and evaluating ongoing research activities has been produced thus far. The primary focus is on evaluating the effectiveness and efficiency of the research program, including decision-making procedures, program leadership, and the adherence of scientists to accepted standards of research execution and reporting. Important associated elements of personnel management are presented in the ISNAR paper, "Human Resource Management in Agricultural Research".

Planning or ex ante evaluation is probably the single most important activity of a research manager. ISNAR has prepared a separate paper, "Priority Setting in Agricultural Research" which describes different planning techniques at the national level, including simple checklists, scoring models, and benefit/cost analysis. A more thorough paper on ex ante evaluation at the program and project levels is being produced; it will provide more information on establishing baselines, defining targets, and identifying criteria and indicators for subsequent monitoring and evaluation.

An additional annex will eventually be written on ex post evaluation, the measurement of performance, quality, and relevance of a completed research project or program. Ex post evaluation provides the basis for incorporating lessons learned into subsequent planning exercises. This evaluation uses the information from ex ante evaluation as its reference if it exists.

The development of materials for impact evaluation of research programs has not yet been undertaken by ISNAR. Impact evaluation of research is an object of study in many universities and other organizations. It is an evaluation whose greatest contribution is to policy dialogue, but it has limited use as a management device. At the present time, ISNAR's resources are being used to develop approaches and methods in ex ante, ongoing, and ex post evaluation, which are more useful to research managers in the medium term.
Definitions of terms and concepts

The terms "program" and "project" are used in various organizations to refer to different things. In this paper, the term program refers to coordinated research activities whose combined scientific output addresses national research objectives. Programs are long-term in scope, and somewhat continuous. They are composed, in some cases, of sub-programs, and of projects. Projects address specific research problems, and have explicitly defined time frames, resources, and targets. Each project in turn comprises a number of specific operations or experiments.

For example, a maize program might be created to address the research objective of improved maize technology, which itself responds to development objectives of increased cereal production. It is divided into two main sub-programs: maize breeding and agronomy. Within the agronomy sub-program there are three projects: maize fertilization, maize intercropping, and socioeconomic study of local practices. Operations within the maize fertilization project might include trials using rock phosphates, compound fertilizers, and manuring.

The complexity of a nation's agriculture and the size and structure of the research system will determine the appropriate hierarchy of programs, sub-programs, projects, and other subdivisions. However they are defined, objectives must be determined for each level of the research hierarchy. In turn, research evaluation should take place at all levels in reference to these objectives: from experiments and operations, to individual projects and programs, to programs in the aggregate. This ensures the soundness of technical decisions from program planning to the execution of experiments. By routinely evaluating research activities, researchers and supervisors can modify these activities in the course of program implementation in light of information gained.

Relationship between ex ante and ongoing research evaluation

Good planning or ex ante evaluation is necessary for the evaluation of ongoing research. It is against the original plan - its targets and assumptions - that an activity is judged. There are, of course, different levels of ex ante evaluation in national agricultural research. The highest level determines how well the research system responds to national development objectives. It can involve priority setting and broad resource allocations across commodities, regions, and disciplines. At the subsequent echelon of decision making, resources are allocated to alternative research thrusts or approaches within commodities, based on an analysis of the technical constraints and opportunities, and the availability of resources. At the next level, programs and projects within programs are defined and alternative research activities selected.
At every level of program planning there should be clear definitions of objectives, identifiable inputs and expected outputs, and some notion of time frame. Any assumptions used in planning, whether for a program strategy or a project proposal, should be explicit and may be subject to evaluation later on. It is during ex ante evaluation exercises that the key indicators used to monitor and evaluate progress are identified.

Monitoring ongoing research

Monitoring is primarily focused on research project performance, the use of resources and the achievement of outputs. It comprises several processes: the regular recording of key indicators; analysis which transforms data into information; reporting the information to appropriate levels of management; and a system of information storage which is easily accessible (Figure 1). These processes are integrated into day-to-day management for the purpose of keeping an activity moving as planned. Monitoring is primarily focused on inputs and outputs, on whether personnel, buildings, equipment, supplies, funds, and support services are available and on schedule.

Figure 1: Relationship of Monitoring to Evaluation
Data are available on research activities through various sources. Administrative personnel may keep detailed records of staff time, funds, and equipment used. Technical data are recorded in field notebooks, periodic research reports, and annual project reports. If these data are systematically collected and analyzed in a timely way, problems can be identified and resolved, and information valuable to other researchers can be circulated. While most data used in monitoring are recorded by researchers or administrative staff, project leaders are usually responsible for their compilation and analysis. There should be clear assignments of responsibility for data collection, analysis, reporting, and remedial action.

Monitoring and evaluation are facilitated if a project management approach is used. The key indicators to be monitored are identified at the outset when drawing up the research project workplan. A Logical Framework matrix, described in ISNAR Working Paper No. 12, is one technique that can be used for defining indicators and sources of data (Table 3). The link between what is scheduled and what actually takes place can be directly established by comparing periodic progress reports with the original workplan. This not only forces project leaders to keep track of their activities, it also facilitates communication of problems to higher levels of management.

In the instituting of a new monitoring procedure, it is necessary to start with an analysis of the current situation: what reporting is currently required, how well is it accomplished, and what additional reporting is necessary? The functions of a monitoring system should be agreed upon by the people implementing it. Several questions should be answered when designing a monitoring system:

- Who needs the information and for what purpose?
- What are the simplest means possible of collecting the necessary data? Can they be obtained from existing sources? If not available, can they be collected at reasonable cost in relation to their usefulness?
- Can the information resulting from data analysis be presented in a simple, standard format for timely use in decision making?
- Can the information be stored in a format compatible with that from other sources, so findings from similar activities can be compared?

With the increased use of microcomputers in developing countries, it is appropriate to determine which monitoring procedures, if any, should be computerized. Microcomputers can be very useful for analyzing and storing large volumes of data, but they are not necessary for all research organizations or for all M&E processes. A lack of computer capability should never be accepted as an excuse for inadequate record keeping, just as the existence of computers does not justify increasing the quantity of data gathered. On the other hand, once a good data base has been created, it becomes easy with computers to update it periodically and to retrieve data in various forms.

Computers can be especially useful for maintaining a data base on personnel, for program budgeting in larger research systems, and for management of physical and financial resources. Computers certainly facilitate the
<table>
<thead>
<tr>
<th>Levels of management</th>
<th>Possible indicator</th>
<th>Means of verification</th>
<th>Responsibility for data collection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Inputs</strong></td>
<td>Based on operation workplans:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- personnel</td>
<td>Scientific and support time</td>
<td>Time sheets</td>
<td>Individual reports</td>
</tr>
<tr>
<td>- funding</td>
<td>Expenditures on-site report</td>
<td>Accounting data</td>
<td>Accounting office</td>
</tr>
<tr>
<td>- facilities</td>
<td>Construction or procurement data</td>
<td>Institute engineer</td>
<td>Accounting office</td>
</tr>
<tr>
<td>- equipment &amp; supplies</td>
<td>Acquisition lab/station logs</td>
<td>Lab/station manager</td>
<td></td>
</tr>
<tr>
<td>- leadership</td>
<td>Project meetings meeting reports</td>
<td>Project head</td>
<td></td>
</tr>
<tr>
<td>- training</td>
<td>Program meetings meeting reports</td>
<td>Program head</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>- preliminary research results</td>
</tr>
<tr>
<td>- completed research results</td>
</tr>
<tr>
<td>- research capacity improved</td>
</tr>
</tbody>
</table>

| Program | Contribution of knowledge from research programs to research, development and policy-making bodies: |
|----------------|
| - new knowledge of interest to research, extension & policymakers |
| - increased crop production |
| - intensified land use |
| - conservation & land use |
| - increased income |
| - improved nutrition |

<table>
<thead>
<tr>
<th>National/Institute</th>
<th>Research relationship to national development objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- increased crop production</td>
<td></td>
</tr>
<tr>
<td>- intensified land use</td>
<td></td>
</tr>
<tr>
<td>- conservation &amp; land use</td>
<td></td>
</tr>
<tr>
<td>- increased income</td>
<td></td>
</tr>
<tr>
<td>- improved nutrition</td>
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</tr>
</tbody>
</table>
use of management tools, such as the critical path analysis described in ISNAR Working Paper No. 13, when scheduling tasks and tracking progress. Data collection systems should be designed taking into account whether techniques will be done manually or on computer; if computers are to be used there can be advantages to decentralizing the inputting of data on microcomputers at research stations. This minimizes the risk of transporting data and makes management at these stations responsible for the accuracy of these data. It is also important to select the software for tabulation and analysis before designing the forms on which data will be recorded.

The most common form for reporting information in monitoring is the periodic progress report. Researchers and project leaders are often required to submit such reports on resources used, problems encountered, and tasks achieved. They signal management to take remedial actions. Progress reports can be used in conjunction with program budgeting forms and project workplans to check progress against planned objectives. Progress reports do not necessarily require a narrative text, and they can be further simplified by using a standard format which refers back to the original workplan.

A simple format for reporting facilitates analysis and synthesis of information. For instance, program leaders can much more easily review the project progress reports and summarize them if the format is standard and problems in implementation are easily identifiable. In cases where related information is reported from different sources, a similar format permits easier cross analysis. At each level of management (project, program, institute) some degree of reporting is required (Table 4), and if information is not summarized at each level as it moves upward, the directorate will receive unmanageable quantities of information, often of unnecessary detail.

Storage is another important aspect of a monitoring system. Whether manual or computerized, information must be accessible. A centralized system of information storage can cause unnecessary delays at outlying stations that need it. Conversely, detailed back-up data from stations are not necessary in central files. When deciding where to store data and information, the need for it, the facility of movement, and the security of storage should all be considered.

On a purely technical level, research managers also monitor the potential success and acceptance of a technology during the course of its development. This can be done through the early introduction of on-farm research to study socioeconomic aspects of the proposed technology and to verify whether technology being developed is appropriate. Several techniques are available to gain information on farmers’ constraints, interests, and capabilities through this process. Other techniques for getting feedback on adaptive research are formal and informal surveys of attitudes and practices. All of these feed information into ongoing research and can be thought of as monitoring techniques.
Table 4. Flow of Monitoring Reports

<table>
<thead>
<tr>
<th>Person responsible</th>
<th>Report</th>
<th>Sent to whom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountant</td>
<td>Monthly or quarterly budgetary statement</td>
<td>Researcher/Project leader</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chief accountant</td>
</tr>
<tr>
<td>Researcher</td>
<td>Periodic progress report includes financial summary</td>
<td>Project leader</td>
</tr>
<tr>
<td></td>
<td>Annual/final research report</td>
<td>Station head</td>
</tr>
<tr>
<td>Project leader</td>
<td>Summary of progress reports</td>
<td>Program leader</td>
</tr>
<tr>
<td></td>
<td>Annual project summary</td>
<td>Program leader</td>
</tr>
<tr>
<td>Program leader</td>
<td>Summary of progress reports</td>
<td>Research director</td>
</tr>
<tr>
<td></td>
<td>Annual program meeting minutes and report</td>
<td>Research director</td>
</tr>
<tr>
<td>Station head</td>
<td>Summary of station data on resources used and needed</td>
<td>Directorate officers in charge of funds, supplies, and facilities</td>
</tr>
<tr>
<td>Research director</td>
<td>Annual report</td>
<td>Technical, planning and finance ministries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Donors</td>
</tr>
</tbody>
</table>

Evaluating ongoing research

Evaluating ongoing research, also called interim evaluation, looks beyond the monitoring of performance, and also considers aspects of quality and relevance, the latter being largely achieved through careful ex ante evaluation. While evaluation is an important management tool, it should be underscored that no M/E system can make up for a lack of key scientific leadership, as so often occurs in research organizations where staff are young and inexperienced. There are, however, some mechanisms, such as the rigorous review of project proposals, regular reporting, and an annual defense of research activities, that help those existing senior scientists supervise the work of younger scientists. Evaluations of
ongoing research take place annually in the case of projects, and at greater intervals, say every 3-5 years, in the case of entire programs. The essential elements of these different types of evaluations will be discussed here, commencing with a brief introduction to the importance of peer review in the process.

Role of peer and expert review. Research evaluation examines aspects of performance, quality, and relevance. All aspects imply an assessment of the technical judgement and skill employed in the research, and the organizational support and resources provided. Peer review, the assessment of research by colleagues, is the approach often taken in annual project reviews; expert review is more often applied to comprehensive program reviews. Peer and expert review work best where constructive criticism and open discussion are acceptable.

Peer review can play a role in many aspects of research, such as whether project and program objectives continue to address important research priorities; the degree to which planned objectives have been achieved; the need to modify objectives or to propose activities in light of new information; the quality of the research conducted; its efficiency relative to other projects; the timeliness and effectiveness of research communications; and the need to develop interdisciplinary teams for implementation and analysis.

Role of strong program leadership. In many developing countries the majority of scientists are young and relatively inexperienced when they assume research responsibilities. For this reason, many research organizations in developing countries have adopted a project approach to research, versus a researcher-oriented one allowing maximum autonomy. Strong program leadership and supervision of less-experienced staff are indispensable in these research systems, though care must be taken not to stifle initiative or innovative thinking. The project management approach adds transparency to the research organization, and requires a certain rigor in planning; this lends itself to involving more-experienced staff in the process of proposal development.

Annual project and program evaluations. Good program evaluation is based on an annual review of component projects. The annual project evaluation is a peer review of completed and proposed experiments, and includes a discussion of objectives, rationale, and methodologies. Senior scientists play a crucial role in these reviews, structuring the discussions and suggesting alternative ideas and approaches to less-experienced researchers. Senior research management should be able to assess the quality of this process if good minutes are written up of the meeting, including the topics discussed, issues raised, and recommendations made.

The annual project review depends on the timely submission of annual project reports. Writing these reports seems to be a bottleneck in many NARS. Preparation for and participation in these technical reviews, including prompt report writing, is part of a researcher's job and, therefore, provides one possible criterion for employee performance appraisal, and the application of rewards and sanctions.
Annual reporting usually includes a summary of the objectives of the project, methods, data analysis, results, and discussion. The length and complexity of this annual report will depend on the type of experiment and the state of advancement of the project. A summary account of resources used and costs are attached, based upon the periodic progress reports and the original workplan. It would be beneficial if a final research report on a completed project were more comprehensive, taking the form of a scientific report. This would include an abstract, research objectives, materials and methods, results and discussion, conclusions, and references. Should the scientist wish to publish in a professional journal, this report need only be edited and modified to conform to particular journal requirements.

Annual program evaluation and planning meetings require the active participation of researchers, project leaders, and program heads. Experts from outside the institute may be invited to participate. These reviews deal with the scientific/technical content and resource requirements of all projects which comprise the program. They also provide a forum for discussing problems in program management and certain aspects of station management. The annual program evaluation and planning meeting is monitored through minutes, and an annual program report summarizes the year's activities and the decisions taken to initiate, continue, strengthen, or terminate projects. The institute director and/or research committee then develops the plan and the proposed budget of the institute for the following year based on reports and recommendations of the annual program reviews.

Comprehensive program evaluation. Periodically, say every three to five years, it is important to organize program-level evaluations that are more in-depth than those occurring annually. These more comprehensive program reviews are both formative, that is, results from the evaluation are used to modify and improve the existing program, and summative, where decisions are taken to initiate, continue, or terminate programs. The emphasis in program evaluation tends to be on current and future programs, using lessons learned from past research in a forward-looking way. The original objectives, targets, and assumptions of the program are analyzed to see if they are still valid. They are modified accordingly. Project approaches and their likelihood of meeting existing or revised program objectives are examined. They are also viewed in the aggregate, in terms of their importance, resource requirements, and complementarity. This level of program analysis is necessary for setting priorities, allocating resources, and defining long-term research plans at the national and institute levels, as well as for making effective use of program funds. Comprehensive program reviews require experienced scientific leadership, and are greatly facilitated if good annual project reviews have taken place and are well documented.

Many of the available methods and techniques of program evaluation are currently more often used in disciplines other than agricultural research (Table 5). The evaluation of research requires some modification of existing techniques to accommodate the uncertain nature and timing of research, and the interdependence of different technical disciplines. This topic has come under considerable study in recent years, but techniques for research program evaluation are not yet fully defined.
Many different terms are used in the literature to describe the methods and techniques used in program evaluation. The central features of all these approaches are that they are analyses of program processes, not just program content. They, therefore, have implications for improving efficiency and effectiveness. They include quantitative and qualitative techniques. The primary method in program evaluation is informed judgement through peer or expert review. This body is supplied with information on programs through interviews, observation, and analysis of background data. Modeling, simulation, statistical analysis and other quantification techniques are often used. In some cases, analyses of qualitative data using the analytical and data collection methods of social scientists may be appropriate.

Table 5. Techniques Used in Program Evaluation

| Checklists | Consultation with Experts |
| Content Analysis | Cost-Benefit Analysis |
| Cost Effectiveness Analysis | Cross-Impact/Cross-Support Matrix |
| Decision Analysis | Delphi |
| Input-Output Analysis | Interviews and Opinion Surveys |
| Historical Analog | Least Cost |
| Modeling | Network Analysis |
| Probability Tree | Public Participation |
| Rank Size Analysis | Relevance Tree |
| Scoring Models | Simulation |
| Statistical Analysis | Stochastic Estimates |
| Substitution Curves | Trend Analysis |
| Workshops, Panels, Conferences | |


Most research programs in developing countries are responsive to larger development objectives. A comprehensive program evaluation should include, therefore, representatives from development and extension organizations, and a mechanism for bringing user feedback into the process. Program evaluations may also include representatives from planning and finance ministries, depending on the size and importance of the program. Evaluators, particularly for multidisciplinary research which has social and economic dimensions, will always bring with them certain biases. These can be reduced by using standardized checklists, by training evaluators in advance in evaluation methods, team-building techniques, and communication, and by using external evaluators, when possible.

Summary

In summary, this annex has tried to illustrate the importance of integrating monitoring and evaluation activities into day-to-day management practices in national research organizations. It concentrates on the internal monitoring and evaluation which should take place for ongoing research, and focuses primarily on the necessary reporting requirements of the researchers themselves.
On an annual basis, project and program management are most concerned with performance monitoring, and the quality of the research being conducted. The scope of comprehensive program evaluation is broadened, however, to more thoroughly consider aspects of the relevance of research. The primary method employed for all ongoing research evaluation is peer or expert review. There is currently much interest in developing and refining techniques, some borrowed from the social sciences, to make research program evaluations more informative.

Two other ISNAR working papers have been produced which are relevant to ongoing research evaluation. The Logical Framework in Research Planning and Evaluation, Working Paper No. 12, relates project-level activities to larger program and national research objectives, while at the same time identifying targets and assumptions upon which the success of the project and future evaluation are based. Project Management Techniques for Performance Monitoring, Working Paper No. 13, explains the uses of Task Lists, Bar Charts, Milestone Charts, and the Critical Path Network for tracking resources, outputs, and time. Both of these working papers are available from ISNAR for use as companion texts to this paper.
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Special Programme for Developing Countries
Vienna, Austria